ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M. Tech.
CAD/CAM

(Applicable for the batches admitted from 2015 - 2016)

VALLURUPALLI NAGESWARA RAO VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institute, Accredited by NAAC with 'A' Grade
NBA Accreditation for CE, EEE, ME, ECE, CSE, EIE, IT B.Tech. Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH
Recognized as "College with Potential for Excellence" by UGC
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VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
HYDERABAD
An Autonomous Institute

Academic Regulations - M.Tech. Programme
(Applicable for the batches admitted from the academic year 2015-2016)

1. Introduction

Academic programmes of the institute are governed by rules and regulations as approved by the Academic Council of the institute.

These academic rules and regulations are effective from the academic year 2015-16, for the students admitted into two year post graduate programme offered by the college leading to Master of Technology (M. Tech.) degree in different specializations offered by the departments of Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering, Electronics and Communication Engineering, Computer Science and Engineering, Information Technology and Electronics and Instrumentation Engineering.

The M.Tech. degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on students who are admitted to the programme after fulfilling all the requirements for the award of the degree.

1.1 Eligibility for Admissions

Admission to the above program shall be made subject to the eligibility and qualifications prescribed from time to time. Admissions shall be made on the basis of GATE Rank and merit rank obtained at an Entrance Test conducted by the TSSCHE or as decided by TSSCHE subject to reservations prescribed by the university/State Government from time to time.

2. Programmes of study

The following two year M.Tech. degree programmes of study are offered by the departments at VNR VJIET.

Department	Specializations
ME	1.Advanced Manufacturing Systems 2. Automation 3. CAD/CAM
CE	1. Highway Engineering 2.Structural Engineering 3 Geotechnical Engineering
EEE	1. Power Electronics 2. Power Systems
CSE	1. Software Engineering 2. Computer Science and Engineering
ECE	1.VLSI System Design 2.Embedded Systems
EIE	Electronics and Instrumentation
IT	Computer Networks and Information Security

- **'ENGLISH'** language is used as the medium of instruction in all the above programmes.

3. Attendance requirements

Each academic year shall be divided into two semesters, each of 90 Instructions days, excluding examination, evaluation, declaration of results etc.

3.1 A student shall be eligible to appear for the semester end examinations in subject if he / she acquire a **minimum of 75% of attendance in that subject.**

3.2 Shortage of attendance up to 10% in any subject (i.e., attendance of 65% and above and below 75%) in a semester may be condoned by the Institute Academic Committee based on the rules prescribed by the Academic Council of the Institute from time to time.

3.3 A student shall get **minimum required attendance in at least three (03) theory subjects** in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech. degree, the student shall complete all the academic requirements of the subjects, as per the course structure.

3.4 Shortage of **attendance below 65% shall in NO case be condoned**.

3.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

3.6 In case the student secures less than the required attendance in any subject(s), he shall not be permitted to appear for the semester end examination in that subject(s). He shall re-register for the subject when offered next.

4. Evaluation

i. The performance of a student in each semester shall be evaluated subject–wise with a maximum of **100 marks for theory** and **100 marks for practical subjects**. In addition, **mini-project** and **comprehensive viva-voce** shall be evaluated for **100 marks** respectively.

ii. For theory subjects, the distribution shall be **40 marks for mid-term evaluation** and **60 marks for the semester end examination**.

❖ **Mid-Term Evaluation (40 M):**

Mid-term evaluation consists of **mid-term examination (30 M)** and **assignment/objective test/case study/course project (10 M).**

➢ **Mid-term examination (30 M):**

- For theory subjects, two mid-term examinations shall be conducted in each semester as per the academic calendar. Each mid-term examination shall be evaluated for 30 marks.
- Pattern of Mid-term examination:
  3 X 10M = 30 M (three internal choice questions one from each UNIT shall be given, the student has to answer ONE question from each UNIT)
- There shall be TWO mid-term examinations for each subject and the average of two mid-term examinations shall be considered for calculating final mid-term examination marks in that subject.

- **Assignment/objective exam/ case study/course project (10 M):**
  - Two assignment/objective exam/ case study/course project shall be given to the students covering the syllabus of first mid-term and second mid-term examinations respectively and evaluated for 10 marks each.
  - The first assignment/objective exam/ case study/course project shall be submitted before first mid-term examination and the second one shall be submitted before second mid-term examination.
  - The average of 2 assignments shall be taken as final assignment marks.

iii. For practical subjects, there shall be a **continuous evaluation during the semester for 40 marks and 60 marks for semester end examination**. Out of the 40 marks, **day-to-day work in the laboratory shall be evaluated for 10 marks**, and **15 marks for practical examination** and **15 marks for laboratory record.**

- **Semester End Examination (60 M):**

(a)Theory Courses

Question paper pattern for semester end examination (60 Marks)

- Paper shall consist of 05 questions of 10 marks each. (05X12M = 60 M)
- There shall be 01 question from each unit with internal choice.

(b) Practical Courses

Each laboratory course shall be evaluated for 60 marks. The semester end examination shall be conducted by two examiners, one Internal and other external concerned with the subject of the same / other department / Industry. The evaluation shall be as per the standard format.

4.1. Evaluation of Mini-Project: There shall be two presentations during the first year, one in each semester. For mini-project 1 and mini-project 2, a student under the supervision of a faculty member, shall collect the literature on a topic, critically review the literature, carry out the mini-project, submit it to the department in a report form and shall make an oral presentation before the departmental Project Review Committee (PRC). The Departmental PRC consists of Head of the Department, supervisor and one senior faculty member of the department. For each mini-project there shall be only internal evaluation of 100 marks. A student has to secure a minimum of 50% to be declared successful.

4.2. There shall be a comprehensive viva-voce in II year I semester. The comprehensive viva-Voce shall be conducted by a committee consisting of Head of the Department and two senior faculty members of the department. The comprehensive viva-voce is aimed to assess the students' understanding in various subjects studied during the M.Tech. programme of study. The comprehensive viva-voce shall be evaluated for 100 marks by the committee. There are no internal marks for the comprehensive viva-voce. A student must secure a minimum of 50% to be declared successful.

4.3. A student shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the semester end examination and a minimum aggregate of 50% of the total marks in the semester end examination and mid-term evaluation taken together.

4.4. A student shall be given one chance to re-register, after completion of the course work, for each subject, provided the internal marks secured by a student are less than 50% and he has failed in the semester end examination. In such a case student may re-register for the subject(s) and secure required minimum attendance. Attendance in the re-registered subject(s) has to be calculated separately to become eligible to write the end examination in the re-registered subject(s). Re-registration for the subjects is allowed only if those particular re-registration subjects are the hindrance for the award of Degree. Re-registration is allowed in this case provided the student doesn't have any subject(s) yet to pass other than the re-registration subjects where the internal marks are less than 50% with prior permission.

4.5. Laboratory examination for M.Tech. courses must be conducted with two examiners, one of them being laboratory class teacher and second examiner shall be a teacher of same specialization either external or a teacher from the same department other than the teacher who conducted laboratory classes for that batch.

5. Evaluation of Project / Dissertation Work.

5.1 Registration of Project Work: A student shall be permitted to register for the project work after satisfying the attendance requirement of all the subjects (theory and practical subjects).

5.2 A Project Review Committee (PRC) shall be constituted with at least four members namely HOD, PG coordinator of the M.Tech. programme, project supervisor and one senior faculty member of same specialization.

5.3 After getting permission as per 5.1, a student has to submit, in consultation with the project supervisor, the title, objective and plan of action of his project work to the Departmental PRC for its approval. Only after obtaining the approval of PRC, the student can initiate the project work.

5.4 If a student wishes to change his supervisor or topic of the project he can do so with the approval of PRC. However, the committee shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, the date of registration for the project work shall be the date of change of supervisor or topic as the case may be.

5.5 Internal evaluation of the project shall be on the basis of the seminars (Project reviews) conducted during the second year by the PRC. A student shall submit draft report in a spiral bound copy form.

