ACADEMIC REGULATIONS
AND
SYLLABUS

M.Tech.
in
CAD / CAM
w.e.f.
2015-2016 (VR 15)

DEPARTMENT OF MECHANICAL ENGINEERING

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Jawaharlal Nehru Technological University Kakinada, Kakinada,
NBA Accredited & ISO 9001:2008 Certified)
(Sponsored by Siddhartha Academy of General and Technical Education)
Kanuru, Vijayawada-520 007, A.P, India

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE
(Autonomous)
Kanuru, Vijayawada – 520 007

(Approved by AICTE, Accredited by NAAC with 'A' Grade, and ISO 9001: 2008 Certified) (Affiliated to Jawaharlal Nehru Technological University, Kakinada)

Academic Regulations for M.Tech(VR15) w.e.f: 2015-2016 (Common to all branches)

1. INTRODUCTION

Academic Programmes of the College are governed by rules and regulations as approved by the Academic Council, which is the highest Academic Body of the Institute. These academic rules and regulations are effective from the academic year 2015-16, for students admitted into two year PG programme offered by the college leading to Master of Technology (M. Tech).

The regulations listed under this head are common for postgraduate programmes, leading to award of M. Tech degree, offered by the college with effect from the academic year 2015-16 and they are called as "M. TECH-15" regulations.

The regulations here under are subjected to amendments as may be made by the Academic Council of the college from time to time, keeping the recommendations of the Board of Studies in view. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

a) "Commission" means University Grants Commission (UGC)

b) "Council" means All India Council for Technical Education (AICTE)

c) "University" means Jawaharlal Nehru Technological University Kakinada, Kakinada (JNTUK)

d) "College" means Velagapudi Ramakrishna Siddhartha Engineering College (VRSEC)

e) "Programme" means any combination of courses and/or requirements leading to the award of a degree

f) "Course" means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.

g) "Degree" means an academic degree conferred by the university upon those who complete the postgraduate curriculum.

3. PROGRAMMES OFFERED

The nomenclature and its abbreviation given below shall continue to be

used for the degree programmes under the University, as required by the Council and Commission.

Master of Technology (M. Tech) Besides, the name of the programme shall be indicated in brackets after the abbreviation. For example PG engineering degree in Computer Science and Engineering is abbreviated as M. Tech (Computer Science and Engineering).

Presently, the college is offering Post Graduate programme in Engineering with the following programmes:

Table 1: List of Programmes offered by college leading to M.Tech Degree

S.No	Programme	Department
1	Structural Engineering	Civil Engineering
2	Computer Science and Engineering	Computer Science and Engineering
3	Power Systems Engineering.	Electrical and Electronics Engineering
4	Communication Engineering and Signal Processing	Electronics and Communication Engineering
5	Telematics	
6	VLSI Design and Embedded Systems	
7	Computer Science & Technology	Information Technology
8	CADCAM	Mechanical Engineering
9	Thermal Engineering	

These Regulations shall be applicable to any new postgraduate programme (M. Tech) that may be introduced from time to time.

4. DURATION OF THE PROGRAMME

- The duration of the programme is two academic years consisting of four semesters.
- A student is permitted to complete the programme within a maximum duration of 4 years.

5. MINIMUM INSTRUCTION DAYS

- Each semester shall consist of a minimum of 90 instruction days with about 25 to 35 contact periods per week.

6. ELIGIBILITY CRITERIA FOR ADMISSION

- The eligibility criteria for admission into M.Tech programme are as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

6.1 CATEGORY –A Seats:

- These seats will be filled by the Convener, PGECET Admissions.

6.2 CATEGORY –B Seats :

- These seats will be filled by the College as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

7. PROGRAMME STRUCTURE

The programme structure is designed in such a way that it facilitates the courses required to attain the expected knowledge, skills and attitude by the time of their post-graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories to cover the depth and breadth required for the programme and for the attainment of programme outcomes of the corresponding programme.

7.1 Programme Core:

The core consists of set of courses considered necessary for the students of the specific. The courses under this category should satisfy the programme specific criteria prescribed by the appropriate professional societies. The credits for programme core courses is 40.

7.2 Programme Electives:

The Electives are set of courses offered in the which covers depth and breadth to further strengthen their knowledge. The students may register for appropriate electives offered in the based on their area of interest. The credits for the programme electives are 12.

7.3 Independent Learning:

The students are expected to learn the courses offered under this category on their own. The courses offered under this category include:

7.3.1 Self-Learning Course:

The self-learning courses shall be taken from the list of approved MOOCs in the respective Board of Studies. The courses under this category shall carry two credits.

7.3.2 Seminar:

One seminar shall be delivered by the students as individual presentation. The seminar topics shall be related to the contemporary aspects of the programme. The seminar shall carry 2 credits.

- The self learning course and seminar shall be offered either in 1st year or in 2nd year of the programme depending upon this scheme approved by BOS & Academic Council.

7.3.3 Project:

The Project shall be offered in 2nd year of the programme. The project shall be carried out by the students, as individual project, for a minimum period of one academic year. The project shall be carried out in the major areas pertaining to the programme approved by Project Review Committee and may address the societal problems/issues related to the programme. The project shall consist of Part-A and Part-B with a weightage of 10 and 14 credits, respectively spreading over for one semester each. The project part B shall be the extension of project Part A.

- If a candidate wishes to change his/her topic of the project, he/she can do so with approval of the project review committee within one week from the completion of 1st review.

7.3.3.1 PROJECT IN COLLABORATION WITH INDUSTRY:

- A student may, with the approval of the Head of the Department/ Centre, visit an industry or a Research Laboratory for data collection, discussion of the project, experimental work, survey, field studies, etc. during the project period. Projects sponsored by the industry or Research Laboratories will be encouraged and a close liaison with such organizations will be maintained.
- A student may, with the approval of Project Review Committee, do the project work in collaboration with an industry, a Research and

Development Organization. A Joint Supervisor may be appointed from the Industry and Research Laboratory with the approval of the HOD. The student shall acknowledge the involvement and / or contribution of an industry, R&D organization in completing the project in his/her thesis and a certificate to this effect, issued by the supervisor from the industrial organization, will be included in the thesis. The Internal Supervisor may visit the industry or the research laboratory in connection with the project work of his / her student if felt necessary.

- It is mandatory for all the students (especially those who do their project in an Industry, R&D organization in India or abroad) to make full disclosure of all data on which they wish to base their project. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. Any tangible intellectual property other than copyright of the thesis may have to be assigned to the Institute. The copyright of the thesis itself would however lie with the student as per the IPR policy in force.

7.4 Course Code and Course Numbering Scheme

Course Code consists of Nine characters in which the one is the numeral and second to fourth are alphabets and the rest are numerals.

- The First character '15' indicates year of regulation.
- The second to fourth characters are described in Table 2 and 3.

Table 2: Second to Third Character description

Second & Third Characters	Name of the Department
CE	Civil Engineering Department
CS	Computer Science and Engineering Department
EC	Electronics & Communication Engineering Department
EE	Electrical & Electronics Engineering Department
IT	Information Technology Department
ME	Mechanical Engineering Department

The fourth and fifth characters represents specialization offering as mentioned in Table No. 3.

Table 3: Fourth and Fifth Character description

Fourth & Fifth Characters	Name of the Specialization
SE	Structural Engineering
CS	Computer Science and Engineering
SP	Communication Engineering and Signal Processing
VE	VLSI Design and Embedded Systems
TM	Telematics
PS	Power Systems Engineering
CT	Computer Science & Technology
CC	CADCAM
TE	Thermal Engineering

For all the Sixth and Seventh characters represent semester number and syllabus version number of the course offered.

Eighth character represents course type, as per Table No. 4

Table 4: Course type description

EIGHTH CHARACTER	DESCRIPTION
0	Theory course
5	Lab course

Nineth character represents course number as described in Figure 1 below.

For example, in **15 MECC 1051** course, the numeral **15** indicates year of regulation and the course is offered by Mechanical Engineering Department (**ME**) in CAD/CAM specialization offered in the first semester (**1**), the course syllabus version number (**0**), the course is of lab type (**5**) and the course number is (**1**), as given in figure.1 below.

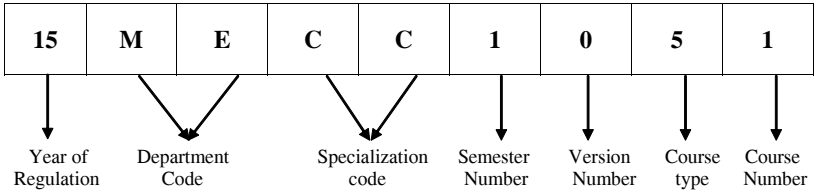

Figure 1: Course Code Description

7.5 Scheme of Instruction for 1st and 2nd Years

The scheme of instruction and exact syllabi of all post graduate programmes are given separately.

7.6 Contact Hours and Credits

Credit means quantifying and recognizing learning. Credit is measured in terms of contact hours per week in a semester.

The Course Credits are broadly fixed based on the following norms:

- Lectures – One Lecture period per week is assigned one credit.
- Tutorials - Two tutorial periods per week are assigned one credit.
- Practical – 2 periods per week is assigned one credit
- Seminar/Mini Project shall have 2 credits.
- Major Project shall have 24 credits.

- However, some courses are prescribed with fixed number of credits depending on the subject complexity and importance.

7.7 Theory / Tutorial Classes

Each course is prescribed with fixed number of lecture periods per week. During lecture periods, the course instructor shall deal with the concepts of the course. For certain courses, tutorial periods are prescribed, to give exercises to the students and to closely monitor their learning ability.

7.8 Laboratory Courses

A minimum prescribed number of experiments have to be performed by the students, who shall complete these in all respects and get each experiment evaluated by teacher concerned and certified by the Head of the Department concerned at the end of the semester.

7.9 Programme Credits

Each specialization of M. Tech programme is designed to have a total of 80 credits, and the student shall have to earn all the credits for the award of degree.