5.6 The work on the project shall be initiated in the beginning of the second year and the duration of project is for two semesters. A student is permitted to submit Project work only after successful completion of theory and practical course with the approval of PRC not earlier than 240 days from the date of registration of the project work. For the approval of PRC the student shall submit the draft copy of thesis to the Head of the Department (Through project supervisor and PG coordinator) and shall make an oral presentation before the PRC.

The student is eligible to submit project work if he has published at least one paper covering 70% of the project work and presented his project work in Show and Tell activity.

5.7 After approval of PRC, every student has to submit three copies of the project dissertation certified by the supervisor to the Department.

5.8 The dissertation shall be adjudicated by one examiner selected by the Chief Superintendent. For this, HOD shall submit a panel of 3/ 5 examiners, who are eminent in that field with the help of the concerned guide.

5.9 If the report of the examiner is not favourable, the student shall revise and resubmit the Dissertation, within the time frame as prescribed by PRC. If the report of the examiner is unfavourable again, the dissertation shall be summarily rejected.

5.10 If the report of the examiner is favorable, viva-voce examination shall be conducted by a board consisting of the project supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The Board shall jointly report students work as:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. The student has to secure any one of the grades as Excellent, Good or Satisfactory on his dissertation and viva-voce. If the report of the viva-voce is unsatisfactory, the student shall retake the viva-voce examination after three months, making modifications as suggested. If he fails to get a satisfactory report at the second viva-voce examination, he has to re-register for the project work as mentioned in clause 5.1. However, the student may select a new guide or new topic or both with the approval of the PRC and submit the project dissertation with a minimum of 240 days from the date of re-registration. Of course, this shall not prejudice the clause 6.1 below.

6. Award of Degree and Class

A student shall be declared eligible for the award of the M.Tech. degree, if he pursues a course of study and complete it successfully for **not less than two academic years** and **not more than four academic years**.

6.1 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his admission, for any reason whatsoever, shall forfeit his seat in M.Tech. Course.

6.2 A student shall register and put up **minimum academic requirement in all 84 credits** and earn **84 credits.** Marks obtained in all 86 credits shall be considered for the calculation of Cumulative Grade Point Average (CGPA).

6.3 CGPA System:

Method of awarding absolute grades and grade points in two year M.Tech. degree programme is as follows:

- Absolute Grading Method is followed, based on the total marks obtained in mid-term evaluation and semester end examinations.

- Grades and Grade points are assigned as given below.

Marks Obtained	Grade	Description of Grade	Grade Points(GP) Value Per Credit
>=90	O	Outstanding	10.00
>=80 and <89.99	A	Excellent	9.00
>=70 and <79.99	B	Very Good	8.00
>=60 and <69.99	C	Good	7.00
>=50 and <59.99	D	Pass	6.00
<50	F	Fail	
Not Appeared the Exam(s)	N	Absent	

The student is eligible for the award of the M.Tech degree with the class as mentioned in the following table.

CGPA	Class
>= 8.0	First Class with Distinction
>= 7.0 and <8.0	First Class
>= 6.0 and < 7.0	Second Class

➢ **Calculation of Semester Grade Points Average (SGPA):**

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

$$\mathbf{SGPA} = \frac{\textbf{Total earned weighted grade points in a semester}}{\textbf{Total credits in a semester}}$$

$$\mathbf{SGPA} = \frac{\sum_{i=1}^{p} C_i * G_i}{\sum_{i=1}^{p} C_i}$$

Where Ci = Number of credits allotted to a particular subject 'i'
Gi = Grade point corresponding to the letter grade awarded to the subject 'i'
i = 1,2,…..p represent the number of subjects in a particular semester

Note: SGPA is calculated and awarded for the students who pass all the courses in a semester.

➢ **Calculation of Cumulative Grade Point Average (CGPA):**

The CGPA of a student for the entire programme shall be calculated as given below:

- Assessment of the overall performance of a student shall be obtained by calculating Cumulative Grade Point Average (CGPA), which is weighted average of the grade points obtained in all subjects during the course of study.

$$\mathbf{CGPA} = \frac{\textbf{Total earned weighted grade points for the entire programme}}{\textbf{Total credits for the entire programme}}$$

$$\mathbf{CGPA} = \frac{\sum_{j=1}^{m} C_j * G_j}{\sum_{j=1}^{m} C_j}$$

Where Cj= Number of credits allotted to a particular subject 'j'
Gj = Grade Point corresponding to the letter grade awarded to that subject 'j'
j = 1,2,….m represent the number of subjects of the entire program.

- Grade lower than D in any subject shall not be considered for CGPA calculation. The CGPA shall be awarded only when the student acquires the required number of credits prescribed for the program.

- **Grade Card**

  The grade card issued shall contain the following:

  a) The credits for each subject offered in that semester

  b) The letter grade and grade point awarded in each subject

  c) The SGPA/CGPA

  d) Total number of credits earned by the student up to the end of that semester.

7. Withholding of Results

If the student has not paid dues to the Institute, or if any case of indiscipline is pending against him, the result of the student may be withheld and he shall not be allowed into the next higher semester. The award or issue of the provisional certificate and the degree may also be withheld in such cases. This delay shall not prejudice clauses Nos.6.0 and 6.1.

8. Transitory Regulations

Students who have discontinued or have been detained for want of attendance or any other academic requirements, may be considered for readmission as and when they become eligible. They have to take up Equivalent subjects, as substitute subjects in place of repeated subjects as decided by the Chairman of the BoS of the respective departments. He/She shall be admitted under the regulation of the batch in which he/she is readmitted.

9. Minimum Instruction Days

The minimum instruction days for each semester shall be **90 instruction days.**

10. General

10.1 The academic regulations should be read as a whole for purpose of any interpretation.

10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

10.3 The Institute may change or amend the academic regulations and syllabi at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the Institute.

10.4 Wherever the words he, him or his occur, they shall also include she, her and hers.

11. Supplementary Examination

Supplementary examinations shall be conducted along with regular semester end examinations. (During even semester regular examinations, supplementary examinations of odd Semester and during odd semester regular examinations, supplementary examinations of even semester shall be conducted).

Vision

- To develop into a Centre of Excellence in Education and Research in the field of Mechanical Engineering, consistent with the contemporary and future needs of the country

Mission

- To impart **high quality education** by using **modern pedagogical tools** so as to make the students **technically competent** in their chosen fields and **socially responsible**
- To inculcate **quality research** by developing **linkages with Industry** and **R & D organizations** in India & abroad

M.TECH. PROGRAMME OBJECTIVES:

- To prepare students for successful careers in their domain that meets the need of Indian and global/multinational organizations.
- To provide a strong foundation in the chosen specialization that enables students to visualize, analyze and solve domain specific mechanical engineering problems.
- To inculcate in students a zeal and attitude for comprehending state of the art advancements and undertake further work in the chosen specialization.
- To prepare students for undertaking research in the chosen specialization and to function effectively in teams/groups.
- To provide students with an academic environment that fosters excellence leadership, ethical codes and guidelines and develops for life-long learning for a successful professional career.

M.TECH. PROGRAMME OUTCOMES:

- **Engineering Knowledge:** Graduates will demonstrate in-depth knowledge of CAD/CAM technologies and systems, mathematics, sciences, essential computational techniques/procedures that help in problem solving. Graduates will be able to assimilate the emerging developments in the field and enhance their understanding.
- **Problem Analysis:** Graduates will be able to demonstrate ability to identify, critically analyze, conceptualize, formulate and solve problems in the specific area with due consideration for safety, environmental, cultural and societal concerns.
- **Design and Development of Solutions:** Graduates will demonstrate ability to design a component, a process or a system in manufacturing or inter/multi-disciplinary region by following research methodology while arriving at a solution working in engineering and science laboratories as teams, involving review of literature, prepare a model, conduct experiments, analyze and interpret data.
- **Modern Tool Usage:** Graduates will demonstrate skills to use modern engineering tools, equipments, processes, state-of-the-art software tools for modeling and analysis while solving problems and drawing inferences in the specialized areas with due regard to their limitations and applicability.
- **Individual and Team Work:** Graduates will demonstrate ability to work as an individual as well as a team member/lead and play his role appropriately in the group with a proper understanding of group dynamics, contribute positively to collaborative multidisciplinary scientific research with positive attitude, open mindedness and objectivity for furtherance of individuals and groups' learning.
- **Ethics:** Graduates will demonstrate knowledge, understanding and application of Professional and Ethical responsibilities, intellectual integrity and human values in all the dealings.
- **Communication:** Graduates will demonstrate ability to communicate in both verbal and written form and present complex engineering activities confidently and effectively.
- **Project Management and Finance:** Graduates will demonstrate ability to administer and regulate projects with emphasis on time management, financial management and personnel management to both individuals own work and the teams collective work.
- **The Engineer and Society:** Graduates will demonstrate a broad understanding of impact of engineering solutions on economy, environment and society while arriving at solutions so as to avoid ill-effects and are sustainable.
- **Life Long Learning:** Graduates will demonstrate recognition of the need and engage in life-long learning, keep abreast with regard to nuances in the chosen field to improve knowledge, proficiency and competence on a continuous basis.
- **Self and Reflective Learning:** Graduates will demonstrate ability to learn, observe, reflect and evaluate ones' own activities for identifying, critically examining and rectifying the mistakes without outside help and thus self-learn.