8. MEDIUM OF INSTRUCTION

The medium of instruction and examination is English.

9. SYLLABUS

As approved by the concerned BOS and the Academic Council.

10. ELIGIBILITY REQUIREMENT FOR APPEARING SEMESTER END EXAMINATION AND CONDONATION

- A regular course of study means a minimum average attendance of 75% in all the courses computed by totaling the number of periods of lectures, tutorials, practical courses and project as the case may be, held in every course as the denominator and the total number of periods attended by the student in all the courses put together as the numerator.
- Condonation of shortage in attendance may be recommended by the respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated

above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.

- Students, having shortage of attendance, shall have to pay the requisite fee towards condonation**.**
- Minimum of 50% aggregate marks must be secured by the candidates in the continuous evaluations conducted in that semester for courses such as theory, laboratory courses, seminar and project to be eligible to write semester end examinations. However, if the student is eligible for promotion based on the attendance, in case necessary, a shortage of internal marks up to a maximum of 10% may be condoned by the Principal based on the recommendations of the Heads of the Departments.
- Students having shortage of internal marks up to a maximum of 10% shall have to pay requisite fee towards condonation**.**
- A student, who does not satisfy the attendance and/or internal marks requirement, shall have to repeat that semester.
- Eligible candidates who failed to register for all courses for the semester-end examinations shall not be permitted to continue the subsequent semester and has to repeat the semester for which he/she has not registered for semester end examinations.

11. EXAMINATIONS AND SCHEME OF EVALUATION

11.1 Continuous Evaluation:

11.1.1 Theory Courses

Each course is evaluated for **40** marks (a+b)

a) The continuous evaluation shall be made based on the two midterm examinations each of 2**0** marks will be conducted in every theory course in a semester. The mid term marks shall be awarded giving a weightage of 2/3rd in the examination in which the student scores more marks and 1/3rd for the examination in which the student scores less marks. Each midterm examination shall be conducted for duration of 90 minutes without any choice**.**

b) The remaining 20 marks are awarded through continuous evaluation of assignments / mini project in each subject as notified by the teacher at the beginning of the semester.

Students shall be informed regarding the comprehensive assignment/ during the first week of the semester and they have to submit completed assignment on or before 12th week of semester.

11.1.2 Laboratory Courses: 40 marks

- For Laboratory courses there shall be continuous evaluation during the semester for 40 continuous evaluation marks. The distribution of continues evaluation marks is given below:

Table 5: Distribution of Marks

Sl. No.	Criteria	Marks
1	Day to Day work	10
2	Record	10
3	Continuous Evaluation	20

11.1.3 Seminar: 40 marks

The distribution of continues evaluation marks for the seminar is given below.

Table 6: Distribution of Marks

Sl. No.	Criteria	Marks
1	Report	15
2	Presentation	15
3	Viva-voce	10

The Seminar Review Committee (SRC) to be constituted by HOD with minimum two members related to programs specialization.

11.1.4 Project: (40 marks)

The continuous evaluation (Project Part A and Project Part B) for 40 marks shall be on the basis of two seminars by each student evaluated by a review committee and the day to day assessment by the supervisor in respective semester. The review committee consists of HOD, Programme coordinator,

respective internal guide and two senior members of faculty of the department with expertise in the respective specialization nominated by HOD. The distribution of marks is as follows in Table 7.

Table 7: Continuous evaluation in each semester

Sl. No.	Criteria	Marks
1	Two reviews	15+15
2	Day to day assessment	10

Rubrics shall be prepared by review committee using appropriate performance indicators for each review separately and informed to the students well in advance.

11.1.5 Self-Learning Courses

For the courses under this category, there shall be continuous evaluation for 40 marks and semester end examination of 60 marks. The distribution of marks for continuous evaluation will be same as theory courses (Section 11.1.1).

11.2 SEMESTER END EXAMINATIONS

11.2.1 Theory Courses: 60 marks

The Semester end examinations shall be conducted for 3 hours duration at the end of the semester. The question paper shall be given in the following pattern: There shall be two questions from each unit with internal choice. Each question carries 15 marks. Each course shall consist of four units of the syllabus.

11.2.2 Lab Courses: 60 marks

40 marks are allotted for experiments/job works & **15** marks are allotted for viva-voce examination and **5** marks for the record.

11.2.3 Seminar: 60 marks

There shall be a seminar presentation. For Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The

Departmental Committee consists of Head of the Department, supervisor and two other senior faculty members of the department. For Seminar, the evaluation is done for 60 marks internally.

11.2.4 Self-Learning Courses: 60 marks

The semester end examinations for courses under this category are evaluated for 60 marks.

11.2.5 Project: 60 marks

The project (Project Part A and Part B) shall be evaluated for 60 marks in respective semesters. The semester end examination for project part – A shall be evaluated by HOD, Programme coordinator and one of the senior Professors of the Department.

Project part – B shall be evaluated by a project evaluation committee consisting of the Head of the Department, project internal guide and an external examiner approved by the Principal from a panel submitted by the HOD.

The rubrics for evaluation of semester end examination shall be defined by the Project review committee separately for Part – A and Part B.

12. CONDITIONS FOR PASS AND AWARD OF CREDITS FOR A COURSE

12.1 Conditions for Pass and award of Grades & Credits:

a) A candidate shall be declared to have passed in individual Theory course if he/she secures a minimum of 50% aggregate marks (continues evaluation & semester end examination marks put together), subject to a minimum of 40% marks in the semester end examination.

b) A candidate shall be declared to have passed in individual labs/ seminar/ course if he/she secures a minimum of 50% aggregate marks (continues evaluation & semester end examination marks put together), subject to a minimum of 50% marks in the semester end examination.

c) If a candidate secures minimum of 40% marks in Theory Courses in the semester end examination and 40% - 49% of

the total marks in the semester end examination and continues evaluation taken together in some theory courses and secures an overall aggregate of 50% in all theory courses in that semester he/she declared to be passed in the theory courses of that semester in semester end Examinations. This provision is applicable for Regular candidates only during Regular Semester – end Examinations.

d) The student has to pass the failed course by appearing the examination when conducted subsequently, as per the requirement for the award of degree.

e) A candidate shall be declared to have passed the Project part A/ Project part B, if he/she secures minimum of 50 % aggregate marks (continuous evaluation and semester end examination marks put together), subject to a minimum of 50 % of marks in semester end examinations.

f) If any candidate does not fulfill the pass requirement as per 12.1.(e) in semester end examination of Project Part – A, he / she will be given two months additional time to re appear at the semester end examination after paying the requisite examination fee and also the candidate has to bear the expenditure for conducting examination. If the candidate does not fulfill the pass requirement again in Project Part – A as per 12.1(e), he/she has to repeat the semester in next academic year.

g) In a special case, if any student does not submit his / her thesis of Project Part – B, due to ill health or any other genuine reason, he / she will be given another chance to appear at Project Part - B examination conducted separately at a later date i.e. within two months from the completion of Project Part – B semester end examination of that particular academic year after paying the requisite examination fee, if the expenditure for conducting Project Part – B is completely borne by the candidate.

h) On passing a course of a programme, the student shall earn assigned credits in that Course.

12.2 Method of Awarding Letter Grades and Grade Points for a Course.

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table 8: Grading System for individual subjects/labs

Theory	Lab	Grade Points	Letter Grade
>= 90%	>= 90%	10	Ex
80-89%	80-89%	9	A+
70-79%	70-79%	8	A
60-69%	60-69%	7	B
50-59%	55-59%	6	C
45-49%	50-54%	5	D
40-44%	-	4	E
< 40%	< 50%	0	F (Fail)
ABSENT	ABSENT	0	AB

12.3 Calculation of Semester Grade Points Average (SGPA)* and award of division for the program.

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$SGPA = \frac{\sum (CR \times GP)}{\sum CR} \quad \text{(For all courses passed in semester)}$$

Where CR= Credits of a course

GP = Grade points awarded for a course

*SGPA is calculated for the candidates who passed all the courses in that semester.

12.4 Calculation of Cumulative Grade Point Average (CGPA) for Entire Programme.

The CGPA is calculated as below:

$$CGPA = \frac{\sum (CR \times GP)}{\sum CR} \qquad \text{(For entire programme)}$$

Where CR= Credits of a course

GP = Grade points awarded for a course

Table 9: Award of Divisions

CGPA	DIVISION
≥7.75	First Class with distinction
≥6.5 - <7.75	First Class
≥5.5 - <6.5	Second Class
≥4 - <5.5	Pass Class
<4	Fail

For the purpose of awarding first class with distinction, the candidate should complete the programme with in 2 years and should get required CGPA.

Detained, Break in study candidates, and the candidates who availed themselves of the opportunity of extension of project part – B for a further period of two months are not eligible for the award of first class with distinction.

For the purpose of awarding first/ second/ pass class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of course including extensions in project, if any shall be considered.

12.5 Transitory Regulations

A candidate, who is detained or discontinued in the semester, on readmission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which the student joins subsequently and the academic regulations be applicable to him/her

which have in force at the time of his/her admission. However, exemption will be given to those candidates who have already passed in such courses in the earlier semester(s) and additional subjects are to be studied as approved by Board of Studies and ratified by Academic Council.

12.6 Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the candidates will be issued after completion of the two years M. Tech Programme.

13. READMISSION CRITERIA

A candidate, who is detained in a semester due to lack of attendance/marks, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of Rs. 1,000/-.

Rules for Calculation of Attendance for Re- Admitted students.

a) No.of classes conducted will be counted from the day 1 of the semester concerned, irrespective of the date of payment of tuition fee.

b) They should submit a written request to the principal of the college, along with a challan paid towards tuition and other fee. for re-admission before the commencement of class work.

c) Student should come to know about the date of commencement of class – work of the semester in to which he / she wishes to get re – admission. The information regarding date of commencement of class – work for each semester is available in the college notice boards / website.

14. BREAK IN STUDY

Student, who discontinues the studies for whatsoever may be the reason, can get readmission into an appropriate semester of M. Tech program after a break-in study only with the prior permission of the Principal of the College provided such candidate shall follow the transitory regulations applicable to such batch in which he/she joins. An administrative fee of Rs. 2000/- per each year of break in study in

addition to the prescribed tuition and special fee has to be paid by the candidate to condone his/her break in study.

15. ELIGIBILITY FOR AWARD OF M.TECH. DEGREE

The M. Tech., Degree shall be conferred on a candidate who satisfies the following requirement. A student should register himself for 80 Credits, and should obtain all the 80 credits in order to become eligible for the award of M.Tech Degree.

16. CONDUCT AND DISCIPLINE

- Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of our Institute.
- As per the order of the Honorable Supreme Court of India, ragging in any form is considered a criminal offense and is banned. Any form of ragging will be severely dealt with.
- The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

  i. Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.

  ii. Willful damage or distribution of alcoholic drinks or any kind of narcotics to fellow students /citizens.

The following activities are not allowed within the campus

- Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
- Mutilation or unauthorized possession of library books.
- Noisy and unseemly behavior, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cyber crime etc.
- Use of cell phones in the campus.

- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the college from time to time.
- Commensurate with the gravity of an offense, the punishment may be reprimanded, fine, expulsion from the institute / hostel, debarment from a examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offense committed in (i) a hostel (ii) a department or in a classroom and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and Break-in-Study candidates are allowed into the campus for academic purposes only with permission from the authorities.
- Misconduct committed by a student outside the college campus, but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature & gravity of such misconduct.
- The Disciplinary Action Committee constituted by the Principal, shall be the authority to investigate the details of the offense, and recommend disciplinary action based on the nature and extent of the offense committed.
- “Grievance appeal Committee” (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative /disciplinary matters.

◆ All the students must abide by the code and conduct rules of the college.

17. MALPRACTICES

◆ The Principal shall refer the cases of malpractices in internal assessment tests and Semester-End Examinations, to a Malpractice Enquiry Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Principal shall take necessary action, against the erring students based on the recommendations of the committee.

◆ Any action on the part of the candidate at an examination trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff, who are in charge of conducting examinations, valuing examination papers and preparing/keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

18. OTHER MATTERS

18.1 The physically challenged candidates who have availed additional examination time and a scribe during their B. Tech/PGECET/GATE examinations will be given similar concessions on production of relevant proof/documents.

18.2 Students who are suffering from contagious diseases are not allowed to appear either internal or semester end examinations.

18.3 The students who participated in coaching/tournaments held at the state / National /International levels through University / Indian Olympic Association during the end semester external examination period will be promoted to subsequent semesters till the entire course is completed as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

18.4 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently

such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved in the Heads of the Departments Meetings, shall be reported to the academic council for ratification.

19. AMENDMENTS TO REGULATIONS

The Academic Council may, from time to time, revise, amend, or change the regulations, Schemes of examination and/or syllabi.

DEPARTMENT OF MECHANICAL ENGINEERING :: VRSEC
M. Tech CAD/CAM
Scheme of Instruction and Evaluation

FIRST SEMESTER:

Name of the Subjects	Hrs / Week			Credits	Evaluation (marks)			
	L	T	P		Internal	External		Total
						Theory	Practical	
1. 15MECC1001 **Optimization Techniques**	4	1	-	5	40	60	-	100
2. 15MECC1002 **Computer Graphics**	4	-	-	4	40	60	-	100
3. 15MECC1003 **CNC & Part Programming**	4	-	-	4	40	60	-	100
4. 15MECC1004 **Computer Aided Modeling**	4	-	-	4	40	60	-	100
5. 15MECC1005 **Elective – I**	3	1	-	3	40	60		100
6. 15MECC1006 **Elective – II**	3	1	-	3	40	60		100
7. 15MECC1051 **CAD Lab**	-	-	3	2	40	-	60	100
8. 15MECC1052 **CAM Lab**	-	-	3	2	40	-	60	100
Total	22	3	6	27	320	360	120	800

ELECTIVE I

15MECC1005 A: **Concurrent Engineering**
15MECC1005B: **Design for Manufacture and Assembly**
15MECC1005C: **Computer Aided Process Planning**

ELECTIVE II

15MECC1006A: **Mechanical Vibrations**
15MECC1006B: **Mechanisms Design & Simulation**
15MECC1006C: **Theory of Elasticity**

SECOND SEMESTER:

Name of the Subjects	Hrs / Week			Credits	Evaluation (marks)			
	L	T	P		Internal	External		Total
						Theory	Practical	
1. 15MECC2001 **Computer Integrated Manufacturing**	4	-	-	4	40	60	-	100
2. 15MECC2002 **Finite Element Analysis**	4	1	-	5	40	60	-	100
3. 15MECC2003 **Additive Manufacturing**	4	-	-	4	40	60	-	100
4. 15MECC2004 **Mechatronics**	4	-	-	4	40	60	-	100
5. 15MECC2005 **Elective-III**	3	1	-	3	40	60	-	100
6. 15MECC2006 **Elective-IV**	3	1	-	3	40	60	-	100
7. 15MECC2007 **(Self Learning) Reliability Engineering**	-	-	-	2	40	60	-	100
8. 15MECC2051 **Automation Lab**	-	-	3	2	40	-	60	100
9. 15MECC2052 **Mini Project & Seminar**	-	-	3	2	40	-	60	100
Total	22	3	6	29	360	420	120	900

ELECTIVE III

15MECC2005A: **Robotics**

15MECC2005B: **Fluidics and Control Systems**

15MECC2005C: **Vision System & Image Processing**

ELECTIVE IV

15MECC2006A: **Mechanics & Manufacturing methods of composites**

15MECC2006B: **Advanced Materials Engineering**

15MECC2006C: **Advanced Production Management**

THIRD SEMESTER & FOURTH SEMESTER:

Code	Course	Credits	Internal	External	Total
15MECC3051	**Major Project Part-A**	**10**	**40**	**60**	**100**
15MECC4051	**Major Project Part-B**	**14**	**40**	**60**	**100**

PROGRAMME OUTCOMES (PO's)

a) Able to apply higher order thinking for enhancement of new knowledge by acquiring in depth knowledge in CAD/CAM. **[Scholarship of knowledge]**

b) Able to analyze complex engineering problems critically and synthesize independently for creative advances. **[Critical Thinking]**

c) Able to think laterally to solve engineering problems for arriving at feasible and optimal solutions considering health, safety, cultural and environmental factors. **[Problem Solving]**

d) Able to conduct research on an unfamiliar problem individually or in teams to generate new scientific or technological knowledge. **[Research Skill]**

e) Able to devise and apply appropriate techniques and modern engineering tools for complex engineering activities. **[Usage of Modern Tools]**

f) Able to work collaboratively in multidisciplinary environments. **[Collaborative and Multidisciplinary work]**

g) Able to apply the principles of management to one's own work to manage projects in multidisciplinary environments. **[Project Management and Finance]**

h) Able to communicate effectively through written reports and oral presentations. **[Communication]**

i) Able to engage in lifelong learning independently for improved competence. **[Lifelong Learning]**

j) Able to understand professional, ethical and social responsibility. **[Ethical Practices and Social Responsibility]**

k) Able to examine critically one's actions independently to take corrective measures and learn from mistakes. **[Independent and Reflective Learning]**

15MECC1001 OPTIMIZATION TECHNIQUES

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 period /week	Credits	: 5

Pre-requisites:

- Operation research, Algorithms and flow charts, Numerical methods.

Course Outcomes:

At the end of the completion of this course the student will be able to

- Understand different classical and numerical Optimization algorithms. **(a, c, e, f, i)**
- Understand principles of ANN and training of networks **(a,d,f,g,i)**
- Understand principles of Genetic Algorithms. **(a,d,f,g,i)**
- Solve different Optimization problems **(a,b,c,f,i)**

UNIT I

Classical Optimization Techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical Methods for Optimization: Interval halving method, Fibonacci method, Quadratic interpolation method, Newton method, Quasi Newton method, Secant method.

UNIT II

Introduction to Neural networks: Knowledge base information processing, general view of knowledge based algorithm, neural information processing, Hybrid intelligence, and artificial neurons.

Characteristics of Artificial Neural Networks: Single Neural Networks, Multi Layer Neural Networks, Training of ANN – objective, supervise training, unsupervised training, overview of training.

UNIT III

Genetic Algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT IV

Applications of Optimization in Design And Manufacturing Systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS:

1. Engineering Optimization – Singiresu S. Rao, New Age Publishers,3rd edition,2010 .
2. Neural Networks and Fuzzy System - Bart Kosko, Prentice Hall of India, 2001.
3. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers,2002.
4. Optimization for Engineering Design: Algorithms and examples – Kalyanmoy Deb, PHI Publishers,2012.

REFERENCES:

1. Multi objective Optimization using Evolutionary Algorithms - Kalyanmoy Deb, PHI Publishers,2010
2. Introduction to Optimum Design- Jasbir S. Arora, Mc Graw Hill (International) Publishers 1989.

Web Resources:

- http://www.nptel.ac.in/courses/105108127/pdf/Module_1/M1L4slides.pdf
- https://en.wikipedia.org/wiki/Artificial_neural_network
- http://www.geneticprogramming.com/Tutorial/
- https://archive.org/stream/
- Advanced_Modeling_and_Optimization_of_Manufacturing_Processes/
- Advanced_Modeling_and_Optimization_of_Manufacturing_Processes_djvu.txt

15MECC1002 COMPUTER GRAPHICS

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 4		

Pre-requisites:

- Engineering graphics, Matrices, Geometry

Course Outcomes:

At the end of the completion of this course the student will be able to

- Understand Contemporary graphic primitives. **(a)**
- Understand various Computer Graphics devices and algorithms used for line and circle drawing **(a, b)**
- Understand the use of Polygons and Transformations **(a, c, h)**
- Understand the concept of Segmenting, Windowing and Clipping **(a, h)**

UNIT – I

Geometry and Line Generation: Introduction, Lines, Line segments, Perpendicular Lines, Distance between a point and a Line, Vectors, Pixels and Frame Buffers.
Graphic Primitives: Introduction, Display devices, Primitive Operations, The Display-File Interpreter, Normalized Device Coordinates, Display-File structures

UNIT – II

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, Hard Copy Output Devices.