M.TECH. (CAD/CAM):

Degree:	**M.Tech.**	Specialization:	**CAD/CAM**
Duration:	**2 Years (4 semesters)**	Details:	**2 semesters – Course work 2 semesters – Project**
Mode:	**Full-time**	Year of starting:	**2013**
Intake:	**18**	Regulations:	**R15**

- **Overview of the programme:**

  CAD/CAM stands for Computer Aided Design/Computer Aided Manufacturing. It is related to the use of computer systems in design and manufacture of products. CAD/CAM implies that an engineer can use the computer system both for designing a product and for controlling manufacturing processes. This two year (four semesters) programme is designed to develop skills in the areas of design/drafting (2D CAD and 3D solid modeling), analysis (finite element analysis) and manufacturing (part programming). Each student will also be exposed to hardware such as coordinate measuring machines (CMM), computer numerically controlled (CNC) machines, and industry grade robotics. It covers a wide range of subjects - both compulsory and electives like advanced CAD, computer aided manufacturing, finite element analysis, stress analysis and vibration, computational fluid dynamics, industrial robotics, automation, computer aided process planning etc.

- **Objectives:**
  - To provide knowledge and understanding of sound engineering principles and practices to solve design and manufacturing problems
  - To emphasize on mathematical modeling and the application of quantitative techniques associated with design, manufacturing, optimization, probability and statistics to the design and operation of the systems
  - To encourage to function effectively in teams or on group projects

- **Outcomes:**

  To enable the students
  - to synthesize a design and prepare a CAD model and
  - to analyze and optimize the engineering designs
  - to produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications
  - to prepare NC and CNC part programs required for carrying out the manufacturing
  - to function effectively in teams and assume leadership roles when appropriate

- **Opportunities:**

  This program prepares the student for a number of opportunities in the engineering and manufacturing-related fields. Passed out students will get opportunities to work as design engineer, technical analyst, technical officer, manufacturing engineer, production supervisor etc. in the design, manufacturing and analysis departments of various industries like aerospace, defence, automobile, general manufacturing etc.

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M. Tech. (CAD/CAM)

(R15 Regulation)

I YEAR I SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	T/P	Credit
AMS01	**Core**	Automation in Manufacturing	3	1	4
CAD01		Advanced CAD	3	1	4
AMS03		Precision Engineering	3	1	4
AMS13	**Elective – I & Elective – II Basket**	Design for Manufacturing & Assembly	3	0	3 + 3
CAD11		Metrology and Non-Destructive Testing	3	0	
AMS15		Mechatronics	3	0	
CAD12		Total Quality Management	3	0	
AMS14		Additive Manufacturing Processes	3	0	
CAD13		Composites Materials - Manufacturing Methods & Mechanics	3	0	
CAD31 AMS32 CAD32	**Open Elective – I**	Computer Integrated Manufacturing Quality and Reliability Engineering Reverse Engineering	3	0	3
CAD51	**Lab**	Computer Aided Design Lab	0	3	2
CAD61		Mini Project - I	0	0	4
Total			**18**	**6**	**27**

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M. Tech. (CAD/CAM)

(R15 Regulation)

I YEAR II SEMESTER **COURSE STRUCTURE**

Code	Group	Subject Name	L	T/P	Credit
CAD02	Core	Computer Aided Manufacturing	3	1	4
CAD03		Rapid Prototyping	3	1	4
CAD04		Finite Element Analysis	3	1	4
CAD21	Elective – III & Elective – IV Basket	Flexible Manufacturing Systems	3	0	3 + 3
AMS21		Quality Engineering in Manufacturing	3	0	
CAD22		Design of Hydraulic & Pneumatic Systems	3	0	
AMS24		Intelligent Manufacturing Systems	3	0	
CAD23		Computer Aided Process Planning	3	0	
AMS26		Industrial Robotics	3	0	
AMS41 CAD41 CAD42	Open Elective – II	Industrial Safety Management Concurrent Engineering Computer Aided Production Planning	3	0	3
CAD52	Lab	Computer Aided Machining Lab	0	3	2
CAD62		Mini Project - II	0	0	4
Total			**18**	**6**	**27**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

M. Tech. (CAD/CAM)

(R15 Regulation)

II YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
CAD63		Comprehensive Viva Voce	0	0	4
CAD71		Internship/Dissertation Phase – I	0	0	8
Total			**0**	**0**	**12**

II YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Group	Subject Name	L	P	Credit
CAD72		Dissertation Phase – II	0	0	18
Total			**0**	**0**	**18**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY, HYDERABAD

I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(AMS01) AUTOMATION IN MANUFACTURING

Course Prerequisites: Industrial engineering and Manufacturing technology concepts.

Course Objectives:

- Understand the basic principles of automation and tool transfer, implementation of automated flow line.
- Understand design aspects and analysis of material handling system.
- Understand ways of improving line balance and solving line balancing problems.

Course Outcomes:

Students will be able to:

- Implement concepts of a productive system in automation.
- Apply the concepts of automated flow lines and design technologies.
- Apply it in material handling systems for balancing assembly lines.

UNIT I:
Fundamentals of Manufacturing Automation: Basic Principles of automation, Types of automated systems, Degrees of automation, Automation - reasons, Production operations and automation strategies, Plant Layout, Production concepts and mathematical models, Design the parts for automation, Automatic loading Systems.

UNIT II:
High Volume Production Systems: Automated flow lines, Methods of work flow, Transport transfer mechanisms, buffer storage, Control functions, Automation for machining operations, Design and fabrication considerations.

UNIT III:
Analysis of Automated Flow Lines: Analysis of transfer lines without storage, Partial automation, Automated flow lines with storage buffers, Implementation of automatic flow lines, Line balancing problems, Considerations in assembly line design.

UNIT IV:
Assembly Systems and Line Balance: Manual assembly lines, Line balancing problem, Methods of line balancing, Ways to improve line balancing, Flexible manual assembly lines, Automated assembly systems, Analysis of multi station assembly. Manufacturing Cells, Automated Cells, Analysis of Single Station Cells.

UNIT V:
Automated Material Handling: Types of equipment and functions, Design and analysis of material handling system, Conveyor system, Automated guided vehicle system, Components operation, Types, Design of automated guided vehicles and applications, Automated storage and Retrieval systems - Types, Basic components and Applications, Design for Automated Assembly, Communication Systems in Manufacturing.

Text Books &References:

1. Mikell P. Groover, “Automation, Production Systems and CIM”, PHI Pvt., Ltd., 1998
2. P.Radha Krishnan & S. Subrahamanyam and Raju, “CAD/CAM/CIM”, New Age International Publishers, 2003.
3. Singh, “System Approach to Computer Integrated Design and Manufacturing”, John Wiley 1996.

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD01) ADVANCED CAD

Course Prerequisites: Mathematics, CAD/CAM.

Course Objectives:

- Understand the various CAD tools & devices used in modeling.
- Understand the parametric representation & analysis of curves & surfaces.
- Understand the different representation schemes, data exchange format & application of CAD.