Point Plotting Techniques: Coordinate system, Incremental methods, Line Drawing Algorithms: DDA algorithm, Bresenham's line drawing algorithm: Circle generators.

UNIT – III

Polygons: Introduction to Polygons, Polygon representation, Polygon Interfacing Algorithms, Filling Polygons, Filling with a pattern, Initializing, Anti-aliasing.

Transformations: Introduction, Scaling Transformations, Rotation, Homogeneous Coordinates and Translations, Coordinate Transformations, Rotation about an arbitrary point, Inverse Transformations.

UNIT – IV

Segments: The segment table, Segment creation, Closing a segment, Deleting a segment.

Windowing: Introduction, The Viewing Transformation, Viewing transformation implementation

Clipping: Clipping, the Cohen-Sutherland Algorithm, Clipping of Polygons.

Text Book:

Computer graphics by Steven Harrington Mc Graw Hill Education (India) Private Limited. Second Edition, 2014

Reference Books:

1. Procedural Elements for Computer Graphics by David F. Roger, Tata McGraw Hill Publishing Company Limited, Second Edition, 1997
2. Principles of Interactive Computer Graphics by Robert F. Sproull, William M Newman, Tata McGraw Hill Publishing Company Limited, 1979

Web resources:

1. https://en.wikipedia.org/wiki/Computer_graphics
2. http://nptel.ac.in/courses/106106090/
3. https://www.youtube.com/watch?v=fwzYuhduME4

15MECC1003 COMPUTER NUMERICAL CONTROL AND PART PROGRAMMING

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 4		

Pre-requisites:

- Machining processes, Part-modeling, Co-ordinate systems.

Course Outcomes:

At the end of the completion of this course the student will be able to

- Understand the basic components,their operations and design features NC Machines **(a, f)**
- Understand the concepts of manual part programming and solve simple problems. **(a, b, c, e)**
- Understand the principles of APT programming and solve simple problems **(a, b, c, e)**
- Differentiate NC, CNC & DNC systems and understand the benefits of adaptive control machining systems **(a,f)**

UNIT - I

Introduction: Fundamentals of numerical control, advantages of NC systems, classification of NC systems, point to point and contouring NC systems, incremental and absolute systems.

Machine control unit & tooling: Functions of MCU, NC actuation systems, MCU organization, Computerised numerical control, Tooling for NC machining centres and NC turning machines, Steps in NC Manufacturing.

UNIT –II

NC Part Programming: Introduction, NC coordinate system, Manual part programming, Codes and concepts, types of tape formats, Tool Length and radius compensation, point to point and contour programming examples.

NC Part Programming (Contd.): Canned cycles, Subroutines, MACROS, simple problems of Drilling, Turning and two-dimensional Milling.

UNIT –III

Computer Aided Part Programming: NC language: APT. Preprocessor, Post processor, advantages of computer aided programming, post processor, APT

programming, Geometric statements, motion statements, additional APT statements, simple problems of APT programming.

UNIT – IV

CNC, DNC and Adaptive Control: Introduction, problems with conventional NC, principles of operation of CNC, features of CNC, advantages of CNC, direct numerical control, types and functions of DNC, advantages of DNC, Adaptive Control machining systems, types, benefits of Adaptive control systems.

TEXT BOOKS:

1. Automation, Production Systems and CIM – M.P.Groover, Pearson International Edition 3rd edition, 2007
2. Computer Control of Manufacturing Systems - Y. Koren, McGraw-Hill Inc,1983

REFERENCES:

1. CAD/CAM – M.P.Groover & E.W.Zimmers.Prentice Hall India
2. CAD/CAM:Principles and Applications- P N Rao, (PHI),3rd edition, 2010
3. Numerical Control & Computer Aided Manufacturing – Kundra, Mc graw-Hill 1987
4. Computer Aided Manufacturing – Rao, P, Tewari, N and T.K. Kundra, Tata .Mc Graw .Hill 1998

Web Resources:

- http://www.technologystudent.com/cam/cncman4.htm
- http://www.cnccookbook.com/CCCNCMachine.htm
- https://www.cncci.com/resources/articles/what%20is%20cnc.htm

15MECC1004 Computer Aided Modeling

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 4		

Pre-requisites:

- Engineering Graphics, Auto-Cad Lab

Course Outcomes:

At the end of the completion of this course the student will be able to

- Differentiate the features of computer aided design, with traditional design approaches. **(a)**
- Apply different algorithms and parametric equations to generate graphic entities like Line, Circle, Bezier curve, B- Spline curve etc. **(a, b, e)**
- Apply different algorithms and parametric equations to generate various surfaces, removal of hidden lines & surfaces **(a, b, c, e)**
- Apply different assembly techniques for various mechanical components **(a, c, k)**

UNIT-I

Introduction to CAD: Fundamentals of CAD, Applications of computer for design, benefits of CAD, design work station, graphics terminal, product cycle, input / output devices, Transformations - (translation, rotation, scaling & mirror) Homogeneous representation of transformation, Concatenation of transformations.

UNIT-II

Geometric Modeling: Parametric equations of line, circle, ellipse, cubic spline, Bezier curve, B-spline curve.

Parametric equations of Surfaces: Bezier surface, B-spline surface, Surfaces of revolutions, Sweep surfaces, Tabulated cylinder.

UNIT-III

Visual Realism: Introduction, Hidden line removal algorithm - the priority algorithm, advantages & applications.

Hidden surface algorithm- z-buffer algorithm, advantages & applications Shading techniques- Gourant shading & Phong shading, applications, Coloring techniques

UNIT-IV

Assembly of Parts: Introduction, assembly modeling: part modeling representation, Hierarchical relationship, mating conditions; Generation of assembly sequence: Precedence diagram, liaison sequence analysis with different case studies

Text book:

1. CAD/CAM – Theory & Practice, Ibrahim Zied, Mc Graw Hill, International edition, 2009.
2. CAD/CAM, Mikel P Groover & W Zimmers Jr, Pearson Education, India, 5th impression 2008

References:

1. CAD/CAM, P.N.Rao, Tata McGraw Hill, 6th reprint, 2006
2. Procedural elements for Computer Graphics by Rogers, Tata McGraw Hill, 2005
3. Principles of Interactive Graphics by Newman and Sproull, Tata McGraw Hill, 1979
4. CAD/CAM concepts & applications, Chennakesava R. Alavala,(PHI)2008.

Web resources:

1. http://itc.fgg.uni-lj.si/bled96/papers/fridqvis.pdf
2. http://www.autodesk.com/solutions/cad-software
3. http://math.harvard.edu/~ytzeng/worksheet/0926_sol.pdf
4. http://wwwme.nchu.edu.tw/~CIM/courses/Flexible%20Manufacturing%20Systems/Microsoft%20Word%20-%20Chapter8F-ASSEMBLY%20SYSTEMS%20AND%20LINE%20BALANCING.pdf
5. http://web.iitd.ac.in/~hegde/cad/lecture/L6_3dtrans.pdf

15MECC1005A CONCURRENT ENGINEERING

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Product life cycle, Industrial management, Machine Design, Production technology.

Course Outcomes:

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

- Understand the importance of collaborative product development and use of information technology in concurrent engineering.**(a, e)**
- Understand various aspects of design of products. **(a, b)**
- Understand the concurrent approaches to design and manufacturing. **(a, b, c, g)**
- Understand the concepts of economics in design and project management. **(a, b, g)**

UNIT-I

Introduction: Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

Use of Information Technology: IT support - Solid Modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design

UNIT-II

Design Stage: Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints

UNIT- III

Manufacturing Concepts and Analysis: Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system - JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing

UNIT- IV

Project Management: Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development

Text Books:

1. "Integrated Product Development", Anderson MM and Hein, L. Berlin, Springer Verlog, 1987.
2. "Design for Concurrent Engineering", Cletus, J, Concurrent Engg. Research Centre, Morgantown, WV, 1992.

References:

1. "Concurrent Engineering: Automation Tools and Technology", Andrew Kusaik, John Wiley and Sons Inc., 1993.
2. "Concurrent Engineering Fundamentals: Integrated Product Development", Biren Prasad, Prentice Hall, 1996.
3. "Successful Implementation of Concurrent Product and Process", Sammy G Sinha, John Wiley and Sons Inc., 1999.

Web Resources:

- www.tm.tue.nl/race/ce/ce95.html

15MECC1005B DESIGN FOR MANUFACTURE AND ASSEMBLY

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Metrology, Manufacturing processes, Machine Design, Manufacturing Management.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the concept of design philosophy steps in engineering design process.**(a, b)**
- Analyze various machining process in view of design tolerances. **(a, b)**
- Describe the advantages and disadvantages of the different classes of manufacturing processes. **(a, b)**
- Understand the concept of a product design specification (PDS), and be able to indicate some of the factors which should be included in producing one. **(a, b)**

UNIT I

Engineering design – Kinds of design – Design process steps – Factors influencing design – Concurrent Engineering – Material selection process – Evaluation methods for material selection

UNIT II

Process capability analysis – Cumulative effect of tolerances – Centrality analysis – Compound assembly – Selective and Interchangeable assembly – Grouped Datum systems

UNIT III

Design for castings – Design for weldments – Design for forgings – Design for sheet metal formed parts – Design for powder metallurgy parts – Design for plastic parts

Design for machining – Design for economy – Design for clampability – Design for ease of assembly – Design for disassembly

UNIT IV

Advances in DFMA- Design for robustness – Axiomatic design – Design for environment – DFA index – Poka Yoke – Lean principles – Six sigma concepts – Computer aided DFA using software.