Course Outcomes:

Students will be able to:

- Identify the CAD systems, classify between the types of modeling and relate to the applications of CAD.
- Find the parametric representation of synthetic entities.
- Validate the solid models through B-rep and CSG representation schemes and relate to the various data exchange formats.

UNIT I:
CAD Tools : Definition of CAD Tools, CAD/CAM system evaluation criteria, Brief treatment of input and output devices, Graphics standard, Functional areas of CAD, Modeling and Viewing, Software documentation, Efficient use of CAD software.

UNIT II:
Geometric Modeling – 2D: Types of mathematical representation of curves, Wire frame models, Wire frame entities, Parametric representation of synthetic curves, Hermite Cubic Splines, Bezier curves, B-Splines.

UNIT III:
Surface Modeling : Mathematical representation surfaces, Surface model, Surface entities, Surface representation, Parametric representation of surfaces, Plane surface, Ruled surface, Surface of revolution, Tabulated Cylinder.

UNIT IV:
Parametric Representation of Synthetic Surfaces: Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, 2-D & 3-D Transformations: Translation, Rotation, Scaling, Reflection, Shear.

UNIT V:
Geometric Modeling - 3D: Solid modeling, Solid Representation, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG).
CAD/CAM Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation.
Overview of Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

Text Books:
1. CAD/CAM Theory and Practice / Ibrahim Zeid / McGraw Hill international.

References:
1. Mastering CAD-CAM / Ibrahim Zeid / McGraw Hill international.
2. CAD/CAM / P.N.Rao / TMH.

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I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(AMS03) PRECISION ENGINEERING

Course Prerequisites: Accuracy and tolerances, geometric dimensioning, machine drawing and production engineering.

Course Objectives:

- Asses the machine tool accuracy and types of errors, datum features, tolerance zone conversion, process capability and surface finish.
- understand the tolerance charting techniques.
- Explain the fundamentals of nanotechnology and nanometer accuracy.
- Understand measuring system processing – Mechanical and optical measuring systems.

Course Outcomes:

Students will be able to:

- Apply fundamental knowledge of machine tool accuracy and geometric dimensioning for Components.
- Apply the concept of process capability while choosing the machine.
- Decide on measuring system for inspection components.
- Apply nanotechnology and nanometer accuracy

UNIT I:

Concepts of Accuracy: Introduction - Concept of Accuracy of Machine Tools - Spindle and Displacement Accuracies - Accuracy of Numerical Control Systems - Errors due to Numerical Interpolation, Displacement Measurement System and Velocity tags

Geometric Dimensioning and Tolerancing: Tolerance Zone Conversions - Surfaces, features, Features of Size, Datum Features - Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's - Datum Feature of Representation - Form controls, Orientation Controls - Logical Approach Tolerancing.

UNIT II:

Datum Systems: Design of freedom, Grouped Datum System - different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue - slot pair - Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT III:

Tolerance Analysis: Process Capability, Mean, Variance, Skewness, kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT IV:

Tolerance Charting Techniques: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum features - functional and manufacturing Components design - Machining Considerations, Redesign for manufactured, Examples.

UNIT V:

Fundamentals of Nanotechnology: Systems of nanometer accuracies, Mechanism of metal Processing, Nano physical processing of atomic bit units, Nanotechnology and Electrochemical atomic bit processing.

Measuring Systems Processing: In processing or in-situ measurement of position of processing point, Post process and on-machine measurement of dimensional features and surface, Mechanical and optical measuring systems.

Text Books:

1. Precision Engineering in Manufacturing/Murthy R.L/New Age International (P) Limited, 1996
2. Geometric Dimensioning and Tolerancing/ James D. Meadows / Marcel Dekker Inc. 1995

References:

1. Nano Technology / Norio Taniguchi / Oxford University Press, 1996.
2. Engineering Design - A systematic Approach / Matousek / Blackie & Son Ltd., London.

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I Year – I Sem. M.Tech. (AMS, Automation& CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS13) DESIGN FOR MANUFACTURING AND ASSEMBLY

Course Prerequisites: Production technology, Machine Tools, Material Technology

Course Objectives:

- Impart the knowledge on steps involved in design process and material selection
- Understand about the design rules involved in machining and casting
- Understand about the design rules involved in metal joining, forging, extrusion and sheet metal work
- Understand about the design principles involved in manual and automatic assembly transfer systems

Course Outcomes:

Student will be able to:

- Apply the knowledge on steps involved in design process and material selection
- Apply the knowledge on design rules involved in machining and casting
- Analyze the design rules involved in metal joining, forging, extrusion and sheet metal work
- Design and analyze the principles involved in manual and automatic assembly transfer systems
-

UNIT I:

Introduction: Design philosophy, Steps in Design process, General Design rules for manufacturability, Basic principles of designing for economical production, Creativity in design.

Materials: Selection of Materials for design, Developments in Material technology, Criteria for material selection, Material selection, Interrelationship with process selection, Process Selection charts.

UNIT II:

Machining Process: Overview of various machining processes, Design rules for machining, Redesigning of components for machining ease with suitable examples

Metal Casting: Appraisal of various casting processes, General design considerations for casting, Overview of solidification simulation in casting design, Product design rules for sand casting, Casting Defects.

UNIT III:

Metal Joining: Appraisal of various welding processes, Factors in design of weldments, General design guidelines, Pre and post treatment of welds, Effects of thermal stresses in weld joints, Welding Defects, Design of brazed joints.

Forging: Design factors for Forging, Closed die forging design, Parting lines of die drop forging die design

Extrusion& Sheet Metal Work: Design guidelines for extruded sections, Design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram, Die Design for Blanking.

UNITIV:

Assembly Advantages: Development of the assembly process, Choice of assembly method, Assembly advantages, Social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, Intermittent transfer, Indexing mechanisms and operator paced free transfer machine.

UNITV:

Design of Manual Assembly: Design for assembly fits in the design process, General design guidelines for manual assembly, Development of the systematic DFA methodology, Assembly efficiency, Classification system for manual handling, Classification system for manual insertion and fastening, Effect of part symmetry on handling time, Effect of part thickness and size on handling time, Effect of weight on handling time, Parts requiring two hands for manipulation, Effects of combinations of factors, Effect of symmetry, Effect of chamfer design on insertion operations, Estimation of insertion time.

Text Books:

1. Geoffrey Boothroyd, “Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Engineering Design – Material & Processing Approach – George E. Dieter, McGraw Hill Intl. 2nd Ed. 2000.

References:

1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekker, N.Y. 1990.
2. A. Delchambre "Computer Aided Assembly Planning”, Springer London, 1992.

I Year – I Sem. M.Tech. (CAD/CAM)	L	P	C
Elective – I & II	3	0	3

(CAD11) METROLOGY AND NON DESTRUCTIVE TESTING

Course Prerequisites: Mathematics, Engineering Metrology

Course Objectives:

- To understand the working of various measuring machines
- To learn the various Statistical Quality Control measures and tools
- To know about the various liquid penetrant and magnetic particle tests
- To understand the Radiography, the Ultrasonic and Acoustic Emission techniques

Course Outcomes:

Student will be able to:

- To realize the working of various measuring machines
- To correlate the various statistical quality control measures and tools
- To analyze the various liquid penetrant and magnetic particle tests
- To apply the radiography, the ultrasonic and acoustic emission techniques

UNIT I:

Measuring Machines: Tool Maker`s Microscope - Co-ordinate Measuring Machines - Universal measuring Machine - Laser viewers for production profile checks - Image shearing microscope - Use of computers - Machine vision technology - Microprocessors in Metrology

UNIT II:

Statistical Quality Control: Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing

UNIT III:

Liquid Penetrant And Magnetic Particle Tests

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

UNIT IV:

Radiography: Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications

UNIT V:

Ultrasonic And Acoustic Emission Techniques: Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A,B,C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications

References:

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

Web References:

1. www.metrologytooling.com
2. www.sisndt.com
3. www.iuk`tu-harburg.de

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I Year – I Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS15) MECHATRONICS

Course Prerequisites: Basic electronics, manufacturing, intelligence systems.

Course Objectives:

- To understand mechatronics principles and applications.
- To explore architecture of intelligence machines
- Understand machine design principles for similar applications

Course Outcomes:

Students will be able to

- Develop motion control algorithm
- Effectively choose /select proper sensor ,actuator to a given application
- Develop an intelligent automated system and manufacturing data base system

UNIT I:

Introduction: Definition of Mechatronics products, Design Considerations and Tradeoffs, Overview of Mechatronic products. Intelligent Machine vs Automatic. Machine Economic and social justification.

Actuators and Motion Control: Characteristics of Mechanical, electrical, Hydraulic and pneumatic actuators and their limitations. Control parameters and system objectives. Mechanical configurations. Popular control system configurations. S-curve, Motor/Load inertia matching, design with linear slides.

UNIT II:

Motion Control Algorithms: significance of feed forward control loops, shortfalls, Fundamental concepts of adaptive and fuzzy control. Fuzzy logic compensatory control of transformation and deformation non-Z linearities.

UNIT III:

Architecture of Intelligent Machines: Introduction to Microprocessor and programmable logic controllers and identification of system, System design Classification. Motion control aspects in Design.

UNIT IV:

Manufacturing Data Bases: Data Base management system, CAD/CAM Data bases, Graphic Data Base, Introduction to object oriented concepts, objects oriented model language interface, procedures and methods in creation, edition and manipulation of data.

UNIT V:

Sensor Interfacing: Analog and Digital Sensors for Motion Measurement, Digital Transducers, Human — Machine and Machine — Machine Interfacing devices and strategy.

Machine Vision: Feature and Pattern Recognition methods, concepts of perception and cognition in decision making.

Text Books & References:

1. Control sensors and actuators, “Designing Intelligent Machines”, Open University, London
2. Michel B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems” Tata McGraw Hill.
3. C.W. De Silva, “Control sensors and actuators”, 2 Edition, Prentice Hall.

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(CAD12) TOTAL QUALITY MANAGEMENT

Course Prerequisite: Statistics and Quality Assurance.

Course Objectives:

- Understand Quality and its role in today's context.
- Understand Organizing TQM and ways to migrate from a traditional system to a TQM.
- Understand how the quality is measured, existing standards present in general, and how to meet those quality certifications by implementing TQM.

Course Outcomes:

Students will be able to:

- Identify the quality systems in an organization and suggest improvements.
- Design & implement TQM in an industry.
- Transfer a simple traditional system to TQM.

UNIT I:
Introduction: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs., Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT II:
Customer Focus and Satisfaction: Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer- Supplier relationships. Bench Marketing: Evolution of Bench Marketing; meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls' of bench marketing.

UNIT III:
Organizing for TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles, Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT IV:
The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT V:
ISO 9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90, Series Standards/ benefits ISO 9000 certification, the third party audit, Documentation ISO 9000 and services, the cost of certification implementing the system.

Text Books & References:

1. Total Quality Management by Joel E. Ross.
2. Beyond TQM by Robert L.J. Flood.
3. Statistical Quality Control by E.L. Grant.

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I Year – I Sem. M.Tech. (AMS, CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(AMS14) ADDITIVE MANUFACTURING PROCESSES

Course Prerequisites: Manufacturing Technology, CAD/CAM.

Course Objectives:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effect of the additive manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in additive manufacturing.
- Realize the potential implications of AM technologies on product development and identify needs for new technologies to accelerate the advancement and impact of AM.

Course Outcomes:

Student will be able to:

- Upon completion of this course, the student can able to complete different methods to discuss the effects of the additive manufacturing technologies and analyse the characteristics of the different materials in additive manufacturing.
- Select a suitable material for Additive Manufacturing.
- Analyze different Methods for post-processing of additive manufacturing parts.
- Understand the applications of Additive Manufacturing.

UNIT I:

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM,

AM Process Chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.

UNIT II:

Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

UNIT III:

Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

UNIT IV:

Guidelines for Process Selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries

UNIT V:

Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM: Introduction, new types of products and employment and digiproneurship.

Text Books & References:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
2. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
3. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001
5. Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Hanser Publishers, 2013.

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Elective – I & II	**3**	**0**	**3**

(CAD13) COMPOSITE MATERIALS - MANUFACTURING METHODS AND MECHANICS

Course Prerequisites: Basic Material Science, Engineering mechanics, Mechanics of solids

Course Objectives:

- Understand characteristics of composite materials.
- Understand the principles of material science applied to composite materials.
- Apply governing equations to analyze problems by making good assumptions and understand systematic engineering method to solve practical composite of mechanics problems.

Course Outcomes:

Students will be able to:

- Develop knowledge of mathematics to model and analyze composites.
- Analyze failure of composites.
- Apply fundamental principles to different types of composite materials.

UNIT I:

Basic Concepts and Characteristics: Geometric and Physical definitions, Natural and man-made composites, Aerospace and structural applications, Types and classification of composites.

Reinforcements: Fibres - Glass, Silica, Kevlar, Carbon, Boron, Silicon carbide and Boron carbide fibres,. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and Ceramic composites.

UNIT II:

Micromechanics: Unidirectional composites, Constituent materials and properties, Elastic properties of a lamina, Properties of typical composite materials, Laminate characteristics and configurations, Characterization of composite properties.

UNIT III:

Manufacturing Methods: Autoclave, Tape production, Moulding methods, Filament winding, Man layup, Pultrusion, RTM.

Coordinate Transformations: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations, Off – axis stiffness modulus, Off - axis compliance.

UNIT IV:

Elastic Behavior of Unidirectional Composites: Elastic constants of lamina, Relationship between engineering constants and reduced stiffness and compliances, Analysis of laminated composites, Constitutive relations.

UNIT V:

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, The failure envelope, First ply failure, Free-edge effects, Micro mechanical predictions of elastic constants.

Analysis of Laminated Composite Plates: Introduction, Thin plate theory, Specially orthotropic plate, Cross and angle ply laminated plates, Problems using thin plate theory.

Text Books:

1. Mechanics of Composite Materials, R. M. Jones, McGraw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials, Isaac and M.Daniel, Oxford University Press, 1994.

References:

1. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman, Wiley - Inderscience, New York, 1980.
2. Analysis of Laminated Composite Structures, L. R. Calcote, Van Nostrand Rainfold, New York, 1969.

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Open Elective I	**3**	**0**	**3**

(CAD31) COMPUTER INTEGRATED MANUFACTURING

Course Prerequisites: Computer aided design, Computer aided manufacturing

Course Objectives:

- To expose the students to the different types of manufacturing available today.
- To learn the fundamentals of computer assisted numerical control programming and programming languages.
- To learn the guide lines and criteria for implementing CAD/CAM systems and assisted softwares for manufacturing.

Course Outcomes:

Students will be able to:

- Know about the sub systems of a computer integrated systems.
- Integrating of communication between the subsystems, modeling, planning and analysis of manufacturing systems.
- Group work is provided for mastering the planning and analysis of methods.

UNIT I:

Introduction: Scope of computer integrated manufacturing, Product cycle, Production automation.

Group Technology: Role of group technology in CAD/CAM integration, methods for developing part families, classification and coding , Examples of coding systems, Facility design using group technology.

UNIT II:

Computer Aided Process Planning: Approaches to process planning- Manual, variant ,Generative approach, Process planning systems—CAPP, DCLASS, CMPP, Criteria for selecting a CAPP system, Part feature recognition.

UNIT III:

Integrative Manufacturing Planning And Control : Role of integrative manufacturing in CAD/CAM integration, over view of production control—Forecasting , Master production schedule, rough cut capacity planning , M.R.P., order release, shop floor control, Quality assurance , Planning and control systems, Cellular manufacturing.

UNIT IV:

Computer Aided Quality Control : Terminology in quality control, contact inspection methods, Non- Contact inspection methods, Computer Aided Testing, Integration of CAQC with CAD/CAM

UNIT V:

Computer Integrated Manufacturing Systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control Systems, FMS.

Text Books & References:

1. Mikell P. Groover, " Automation of Systems", PHI Ltd
2. David D. Bed worth, Mark R. Henderson, Philip M. Wolfe, "*Computer aided design and manufacturing*", McGraw-Hill Publishers.
3. Mikell P. Groover, Emery W. Zimmer, "CAD/*CAM*", PHI Ltd.