TEXTBOOKS

1. Engineering Design- Matousek R., Blackie and Son Limited, Glasgow, 1967.
2. Engineering Design: A Materials and processing Approach- Dieter, G.E. McGraw Hill Co. Ltd, 2000.
3. Assembly, Automation and product design- Boothroyd, G CRC press, 2005.

REFERENCES

1. Engineering Design" Pearson Education- Eggert, R.J, Inc. New Jersey, 2005.
2. Designing for Manufacture-Peck, H. Pitman Publications, London, 1983.
3. Engineering Design for Manufacture - Kalandar Saheb S.D and Prabhakar O, ISPE 1999.

Web Resources:

- http://nptel.ac.in/courses/107103012/module1/lec1.pdf
- https://www.rose-hulman.edu/~stienstr/ME470/DFA.ppt
- web.mit.edu/2.810/www/**Design**%20for%20manual%20**assembly**.pdf

15MECC1005C COMPUTER AIDED PROCESS PLANNING

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Process planning, Computer interface.

Course Outcomes:

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

- Understand fundamentals of the process planning and concepts of Concurrent Engineering. **(a)**
- Select the manufacturing sequence and determine the manufacturing tolerances. **(a, b, c)**
- Use the principle of Generative and Retrieval CAPP systems for automation. **(a, b, c)**
- Differentiate various production families and create awareness about the implementation techniques for CAPP. **(a, b, c, f)**

UNIT I

Introduction: Information requirement for process planning system, advantages of conventional process planning over CAPP, Structure of Automated process planning system. Part Feature recognition, methods. The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering.

UNIT II

Selection of Manufacturing Sequence: Significance, Alternative Manufacturing Processes, Reduction of total set-up cost for a particular sequence, Quantitative methods for optimal selection.

Determination of Manufacturing Tolerances: Design Tolerances, Manufacturing Tolerances, Methods of Tolerance Allocation, sequential approach, Integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

UNIT III

Generative CAPP system: Importance, Principle of Generative CAPP system, Automation of logical decisions, Knowledge based systems, Inference Engine, Implementation, Benefits.

Retrieval CAPP system: Significance, Group technology, Structure, relative advantages, implementation and applications.

UNIT IV

Implementation techniques for CAPP: MIPLAN system, Computer programming languages for CAPP, Criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems. Production families - CAM-I, CAPP, CPPP.

An Intergraded Process Planning Systems: Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

Textbooks:

1. "Principles of Process Planning, A logical Approach ", Gideon Halevi and Roland D. Weill, Springer Verlag, 2012.
2. "An Introduction to Automated Process Planning Systems " Tien-Chien Chang, Richard A.Wysk, Prentice Hall, 1985.
3. Computer Aided Process Planning – Joseph Tulkoff, SME Publications, 1985
4. Computer Aided Process Planning – Hsu-Pin Wang, Jian-Kang Li, Elsevier, 1991

References:

1. Automation, Production systems and Computer Integrated Manufacturing System – Mikell P.Groover,Prentice Hall,2008
2. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R Henderson, Philip M. Wolfe , McGraw-Hill, 1991.

Web Resources:

- http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
- http://Estraj.ute.sk/journal/englo/027/027.htm

15MECC1006A MECHANICAL VIBRATIONS

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Engineering Mathematics, Engineering mechanics, Machine dynamics.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the concepts of damping and, response of forced vibrations of a single d.o.f system. **(a, b,c)**
- Solve multi-degree of freedom systems for natural frequencies and mode shapes. **(a, b)**
- Understand the behavior of critical speeds of shafts and apply numerical methods to multi degree of freedom systems. **(a, b, c, e)**
- Analyze continuous and non-linear systems **(a, b)**

UNIT I

Damped free vibrations of single DOF systems: Different types of damping, free vibrations with viscous damping, Logarithmic decrement, viscous dampers, dry friction or coulomb damping, solid or structural damping, slip or interfacial damping.

Forced vibrations of single DOF systems: Forced vibrations with constant harmonic excitation, forced vibrations with rotating and reciprocating unbalance, forced vibrations due to excitation of the support, energy dissipation by damping, forced vibrations with coulomb damping, forced vibrations with structural damping, determination of equivalent viscous damping from frequency response curve, vibration isolation and transmissibility,

UNIT II

Two-degrees of freedom systems: Principal modes of vibration, Semi-definite system, combined rectilinear and angular modes, undamped forced vibrations with harmonic excitation, vibration absorbers, vibration isolation.

Multi-degree of freedom systems-exact analysis: Free vibrations-equations of motion, influence coefficients, generalized coordinates and coordinate coupling, natural frequencies and mode shapes (Eigen values and Eigen vectors), orthogonal properties of the normal modes, modal analysis (undamped free vibrations).

UNIT III

Multi-degree of freedom systems-numerical methods: Rayleigh's method, Dunkerley's method, Stodola's method, method of matrix iteration, Holzer's method.

Critical speeds of shafts: Critical speed of a light shaft having a single disc-without damping, critical speed of a light shaft having a single disc-with damping, critical speed of a light shaft having two discs without damping.

UNIT IV

Continuous systems: Vibrations of strings, longitudinal vibrations of bars, torsional vibrations of circular shafts, lateral vibrations of beams.

Non-linear vibrations: Introduction, difference between linear and non linear vibrations, examples: simple pendulum, vibrating mass connected to string, hard and soft spring, abrupt non-linearity.

Text Book:

Mechanical Vibrations by G. K. Grover, New Chand & Bros, 8th edition, 2009.

References:

1. Mechanical Vibrations by R. Venkatachalam, PHI Learning Private Limited, 2014.
2. Mechanical Vibrations: V.P.singh, Dhanpat Rai & Co. (P) Ltd, Delhi, 4th edition, 2015

Web Resources:

- http://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall- 2011/mechanical-vibration/
- http://nptel.ac.in/courses/112103112/1
- http://freevideolectures.com/Course/2684/Mechanical-Vibrations

15MECC1006B MECHANISMS DESIGN AND SIMULATION

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites

- Engineering Mechanics, Engineering Mathematics, Kinematics of Machines.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand basic motions of mechanisms. **(a)**
- Analyze multi linked mechanisms. **(a, b, c)**
- Design the mechanisms to acquire required path & motion. **(a, b, c)**
- Apply theory and the use of engineering tools in a mechanism design **(a, c, d. e)**

UNIT I

INTRODUCTION: 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.

UNIT II

KINEMATIC ANALYSIS: 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.

UNIT III

PATH CURVATURE THEORY, COUPLER CURVE: Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp-crunodes-coupler driven six-bar mechanisms-straight line mechanisms.

UNIT IV

SYNTHESIS OF FOUR BAR MECHANISMS: 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.

TEXT 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.

REFERENCES:

1. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2005.
2. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, 1999.
3. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.
4. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

Web Resources:

- https://www.softintegration.com/webservices/mechanism/
- http://designer.mech.yzu.edu.tw/class/mechancialDesign/abst/96_ppt_en/chap4.pdf

15MECC2006C THEORY OF ELASTICITY

Lectures	: 3 Periods/week	Internal Assessment	: 40
Semester end Exam	: 3hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Engineering Mechanics, Engineering Mathematics, Mechanics of Solids.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the concepts and transformation of stresses. **(a,e)**
- Understand the concepts and transformation of strains. **(a,e)**
- Solve 2-dimensional problems of elasticity. **(a,b,e)**
- Apply the concepts of elasticity to cylinders, discs, plate with hole and rings. **(a, b, e)**

UNIT I

Introduction to the general theory of elasticity with assumptions and applications of linear elasticity. Analysis of stress, stress tensors. Two-dimensional state of stress at a point, principal stresses in two dimensions, Cauchy's stress principle, direction cosines, stress components on an arbitrary plane with stress transformation. Principal stresses in three dimensions, stress invariants, equilibrium equations, octahedral stresses, Mohr's stress circle, construction of Mohr Circle for two and three dimensional stress systems, equilibrium equations in polar coordinates for two-dimensional state of stresses.

UNIT II

General state of stress in three-Dimensions in cylindrical coordinate System. Introduction to analysis of strain, types of strain, strain tensors, strain transformation. Principal strains, strain invariants, octahedral strains, Mohr's Circle for Strain, equations of Compatibility for Strain, strain rosettes. Stress-strain relations, generalised Hooke's law, transformation of compatibility Condition from Strain components to stress components. Strain energy in an elastic body, St. Venant's principle, uniqueness theorem.

UNIT III

Two dimensional problems in Cartesian coordinate system, plane stress and plane strain problems. Stress function, stress function for plane stress and plane strain

cases. Bending of a cantilever loaded at the end, Bending of a simply supported beam under uniform load.

UNIT IV

Two dimensional problems in polar coordinate system, strain-displacement relations, compatibility equation, stress- strain relations, stress function and biharmonic equation.

Axisymmetric problems, thick-walled cylinders, rotating disks of uniform thickness, stress concentration, effect of circular holes on stress distribution in plates. Winkler's - Bach theory, stresses in closed rings.

Text Book:

1. T.G. Sitharam and L.GovindaRaju, "Applied Elasticity", Interline Publishers, 2006.

References:

1. Y. C. Fung, "Foundations of Solid Mechanics", Prentice - Hall Publishers, 1965.
2. S.P.Timoshenko and J.N. Goodier, "Theory of Elasticity", McGraw-Hill(India), 3rd edition, 2010.
3. C.T. Wang, "Applied Elasticity", McGraw-Hill, 1953.