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I Year – I Sem. M.Tech. (AMS ,Automation& CAD/CAM)	**L**	**P**	**C**
Open Elective I	**3**	**0**	**3**

(AMS32) QUALITY AND RELIABILITY ENGINEERING

Course Prerequisites: Mathematics, Statistics, Quality Control and Industrial Engineering

Course Objectives:

- To understand the approaches and techniques to assess and improve process or product quality and reliability.
- To understand the robust design methodology in solving practical engineering problems
- To understand the types of factors and principles of Quality Loss Function and to Comprehend various quality control tools.
- To understand the tools and techniques that can be used early in the design phase to effectively influence a design from the perspective of system reliability, maintainability, and availability.

Course Outcomes:

Students will be able to:

- Select and use the proper orthogonal arrays in designing, conducting and analyzing the experiments.
- Utilize the analytical techniques to find out the variation in the data and obtain optimal results in the process of achieving robust design.
- Identify, formulate, and solve Quality and reliability engineering related problems
- Develop an ability to design a system component or process to meet desired quality within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

UNIT I:

Quality Engineering: Concepts of Quality Engineering, Taguchi's Approach to Quality, On-line and Offline Quality Control, Difference from Classical Approach, Quality Loss Function, System Design, Parameter Design, Tolerance Design, Causes of Variation, Classification of Parameters, Parameter Design Strategy

UNIT II:

Steps in Robust Design, Quality Characteristics and Objective Functions, Control Factors and their Levels, Noise Factors and Testing Conditions, Planning and Conducting the Experiment Response Surface Methodology – First- order and Second-order Models Crossed Array Experiments, Signal-to-Noise Ratios

UNIT III:

Reliability Engineering: The Reliability Function, Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics, Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models – Constant-hazard, Linear-hazard, Nonlinear-hazard and Gamma Models

UNIT IV:

System Reliability, Two-state Modeling, Series Models, Parallel Models, Series-parallel and Parallel-series Models, *k-out-of-m* Models, Standby Models, Non-series-parallel Models, Fault-tree Approach to System Modeling

UNIT V:

Maintained Systems, Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance

Text Books & References:

1. Antony J (2003). Design and Experiments for Engineers and Scientists, Butterworth- Heinmann.
2. Cochran W and Cox G (2000). Experimental Designs, 2nd edition, John Wiley and Sons Inc.
3. Dean A and Voss D (2006). Design and Analysis of Experiments, Springer.
4. Jeff Wu C and Hamada M (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley and Sons Inc.
5. Montgomery D (2001). Design and Analysis of Experiments, 5th edition, Wiley.
6. Phadke, M (1989). Quality Engineering using Robust Design, Prentice Hall.
7. Ross, P (1996). Taguchi Techniques for Quality Engineering, 2nd edition, McGraw Hill.
8. Balgurusamy E (2003). Reliability Engineering, Tata McGraw Hill.
9. Birolini A (2004). Reliability Engineering: Theory and Practice, 4th edition, Springer.
10. Crowder M, Kimber A, Smith R and Sweeting T (1991). Statistical Analysis of Reliability Data, Chapman and Hall.
11. Kumamoto H and Henley E (1996). Probabilistic Risk Assessment and Management for Engineers and Scientists, IEEE Press.

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I Year – I Sem. M.Tech. (AMS ,Automation& CAD/CAM)	**L**	**P**	**C**
Open Elective I	**3**	**0**	**3**

(CAD32) REVERSE ENGINEERING

Course Pre-requisites: CAD, Geometric modeling

Course Objectives:

- Understand the Reverse Engineering (RE) Methodology
- Disassemble products and specify the interactions between its subsystems and their functionality
- Understand Computer-Aided RE and Rapid Prototyping Technology

Course Outcomes:

Students will be able to:

- Understand the basics of engineering systems.
- Understand the terminologies related to re-engineering, forward engineering, and reverse engineering.
- Understand Reverse Engineering methodologies.
- Understand Reverse engineering of Systems.

UNIT I:
Introduction
Scope and tasks of RE - Domain analysis- process of duplicating

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

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

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

UNIT V:
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing –surface and solid members

Text Books & References:

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897,
7. American Gear Manufacturers Association

I Year – I Sem. M.Tech. (CAD/CAM)	L	P	C
	0	3	2

(CAD51) COMPUTER AIDED DESIGN LAB

Course Prerequisites: Engineering Graphics, Machine Design, Production Drawing Practice.

Course Objectives:

- Understand and draw part drawings with appropriate tolerances using CAD software package.
- Understand and generate 3D models, surface and assembly modeling using modeling software package

Course Outcomes:

Students will be able to:

- Make drawings using CAD software package in all completeness.
- Generate 3D models, surface and assembly modeling using modeling software package for further analysis.

i) 2D Drawing using Sketcher workbench	–	1 exercise containing atleast 3 drawings
ii) 3D modeling using 3D features	–	1 exercise containing atleast 3 models
iii) Assembly and drafting	–	1 exercise containing 1 assembly
iv) Surface Modeling	–	1 exercise
v) Sheet Metal Working	–	1 exercise

Softwares: ***AutoCAD, IronCAD, CATIA, CREO***

I Year – I Sem. M.Tech. (CAD/CAM)	L	P	C
	0	0	4

(CAD61) MINI PROJECT – I

A mini project work shall be carried out on any topic of CAD/CAM and a seminar should be given on the same along with a brief report.

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD02) COMPUTER AIDED MANUFACTURING

Course Prerequisites: CAD/CAM, Manufacturing & Production Technology.

Course Objectives:

- Understand the NC Systems, NC part programming fundamentals
- Understand the CNC systems, APT language and develop the APT program for geometric shapes
- Understand the concepts of CNC Tooling, DNC, Adoptive control ,CAD/CAM software implementation, Postprocessor
- Understand the concept of Computer aided process planning & hybrid CAPP, and Artificial Neural Network in CAD.

Course Outcomes:

Students will be able to:

- Apply knowledge and work the NC Machines and able to program
- Develop an optimal APT program for a given component.
- Apply Tooling, DNC & Adoptive control, CAD/ CAM software, Post processor knowledge
- Work with models of CAPP, CAI & QC

UNIT I:

Computer Aided Programming [1]: General information

NC Systems [2]**:** NC Coordinate systems, elements of NC systems, Classification of NC Systems, Advantages & Disadvantages of NC Systems

NC Part Programming [2]**:** Manual Part Programming fundamentals(word address format, Preparatory function , Feed, Speed, Tool Change functions, Dimensional words, Canned Cycles, Tool Offset, Tool Length Compensation, Tool nose radius compensation)

UNIT II:

CNC Systems [2]**:** What is CNC, functions of CNC, Features of CNC, Advantages of CNC

APT programming [1&2]**:** Computer Assisted Part Programming, Computer Assisted NC Part programming Languages, APT Language & programming (statements & Programming), Examples of APT programming problems (2D machining- Millling & Drillling only)

UNIT III:

Tooling for CNC Machines [-]**:** Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, Quick change tooling system, automatic head changers/ ATC, Modular fixturing

DNC Systems[2] **:** DNC Concepts, Objectives of DNC, Components of DNC, Types of DNC, advantages and disadvantages of DNC

Adaptive Control [1] **:** Adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, Grinding

UNIT IV:

Introduction to CAD/CAM software [2]**:** NC programming using CAD/CAM, Tool path generation using CAD/CAM, Technology of CAM, How Computer assisted programming systems work

Post Processors for CNC [3]**:** Introduction to Post Processors, The necessity of a Post Processor, the general, structure of a Post Processor, the functions of a Post Processor

UNIT V:

Computer Aided Process Planning [2]**:** CAPP system- Retrieval type CAPP System, Generative type CAPP system, Hybrid CAAP System

Computer Aided Inspection and Quality Control [2] **:** CMM Construction, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods

Text Books:

1. Computer Control of Manufacturing Systems- Yoram Koren- McGraw Hill
2. Computer Aided Design Manufacturing - K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI
3. Numerical Control Machine Programming and Software Design- C H Chang, M A Melkanoff, Prentice Hall

References:

1. CAD/CAM Computer Aided Design And Manufacturing- Mikell P. Groover, E W Zimmers Jr.
2. CAD/CAM Principles and Applications- P.N. Rao, McGraw Hill
3. Computer Aided Manufacturing- TC Chang, Wysk, HP Wang, Pearson/ Prentice Hall International
4. Mastering CAD/CAM - Ibrahim Zeid

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I Year – I Sem. M.Tech. (AMS &CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD03) RAPID PROTOTYPING

Course Prerequisites: Manufacturing Technology, Materials Technology, CAD/CAM

Course Objectives:

- An understanding of the various rapid prototyping and rapid tooling technologies;
- The knowledge to select appropriate technologies for product development purposes.
- The rapid prototyping process will be illustrated by the actual design and fabrication of apart.

Course Outcomes:

Students will be able to:

- Describe the differences and of the application of a range of additive manufacturing processes.
- Select and use correct CAD formats in the manufacture of a 3D printed part.
- Set up and fabricate a 3D part using an additive manufacturing machine.
- Select the appropriate fabrication technology, or technologies, for a given prototyping task.

UNIT I:
Introduction: Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP, RP Process chain, 3D modeling, data conversion and transmission, checking and preparing, building, post processing.

UNIT II:
Liquid Based RP System: 3D systems' SLA, Cubital's SGC, Sony's SCS, Other similar commercial RP systems, micro fabrication.

UNIT III:
Solid Based RP System: Helices' LOM, Stratus's' FDM, 3D systems MJM, Other similar commercial RP systems.

UNIT IV:
Powder Based RP Systems: DTM's selective laser sintering (SLS), MIT's 3D printing (3DP), BPM Technology's ballistic particle manufacturing (BPM)

UNIT V:
Rapid Prototyping Data formats: STL format, STL file problem, Consequences of building a valid and invalid tessellated model, STL file repair, newly proposed formats.

Text Books:
1. Rapid Prototyping: Principles and Applications - Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, World Scientific Pub Co.
2. Rapid Manufacturing – D.T. Pham and S. S. Dimov, Springer Publication.

References:
1. Rapid Prototyping : Theory and Practice - Ali Kamrani, Emad Abouel Nasr (Editors), Springer Publication
2. Rapid Prototyping: Principles and Applications- Rafiq I. Noorani, Wiley.
3. Rapid Prototyping -- Andreas Gebhardt, Hanser Gardner Publications

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
	3	**1**	**4**

(CAD04) FINITE ELEMENT ANALYSIS

Course Prerequisites: Numerical Methods, Engineering Mechanics, Solid Mechanics.

Course Objectives:

- Understand the concept of Finite Element Method, Identify the areas of application of FEM and study the procedure.
- Understand different methods of solving linear problems and differentiate them.
- Understand the concept of FEM to solve basic non linear problems.

Course Outcomes:

Students will be able to:

- Apply the concepts of FEM to linear 1D, 2D and 3D problems.
- Solve simple non linear problems numerically.
- Perform analysis on a given problem using ANSYS.

UNIT I:

Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods, Variational approach, Galerkin methods.

Co-ordinates, Basic element shapes, Interpolation function. Virtual energy principle, Rayleigh - Ritz method, Properties of stiffness matrix, Treatment of boundary conditions, Solution of system of equations, Shape functions and characteristics, Basic equations of elasticity, Strain displacement relations.

UNIT II:

1-D structural problems, Axial bar element, Stiffness matrix load vector, Temperature effects, Quadratic shape function, Analysis of Trusses, Plane Truss and Space Truss elements, Axis symmetric solid subjected to axisymmetric loading.

Analysis of beams: Hermite shape functions, Stiffness matrix, Load vector, Problems.

2-D problems: CST, LST, Force terms, Stiffness matrix and load vector, Boundary conditions.

UNIT III:

Isoparametric element, Quadrilateral element, Shape functions, Numerical Integration, sub parametric and super parametric elements.

3-D problems: Tetrahedron element, Jacobian matrix, Stiffness matrix.

Scalar field problems: 1-D Heat conduction, 1-D fin element, 2-D heat conduction, Problems, Introduction to Torsional problems.

UNIT IV:

Dynamic considerations, Dynamic equations, Consistent mass matrix, Eigen Values, Eigen Vector, Natural frequencies, Mode shapes, Modal analysis.

UNIT V:

Non linearity, Introduction, Non-linear problems, Geometric non-linearity, Non-linear dynamic problems, Analytical problems.

Text Books & References:

1. Introduction to finite elements in engineering, Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. Concepts and applications of finite element analysis, Robert Cook
3. The finite element methods in Engineering, S.S. Rao, Pergamon, New York
4. An Introduction to Finite Element Methods, J. N. Reddy, McGraw Hill
5. The Finite element method in engineering science, O.C. Zienkowitz, McGraw Hill.
6. Finite Element Procedures in Engineering analysis, K. J Bathe
7. Hutton: Fundamentals of Finite Element Analysis, Hutton D. V
8. Lagan: A First course in the of Finite Element method, Dary L. lagan.

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(CAD21) FLEXIBLE MANUFACTURING SYSTEMS

Course Prerequisites: Knowledge of Manufacturing, Supply Chain Management.

Course Objectives:

- Understand the knowledge about the design, operation, and selection of Flexible Manufacturing Systems and their integration in today's production environments.
- Understand the integration of components of FMS under different production management approaches.
- Calculation of performance measures, including throughput, in-process inventory, and meeting production commitments.

Course Outcomes:

Students will be able to:

- Apply the concepts of Probability & Statistics to develop the manufacturing systems
- Plan, schedule and control a developed FMS.
- Apply preventive maintenance, Kan ban system effectively.

UNIT I:
Introduction to flexible manufacturing systems. Planning and scheduling and control of FMS, Knowledge based scheduling, Types of Productions, Types of FMS, Types of FMS Layouts, advantages and disadvantages of FMS.

UNIT II:
Hierarchy of computer control. Supervisory computer. Components of FMS, Types of flexibility, trade off, computer control and functions, coordinate measuring machines, types, working and capabilities.

UNIT III:
Software for simulation and database of FMS, Specification and selection, Trends, Application of simulation software. Cutting tools and tool management, work holding considerations, acceptance testing.

UNIT IV:
Manufacturing data systems data flow, CAD/CAM considerations. Planning FMS database, Just in time characteristics, Pull method, Quality small lot sizes, Work station loads, Close supplier ties, Flexible workforce – Line flow strategy, types of FMS softwares.

UNIT V:
Preventive maintenance, Kanban system, Implementation issues, value engineering, MRD JIT, lean manufacture, quality concepts, and Management.

Text Books:

1. Hand Book of Flexible Manufacturing Systems, Jha N. K., Academic Press.

References:

1. Production System beyond Large Scale Production, Taiichi Ohno, Toyota, Productivity Press India Pvt. Ltd.
2. Flexible Manufacturing Systems, Shivanad H.K, Benal M.M, Koti. V, New age international (p) Limited, New Delhi 2006.

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I Year – II Sem. M.Tech. (AMS, Automation & CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(AMS21) QUALITY ENGINEERING IN MANUFACTURING

Course Prerequisites: Statistics, Statistical Quality Control.

Course Objectives:

- Understand the types of factors and principles of Quality Loss Function.
- Understand the robust design methodology in solving practical engineering problems.
- Comprehend the various quality control tools.

Course Outcomes:

Students will be able to:

- Value the concept of quality, use quality tools and obtain the quality loss.
- Utilize the analytical techniques to find out the variation in the data and obtain optimal results.
- Select and use the proper orthogonal arrays in designing, conducting and analyzing the experiments.

UNIT I:

Quality Value and Engineering: An overall quality system, Quality engineering in product design, Quality engineering in design of production processes, Quality engineering in production.

Loss Function and Quality Level: Derivation and use of Quality Loss Function (QLF), Economic consequences of tightening tolerances as a means to improve quality, Evaluations and types tolerances - N-type, S-type and L-type.