Web resources:

- http://www.nptel.ac.in/syllabus/syllabus_pdf/105108070.pdf

15MECC1051 CAD LAB

Practicals	: 3 periods / Week	Internal Assessment	: 40
Final Exam	: 3 hrs	External Assessment	: 60
Credits	: 2		

Pre-requisites:

- Basic CAD commands, Graphics, Strength of material, Finite element analysis

Course Outcomes:

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

- Develop different drawing Algorithms for various surfaces. **(a, b, c,e, f)**
- Generate geometrical models of part and assemblies of machine components using PRO-E software. **(a, b, c, e)**
- Model complex freeform surfaces using CATIA software. **(a, b, c, e)**
- Build and Analyze FEA models for various Mechanical engineering problems using ANSYS software. **(a, b, c, d, e)**

1. Development of Drawing Algorithms using open GL software and C^{++}
   a) Line b) Circle c) Ellipse d) Bezier curve e) B – Spline Curve
2. Modeling using Solid and Surface Modeling Packages **(PRO-E/CATIA)**
   a) Solid Modeling, Part Modeling and Assembly of I/C Engine Components, Other Mechanical Components like Stuffing box, Screw jack, Pipe vice etc.
   b) Surface Modeling.
3. Finite Element Analysis using analysis packages **(ANSYS)**
   For different structures that can be described with 1-D, 2-D & 3-D elements to perform the following analysis:
   a) Static Analysis.
   b) Dynamic Analysis.
   c) Buckling Analysis.
   d) Analysis of slider crank mechanism.
   e) Analysis of Composite Structure.

REFERENCE BOOKS:

1. Pro/ENGINEER Wildfire 4.0 for Engineers and Designers - Prof. Sham Tickoo, Publications – CADCIM Technologies, 2010.
2. CATIA V5R20 for Designers - Sham Tickoo, Publications - Purdue University Calumet and **CADCIM Technologies,** USA Published by CADCIM Technologies, USA - ISBN: 978-1-932709-94-0.

3. Finite Element Analysis using ANSYS 11.0 - Paleti Srinivas, published by PHI Learning Private Limited, New Delhi, 2013.

Websites:

1. www.engr.uvic.ca/~mech410/**proe**_tutorials.../Getting_Started_**ProE**.pdf
2. https://**catia**tutor.com/
3. www.mece.ualberta.ca/tutorials/ansys/
4. nccastaff.bournemouth.ac.uk/jmacey/.../www/opengl_programming.html

15MECC1052 CAM LABORATORY

Practicals	: 3 Periods / Week	Internal Assessment	: 40
Final Exam	: 3 Hrs	Final Examination	: 60
Credits	: 2		

Pre-requisites

- Machining Processes, Modeling, Part Programming

Course Outcomes:

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

- Understand and prepare Part Programs for Step Turning, Taper Turning and Thread Cutting Operations using FANUC (OT & OM) Simulation Software **(a, e)**
- Understand and prepare Part Programs for Drilling Operation using FANUC (OT & OM) Simulation Software **(a, e)**
- Understand and prepare Part Programs for Milling Operations such as Linear and Circular Interpolation and Mirror Imaging using FANUC (OT & OM) Simulation Software **(a, b, e, k)**
- Understand and Perform Pick and Place Operations and moving the Robot arm along a defined path using SCORBOT ER 4u Robot. **(a, b, k)**
- Understand and Build 2D and 3 D Models using Master CAM **(a, b, k)**
- Understand and Simulate Models for Step, Taper, Facing and Thread Cutting Operations using Master CAM **(a, e, k)**
- Understand and Simulate Models for Step Milling and Grooving Operations using Master CAM **(a, b, e, k)**
- Understand the Operation of CNC Lathe Jobber XL **(a, e)**

Manual Part Programming

- Step & Taper Turning
- Linear & Circular interpolation
- Mirror Imaging

Computer Assisted Part Programming

- Facing, Step and Taper Turning
- Thread Cutting & Chamfering, Filleting

Material Handling

- Pick and Place Programming with Robot

Manufacturing

- Demonstration of making any two parts on CNC Lathe

Additive Manufacturing

- Making a Bolt and Nut
- Making a Sectional Model

Reference Books:

1. CAM/CAM - PN Rao, PHI, 2004
2. Computer Control of Manufacturing Systems – Y Koren, McGraw Hill, 1983

Web Resources:

- http://www.mfg.mtu.edu/cyberman/machtool/auto/nc/index.html
- http://www.instruction.greenriver.edu/manufacturing/08Spr/NC%20PGM.pdf
- http://elabz.com/wp-content/uploads/2010/04/ER4u_User_Manual.pdf
- http://cncmanual.com/?s=mastercam+manual
- http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20ManufacturingII/Module%20F/Module%20F(1)/p1.htm
- http://www.mfg.mtu.edu/cyberman/machtool/auto/nc/method.html

15MECC2001 COMPUTER INTEGRATED MANUFACTURING

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 4		

Pre-requisites:

- CAD, CNC machines, Science of measurement

Course Outcomes:

At the end of the completion of the course the student will be able to

- Learn fundamental concepts of manufacturing, automation, CAD/CAM and CIM. **(a)**
- Understand the basic concepts of Group technology, Machine cell design and Robotics. **(a, b, c)**
- Learn the building blocks of FMS and automated material handling systems such as AGVS. **(a, b)**
- Understand various types of Automated Storage and Retrieval Systems, automated contact and non contact inspection techniques. **(a, b, e)**

UNIT – I

Introduction: Definition of Automation, Need for Automation, Types of Automation, Advantages and Disadvantages of Automation, Types of Production, Functions in manufacturing, Automation Strategies, Introduction to CAD, Applications of Computers in Design, Introduction to CAM, Manufacturing Planning and control, Fundamentals of computer Integrated Manufacturing.

UNIT – II

Group Technology: Introduction, Part families, Parts classification and coding (OPITZ & MULTI CLASS), Production flow analysis, Machine cell design, Types of cell design, Benefits of Group Technology.

Robotics: Robot anatomy, Robot Configuration, Basic Robot motions, Types of drivers, End effectors.

UNIT – III

Flexible Manufacturing Systems: What is FMS, FMS Workstations, Materials Handling and storage system, Computer Control System, Planning the FMS, Applications and Benefits.

Automated Material Handling: Introduction, Types of material handling equipment, automated guided vehicle system (AGVS), Applications, Vehicle guidance and routing, Traffic control and safety, System management.

UNIT – IV

Automated Storage Systems (As): Storage systems performance, Automated storage / Retrieval systems (AS / RS), Basic components of AS /RS, AS / RS controls, Special features, applications. **Automated Inspection & Testing:** Automated inspection principles and methods, sensor technologies for automated inspection, Co-ordinate measuring machines (CMM), construction, operation & programming, CMM benefits and trends. Introduction to machine vision & non contact inspection methods.

TEXT BOOK:

1. Automation, Production Systems, and Computer Integrated Manufacturing – M.P.Groover Pearson New International Edition,2013.

REFERENCES:

1. CAD/CAM - Mikell P.Groover, and Emory W.Zimmers.Jr. PHI Publishers,1984
2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers,2008
3. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers

Web References:

- http://www.enotes.com/computer-integrated-manufacturing
- http://www.britannica.com/EBchecked/topic/computer-integrated – manufacturing
- http://en.wikipedia.org/wiki/computer-integrated-manufacturing#overview

15MECC2002 FINITE ELEMENT ANALYSIS

Lectures	: 4 Periods/week	Internal Assessment	: 40
Semester end Exam	: 3hrs	Semester end Examination	: 60
Tutorial	: 1 period/week	Credits	: 5

Pre-requisites:

- Strength of materials, Dynamic analysis

Course Outcomes:

At the end of the completion of the course the student will be able to

- Apply 1-D FEM for truss, beam and frame problems. **(a, b, e)**
- Apply 2-D FEM for Plane and axisymmetric solids. **(a, b, e)**
- Understand the formulations for 3-D and non-linear elements. **(a)**
- Apply the FEM for dynamic systems. **(a, c, e)**

UNIT I

Analysis of Trusses, Beams and Frames: Introduction, Space truss element, Beam element, Space Frame element, Planar Frame element.

UNIT II

Analysis of plane stress and plane strain problems: Finite Element modeling using CST and LST elements, element matrices for plane stress and plane strain, Stress calculations, Problem modeling and boundary conditions.

Axisymmetric solids subjected to axisymmetric loading: Axisymmetric formulation, Finite element modeling using linear triangular element, element matrices, Stress calculations, Problem modeling and boundary conditions.

UNIT III

Analysis of Three-dimensional problems: Introduction, Finite Element formulation using Tetrahedron element, element matrices, Stress calculations, Numerical Integration.

Introduction to non-linear FEM: Introduction, direct substitution method, Newton-Raphson method, Simple problems.

UNIT IV

Dynamic Analysis: Dynamic equations of motion, consistent and lumped mass matrices, mass matrices of a space truss, space frame, planar frame, beam, and tetrahedron elements. Free longitudinal vibrations of a stepped bar, Dynamic response using FEM.

Text Book:

1. Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A. D. Belegundu, PHI Learning Private Limited, 3rd edition,2011.

References:

1. The Finite Element Method in Engineering – S. S. RAO, Butterworth-Heinemann publications, 5th edition, 2011
2. Finite Element Methods for Engineers by U.S. Dixit, Cengage learning India Pvt Ltd, 2009.
3. An introduction to Finite Element Method- J. N. Reddy, McGraw-Hill(India),2005.
4. Concepts and applications of Finite Element Analysis – R. D. COOK;Wiley-Eastern.

Web resources

- http://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/
- http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/linear-finite-element-analysis-mitocw.html

15MECC2003 Additive Manufacturing

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 4		

Pre-requisites:

- Computer Aided Modeling, CAD lab

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the importance and application of RP system in engineering design. **(a)**
- Develop various layered models for different RP methods. **(a, e)**
- Understand to edit layered models to improve the part accuracy **(a, b, e)**
- Understand the importance of rapid manufacturing and related processes. **(a, c, e)**

UNIT-I

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.

Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details & Applications.

Selective Laser Sintering (SLS): Principle, Process details, machine details & Applications.

UNIT II

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details & Applications.

Solid ground curing: Principle of operation, Machine details & Applications.

Fusion Deposition Modelling: Principle, process parameter, Path generation & Applications.

UNIT –III

Laser Engineering Net Shaping (LENS): Principle, process parameter, Path generation & Applications

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling, Spray metal tooling, Cast kriksite, 3Q keltool.

Software for RP: STL files, importance of various softwares: Magics, Imics.

UNIT IV

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

Allied Process: Surface digitization and Surface generation from point cloud, Surface modification.

Text books:

1. Chua, Rapid prototyping 3e, Principles & Application, Cambridge University press, 2010
2. Paul F.Jacobs – "stereo lithography and other RP & M Technologies", SME, NY 1996
3. Flham D.T & Din joy S.S – "Rapid Manufacturing "Verlog London 2001

Web resources

- http://www.additive3d.com/rp_int.htm
- https://www.rolanddga.com/applications/rapid-prototyping
- http://www.emeraldinsight.com/journal/rpj
- http://additivemanufacturing.com/
- http://www.eos.info/additive_manufacturing/for_technology_interested

15MECC2004 MECHATRONICS

Lectures	: 4 Periods / Week	Internal Assessment	: 40
Final Exam	: 3 hrs	Final Examination	: 60
Credits	: 4		

Pre-requisites:

- Basic mathematics, Basic electronics, Mechanical systems.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the principles of measurement, control systems and microprocessors. **(a, f)**
- Understand the principles of various sensors and transducers. **(a, e, f)**
- Develop the PLC programmes for various logic operations. **(a, e, f)**
- Understand different case studies of simple Mechatronic systems. **(a, e, f)**

UNIT - I

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

Microprocessors: Comparison between microprocessor and microcontroller, organization of microcontroller system, architecture of microcontroller & Microprocessors, Microprocessor systems, Intel 8085A architecture, internal register organization and pin configuration, interfacing input and output devices

UNIT - II

Sensors and Transducers: Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors.

UNIT - III

Programmable Logic Controllers: Introduction, Basic structure, input/output processing, programming, Mnemonics, Timers, Internal relays and counters. Data handling.- Analog input/ output, D/A Converters and A/D Converters, Selection of PLC.

UNIT – IV

Design and Mechatronics: Designing, Possible design solutions- Timed switch, wiper mechanism, Case studies of Mechatronics systems- Pick and place robot,

Car park barrier, Automatic camera. Temperature control, Traffic light controller, Tank level control system and Sequential switching of motors.

Text book:

1. Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering, Bolton. W, Pearson Education, 5th Edition, 2011.

References:

1. Mechatronics-Principles, concepts and applications, Mahalik, Tata McGraw hill, 2nd reprint, 2006
2. Introduction to Mechatronics and Measurement Systems, Michael B. Histand and David G. Alciatore, McGraw Hill International Editions, 3rd edition, 2006
3. Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics, Lawrence J.Kamm, Prentice Hall, 2000.
4. Mechatronics, Bradley, D.A., Dawspn, D, Buru, N.C. and Loader, AJ., Chapman and Hall, 1993

Web resources

- http://www. cs. indiana.edu.
- http://nptel.ac.in/courses/112103174/

15MECC2005A ROBOTICS

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Mathematics, Kinematics, Basic electronics.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the concepts of robotics, robot motions and end effectors (**a, b)**
- Calculate the transformation matrix for robot manipulator. **(a, b, c, d)**
- Understand fundamental knowledge on drive systems and gripper design. **(a, c)**
- Understand the fundamental languages used in robot programming like VAL. **(a, e)**
- Understand the working principles of Robot sensory devices and Machine vision functions. **(a, b, c, d, e, f, k)**

UNIT - I

Introduction: Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-Material Handling-Processing-Assembly and Inspection -Safety considerations

UNIT - II

Transformations and Kinematics: Vector operations-Translational transformations and Rotational transformations-Properties of transformation matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution- Denavit-Hartenberg (D-H) representation of forward kinematic equations of robots.

UNIT - III

Controls and End Effectors: Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors-Classification- Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design.

UNIT - IV

Robot Programming: Methods -Languages-Computer control and Robot Software-VAL system and Language.

Sensory Devices: Non optical and optical position sensors-Velocity and Acceleration-Range- Proximity-touch-Slip-Force-Torque- Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and categorization-Software consideration.

TEXT BOOKS:

1. Industrial robotics Technology, programming and applications - Groover M.P, McGraw Hill, 1995.
2. Introduction to Robotics Mechanics and Control - Craig J.J, Addison Wesley, 2010.

REFERENCES:

1. Robotics Technology and Flexible Automation - Deb S.R, Tata McGraw Hill, 2009.
2. Robotics control, sensing, vision, and Intelligence- Fu K.S., Gonzalez R.C and Lee C.S.G, McGraw Hill, 1987
3. Robot Engineering An Integrated approach - Klafter R.D., Cmielewski T.A. and Negin M., Prentice Hall of India, 1994.

Web Resources:

- http://nptel.iitm.ac.in/courses.php?branch=Mechanical
- http://academicearth.org/courses/introduction-to-robotics

15MECC2005B FLUIDICS & CONTROL SYSTEMS

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Final Exam	: 3 hrs	Final Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Fluid mechanics, microprocessors

Course Outcomes:

At the end of the completion of the course the student will be able to

- Differentiate various types and working of different hydraulic Pumps, Actuators **(a)**
- Understand the working of various valves. **(a)**
- Design various Hydraulic and Pneumatic circuits. **(a, b)**
- Design various Pneumatic Logic Circuits. **(a, b)**

UNIT-I

Oil Hydraulic Systems: Introduction, Hydraulic Power Generators-Selection and Specification of Pumps, Pump Characteristics

Hydraulic Actuators: Linear and Rotary Actuators-Selection, Specification and Characteristics

UNIT-II

Control and Regulation Elements: Pressure, Direction and Flow Control Valves, Servo and Proportional Valves

UNIT-III

Industrial Hydraulic Circuits: Reciprocation, Quick Return Circuit, Sequencing and Synchronizing Circuits, Accumulator Circuits, Intensifier Press Circuit, Hydraulic Operation of a Milling Machine Circuit.

Safety Circuits: Two Hand Safety Control Circuit, Fail Safe Control Circuit Using Emergency Cut off Valve.

Pneumatics: Basic Pneumatic system, Pneumatic Valves

Pneumatic circuits: Basic Pneumatic Circuit, Speed Control Circuit, Quick Exhaust Circuit, Two Step Feed Control Circuit, Time Delay Circuit

UNIT-IV

Pneumatic Logic Controls: Position and Pressure Sensors.

Design of pneumatic logic circuits: Classic method, Cascade method, Step Counter Method

Maintenance: Fault Finding-Hydro Pneumatic Circuits

Low cost automation: Concepts of Low Cost Automation. Technologies used for Low Cost Automation.

Textbook:

1. Fluid power with Applications by Antony Espossito, Pearson Education India, 6th Edition, 2003
2. Hydraulic and Pneumatic Controls by R Srinivasan, Mc Graw Hill Education (India) Private Limited, 2nd Edition, 2008

References:

1. Basic Fluid Power by Dudley A. Pease and John J. Pippenger, Prentice Hall, 2nd Edition, 1987
2. Hydraulics and Pneumatics by Andrew Parr, (HB), Jaico Publishing House, 2nd Edition, 1999
3. Pneumatic and Hydraulic Systems by Bolton. W, Butterworth – Heinemann Ltd., 1997

Web resources:

- http:// www.pneumatics.com
- http:// www.fluidpower.com.tw

15MECC2005C VISION SYSTEMS AND IMAGE PROCESSING

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Engineering Mathematics

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the basic features of digital images**.(a,b,e)**
- Describe the image transformations. **(a,b,e)**
- Find image edges and segment images. **(a, c)**
- Understand the image classification techniques **(a, c, e)**

UNIT I

Machine vision - Vision sensors - Comparison with other types of sensors – Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.

Image representation - Application of image processing - Image sampling, Digitization and quantization - Image transforms.

UNIT II

Spatial domain techniques - Convolution, Correlation. Frequency domain operations – Fast Fourier transforms, FFT, DFT, and Investigation of spectra. Hough transform

UNIT III

Image enhancement, Filtering, Restoration, Histogram equalization, Segmentation, Region Growing.

UNIT IV

Image compression - Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.

TEXT BOOK:

1. Digital Image Processing - Rafael C and Gonzalez, Addison Wesley, 2013

REFERENCES:

1. Digital Image Processing- S, Jayaraman, T Veerakumar and S Esakkirajan, Academic Press, 2009.
2. Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics - Justin Solomon , CRC Press, kindle edition,2015

Web Resources:

1. https://www.coursera.org/course/images
2. http://www.nptel.ac.in/courses/117104069/4
3. http://nptel.ac.in/courses/106105032/

15MECC2006A
MECHANICS AND MANUFACTURING METHODS OF COMPOSITES

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Mechanics and strength of materials, Theories of failure, Manufacturing methods

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the benefits limitations and application of composites **(a, j)**
- Understand common fabrication techniques of Composites **(a, d, j)**
- Derive constitutive relations and determine stresses and strains in composites.**(a, b, c, d)**
- Analyze failure mechanisms of composites **(a, b, k)**

UNIT: I

Basic Concepts and Characteristics: Geometric and Physical definitions, Classification and characteristics of composite materials, Mechanical behaviour of composite materials, Advantages and limitations of composite materials, Current and potential usage of composite materials.

UNIT: II

Reinforcements And Fabrication Of Composites: Different reinforcing fibers, Matrix materials, fabrication of thermosetting resin matrix composites, fabrication of thermoplastic resin matrix composites, fabrication of metal matrix composites, fabrication of ceramic matrix composites

UNIT: III

Coordinate Transformations: Hooke's law for different types of materials, Transformation of stress and strain.

Elastic Behavior of Unidirectional Composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

UNIT: IV

Strength of Unidirectional Lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design.

TEXT BOOKS:

1. Engineering Mechanics of Composite Materials - Isaac and M Daniel, Oxford University Press, 1994.
2. Analysis and performance of fibre Composites- B. D. Agarwal and L. J. Broutman, Wiley-Interscience, New York, 1980.

REFERENCES:

1. Mechanics of Composite Materials - R. M. Jones,Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures- L. R. Calcote, Van Nostrand Rainfold, New York,

Web Resources:

- http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Composite Materials.

15MECC2006B ADVANCED MATERIALS ENGINEERING

Lectures	*: 3 Periods / Week*	*Internal Assessment*	*: 40*
Semester end Exam	*: 3 hrs*	*Semester end Examination*	*: 60*
Tutorial	: 1 Period / Week	*Credits*	*: 3*

Pre-requisites:

- Engineering Mechanics, Engineering Mathematics, Mechanics of Solids, Materials Science

Course Outcomes:

At the end of the completion of the course the student will be able to

- understand elastic and plastic behavior of materials. **(a,b,c)**
- understand the fracture behavior of materials. **(a,b,c)**
- select appropriate materials for various applications. **(a,b,c,d)**
- understand modern materials and their treatment. **(a,c,d)**

UNIT I

ELASTIC AND PLASTIC BEHAVIOUR: Mechanism of Elastic and Plastic deformation, Anelasticity and viscoelasticity- role of dislocations, yield stress, shear strength of perfect and real crystals –Strengthening mechanism, work hardening, solid solutioning, grain boundary strengthening, Poly phase mixture, precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity.

UNIT II

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

UNIT III

SELECTION OF MATERIALS: Motivation, 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.

UNIT IV

MODERN MATERIALS AND TREATMENT: Dual phase steels, high strength low alloy steel, transformation included plasticity steel, maraging steel, smart materials, properties and applications of engineering plastics and composites materials - advanced structural ceramics – WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN, diamond – Plasma, PVD, CVD- thick and thin film deposition – Functionally Gradient Materials , Nano materials

TEXT BOOKS:

1. Dieter, G.E., "Mechanical Metallurgy", McGraw Hill, 1988.
2. Charles, J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of engineering Materials", (3 rd Edition, Butterworth – Heiremann, 1977.
3. Courtney, T.H.,"Mechanical Behavior of Materials" ,(2nd edition), McGraw Hill, 2000.

REFERENCES:

1. James, K.W., Wiley, Intersam, John, "The Hand book of Advance Materials", Wilson Publishers., 2004.
2. Burakonsa, T.Z. and Wierzchan. T.,"Surface Engg of Meterials"- Principles of Equipment, Techniques.
3. Flinn,R.A.and Trojan ,P.K.., "Engineering Materials and their Applications" (4th Edition), Jaico, 1999.
4. Failure Analysis and Prevention -Metals hand book, vol. 10,10th edition, 1994.

Web resources:

1. http://www.uio.no/studier/emner/matnat/geofag/GEO1011/h05/undervisningsmateriale/forelesninger/Duktildef.pdf
2. http://ocw.mit.edu/courses/materials-science-and-engineering/3-35-fracture-and-fatigue-fall-2003/
3. http://www.sciencedirect.com/science/book/9780750632775

15MECC2006C PRODUCTION & OPERATIONS MANAGEMENT

Lectures	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Tutorial	: 1 Period / Week	Credits	: 3

Pre-requisites:

- Manufacturing, Management

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand Production and Operations strategies **(a, b, e, g).**
- Understand the techniques of Capacity Requirement Planning (CRP) and Materials Requirement Planning (MRP) **(a, b, f, g).**
- Understand the concepts of Quality improvement and Materials Management Information System (MMIS) **(a, b, g).**
- Understand the concepts of Project Management **(a, b, g).**

UNIT I

Production Systems – Nature, Importance and organizational function. Characteristics of Modern Production and Operations function. Organization of Production function. Recent Trends in Production and Operations Management. Role of Operations in Strategic Management - Production and Operations strategy – Elements and Competitive Priorities. Nature of International Operations Management.

UNIT II

Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Requirements Planning (CRP), Aggregate Planning – Approaches- costs- relationship to Master Production schedule. Overview of MRP, MRP II and ERP.

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Service Operations – Types, Strategies, Scheduling

UNIT III

Basic concepts of quality, dimensions of quality, Juran's quality trilogy, Deming's 14 principles, PDCA cycle, Quality circles, Quality improvement and cost reduction-7QC tools and 7 new QC tools, ISO 9000-2000 clauses, coverage QS 9000 clauses, coverage. Six Sigma, Total Productive Maintenance (TPM).

Materials Management – Objectives, Planning, Budgeting and Control. Overview of Materials Management Information Systems (MMIS). Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis.

UNIT IV

Project Management – Scheduling Techniques, PERT, CPM, and Crashing CPM networks – Simple Problems. Facility Location – Theories, Steps in Selection, Location Models – Simple Problems. Facility Layout – Principles, Types, Planning tools and techniques.

TEXTBOOKS

1. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.
2. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.
3. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCES

1. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
4. Chase Jacobs, Aquilano & Agarwal., Operations Management, Tata McGraw Hill, 2006.
5. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.

Web resources:

1. http://operation management.
2. http:// Logistics and Transportation Management
3. http://stratgicmanagement

15MECC2007 RELIABILITY ENGINEERING

Semester end Exam	: 3 hrs	Internal Assessment	: 40
Credits	: 2	Semester end Examination	: 60
		Self Learning	

Pre-requisites:

- Engineering Mathematics.

Course Outcomes:

At the end of the completion of the course the student will be able to

- Understand the various concepts of mortality curve. **(a, b,i)**
- Understand the different types of failure distributions **(a, b,i)**
- Implement the methods of improving the reliability **(a, b, c,i)**
- Understand the concept of reliability management. **(a, b, c, f, g,i)**

UNIT-I

Reliability Concept: Reliability function - failure rate - Mean time between failures (MTBF) - Mean time to failure (MTTF) – a priori and a posteriori concept - mortality curve - useful life availability - maintainability – system effectiveness.

UNIT-II

Reliability Data Analysis: Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques.

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability Management: Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs –Reliability allocation - Replacement model.

Concept of risk- objective and scope of risk assessment- probabilisticRisk- risk perception and acceptability- PRA management- preliminaryhazard analysis- HAZOP and HAZAN, FMEA and FMECA analysis,Fault tree Analysis

TEXT BOOKS:

1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.

REFERENCES:

1. John Davidson, " The Reliability of Mechanical system ", published by the Institution of Mechanical Engineers, London, 1988.
2. Smith C.O." Introduction to Reliability in Design ", McGraw Hill, London, 1976.

Web resources:

1. http://Life Data Analysis
2. http://nptel.ac.in/courses/10567/reliability
3. www.Reliability Growth Analysis.com
4. www.FMEA and FMECA Analysis.com

15MECC2051 AUTOMATION LAB

Practicals	: 3 periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 2		

Pre-requisites:

- Mechatronics and Robotics

Course Outcomes:

At the end of the completion of the course the student will be able to

- Develop ladder diagrams for different logic gates like NOT, AND, OR, NAND, XOR etc. **(a, c, e)**
- Develop the logic programme to control the sequencing of pneumatic cylinders **(a, c, e)**
- Learn the use of various sensors like capacitive, inductive, diffused optical sensor etc. in ladder programming **(a, e, f)**
- Use various simulation software's like H-simulator, P-simulator, PLC- simulator etc. **(a, e, k)**

1. Logic gates using LSM controller package

a) NOT
b) AND
c) OR
d) NAND
e) NOR
f) XOR
g) Motor Latching
h) Traffic lights signal
i) On-off cyclic timer
j) Delay of timer
k) Cascade timers
l) Single acting cylinder
m) Double acting cylinder
n) Sequencing of cylinder

2. Sensor Technology Package-using PLC

a) Through Beam Optical Sensor
b) Capacitive sensor
c) Inductive sensor

d) Retro-reflective optical sensor
e) Diffused optical sensor
f) Reed switches

3. Simulation soft wares

a) Robot simulator
b) H-simulator
c) P-simulator
d) PLC simulator

Reference Book :

1. Mechatronics (Electronic Control Systems in Mechanical and Control Engineering) by W.Bolton, 3rd edition, Pearson, 2010

Web references:

- http://engineering.nyu.edu/gk12/amps-cbri/pdf/Intro%20to%20Mechatronics.pdf
- http://runplc.com/wp-content/uploads/Books/plcprogramming.pdf
- http://www.mechatronic.me/files/ebooks/Mechatronic_Systems_Applications.pdf

15MECC2052 MINI-PROJECT & SEMINAR

Practicals	: 3 Periods / Week	Internal Assessment	: 40
Semester end Exam	: 3 hrs	Semester end Examination	: 60
Credits	: 2		

Course Outcomes:

At the end of the completion of the course the student will be able to

- Identify simple theoretical or practical problems related to the area of program specialization. **(a, d)**
- Analyse / Solve theoretical / practical problems for arriving at feasible solutions. **(b, c, d, k)**
- Prepare an organized report employing elements of technical writing and critical thinking. **(b, h, i, j)**
- Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting. **(h, k)**

15MECC3051 MAJOR PROJECT-A

Credits	: 10	Internal Assessment	: 40
Semester end Exam	: Viva-voce	Semester end Examination	: 60

Course Outcomes:

At the end of the completion of the course the student will be able to

- Identify a topic in relevant areas of thermal engineering. **(a, d)**
- Review literature to identify gaps and define objectives & scope of the work. **(a, b, d)**
- Understand the methods and processes from literature and apply appropriate research methodologies. **(b, d)**
- Develop a model, experimental set-up and / or computational techniques necessary to meet the objectives. **(b, c, e, g, i)**

15MECC4051 MAJOR PROJECT-B

Credits	: 14	Internal Assessment	: 40
Semester end Exam	: Viva-voce	Semester end Examination	: 60

Course Outcomes:

At the end of the completion of the course the student will be able to

- Identify methods and resources to carry out analysis and experiments. **(b, c, e, f, g)**
- Reorganize the procedures with a concern for society, environment and ethics. **(g, j)**
- Analyze and discuss the results to draw valid conclusions. **(b, h, i, k)**
- Prepare a report as per the recommended format and defend the work and explore the possibility of publishing the work. **(h, i, j)**