UNIT II:

Analysis of Variance (ANOVA): NO - way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT III:

Orthogonal Arrays: Introduction to OA, Degrees of Freedom, Structure of OA, Linear Graphs & Interaction tables, Strategies in Experimentation - Typical test strategies, Better test strategies & Efficient test strategies, Steps in designing, conducting and analyzing an experiment.

Interpolation of Experimental Results: Interpretation methods, Percent contribution, Estimating the mean.

UNIT IV:

Tolerance Design and Tolerancing: Functional limits, Tolerance design for N-type, L-type and S-type characteristics, Tolerance allocation for multiple components.

Parameter and Tolerance Design: Introduction to parameter design, Signal to noise ratios, Parameter design strategy, Some of the case studies on parameter and tolerance designs.

UNIT V:

Quality Tools: ISO-9000 Quality System, Business Process Re-engineering (BPRE), Six-sigma, Bench making, Quality circles, Brain Storming, Fishbone diagram.

Text Book:

1. Taguchi Techniques for Quality Engineering /Phillip J. Ross/ McGraw Hill, Intl. II Edition, 1995.

References:

1. Quality Engineering in Production systems / G. Taguchi, A- Elsayed et al / McGraw Hill Intl. Edition, 1989.
2. Taguchi Methods explained: Practical steps to Robust Resign / Tapan P. Bagchi /Prentice Hall Ind Pvt. Ltd., New Delhi.

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(CAD22) DESIGN OF HYDRAULIC & PNEUMATIC SYSTEMS

Course Prerequisites: Machine drawing, Fluid power systems.

Course Objectives:

- Understand the design features and principles of hydraulic and pneumatic systems.
- Use of the above knowledge for sequencing, synchronizing, maintenance and troubleshooting the circuits.
- Understand PLC automation and Microprocessors.

Course Outcomes:

Student will be able to:

- Design and construct hydraulic and pneumatic circuits for a given application.
- Perform troubleshooting on a given circuit.
- Use PLC for control.

UNIT I:
Oil hydraulic systems, Hydraulic pumps, Types and construction details, Sizing and selection, Direction control valves, Flow and pressure control valves.

UNIT II:
Linear actuators, Types, Piston rod design, Sizing and selection, Rotary actuators, Hydraulic reservoir, Accumulators

UNIT III:
Design of hydraulic circuits, Seals and packing's, Hydraulic servo techniques, Cylinders and air motors

UNIT IV:
Sequencing and synchronizing circuits, Accumulator, Low cost automation circuits, Accumulators, Hydro pneumatic circuits, Principles of pneumatic circuit design.

UNIT V:
Maintenance and trouble shooting of hydraulic and pneumatic circuits and components, PLC Automation and use of Microprocessors.

Text Books & References:

1. Oil Hydraulic Systems, S.R. Majumdar, Tata McGraw Hill
2. Pneumatic systems, principles and maintenance, S.R. Majumdar, Tata McGraw Hill
3. Hydraulics and pneumatics, Andrew Darr, Jaico Publishing Hoise.
4. Fluid power with applications, Antony Espossito, Prentice Hall.

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(AMS24) INTELLIGENT MANUFACTURING SYSTEMS

Course Prerequisites: Mathematics, Machine Tools, Process Planning, Plant Layout, Material Handling.

Course Objectives:

- Understand components, structures, function of CIM, computer system Architecture and data requirements.
- Understand components of knowledge based systems, machine learning, Artificial Intelligence and Neural Networks and their applications in manufacturing.
- Understand process planning and its automation, equipment selection and modeling and manufacturing system design.

Course Outcomes:

Students will be able to:

- Design and develop CIM system.
- Apply concepts of neural networks in areas of manufacturing.
- Apply Group Technology models and algorithms for automated manufacturing cells.

UNIT I:

Computer Integrated Manufacturing: Systems, Structure and functional areas of CIM system – CAD, CAPP, CAM, CAQC, ASRS- Advantages of CIM, CIM Models, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information, Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT II:

Components of Knowledge Based Systems — Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition

UNIT III:

Machine Learning: Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV:

Automated Process Planning: Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT V:

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation — Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

Text Books & References:

1. Intelligent Manufacturing Systems by Andre Kusaic.
2. Artificial Neural Networks by Yagna Narayana
3. Automation, Production Systems and CIM by Groover M.P.
4. Neural Networks by Wassarman.

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(CAD23) COMPUTER AIDED PROCESS PLANNING

Course Prerequisites: CAD, CAM, Manufacturing process

Course Objectives:

- Understand process planning techniques.
- Understand various manufacturing parameters effectively in production rate.
- Understand Manufacturing tolerances in design and manufacturing process.

Course Outcomes:

Students will be able to:

- Apply the concept of computer aided process planning.
- Design appropriate tolerances in design and manufacturing and tool paths.
- Implement techniques of CAPP.

UNIT I:

Introduction to CAPP: Introduction and definition of process planning, Scope of process planning, Information requirement for process planning system in CAD\CAM, Role of process planning, Advantages of conventional process planning over CAPP, Structure of Automated process planning system, Feature recognition, Methods.

UNIT II:

Approaches of Process Planning: Manual approach, CAPP approaches.
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. Examples of process planning system-CAM-I, Automated process planning, D-CLASS (CAPP).

UNIT III:

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 IV:

Knowledge-Based Process Planning: Knowledge-based systems. Languages and tools for knowledge-based expert systems. Important issues regarding knowledge-based system projects. Knowledge-based systems and process planning. Knowledge acquisition for process planning.

UNIT V:

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 and Capacity planning system.

Text Books:

1. Automation, Production systems and Computer Integrated Manufacturing System – Mikell P. Groover .
2. Computer Aided Design and Manufacturing – Dr. Sadhu Singh.
3. H.P Wang & J.K Li, Computer Aided Process Planning Elsevier science & Technology Publishers 1st Edition, 1991.
4. Principles of Process Planning-G.Halevi.
5. Computer Aided Engineering – David Bedworth.

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I Year – II Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Elective – III& IV	**3**	**0**	**3**

(AMS26) INDUSTRIAL ROBOTICS

Course Prerequisites: Matrices, Signals and linear systems, Mathematics.

Course Objectives:

- Understand the robot anatomy, the different control systems and components to control the robot manipulator.
- Analyze the forces acting on the joints in robots and develop a general configuration of the controller.
- Understand robot programming and its physical design for proper coordination and control of robots.

Course Outcomes:

Students will be able to:

- Configure a simple robot for a given application.
- Apply knowledge of matrices and vectors to find the movements of the robot manipulator.
- Write a program to control a robot.

UNIT I:

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: Basic concept and models, Controllers, Control system analysis, Robot activation and feedback components, Positions sensors, Velocity sensors, Actuators sensors, Power transmission system.

UNIT II:

Motion Analysis and Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control; robot dynamics, configuration of robot controller,

UNIT III:

End Effectors: Grippers - Types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. Sensors; Desirable features, tactile, proximity and range sensors, uses sensors in robotics'

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage; Image processing and Analysis-image data reduction, Segmentation feature extraction.

UNIT IV:

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements in function.

UNIT V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot dell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work eel 1 controller.

Robot Application: Material transfer, Machine loading/unloading, Processing operation, Assembly Inspection, Feature Application.

Text Books & References:

1. Industrial robotics, Mikell P. Groover/McGraw Hill.
2. Robotics, K.S. Fu / McGraw Hill.

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I Year – I Sem. M.Tech. (AMS & CAD/CAM)	**L**	**P**	**C**
Open Elective II	**3**	**0**	**3**

(AMS41) INDUSTRIAL SAFETY MANAGEMENT

Pre Requisites: Elements of Mechanical, Civil, Electrical and Industrial Engineering

Course Objectives:

- To achieve an understanding of principles, various functions and activities of safety management.
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk.
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

Course Outcomes:

Students will be able to

- Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.
- Communicate effectively on health and safety matters among the employees and with society at large.
- Demonstrate the use of state of the art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations.
- Interpret and apply legislative / Legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces.

UNIT I:

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

UNIT II:

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

UNIT III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety – highway and urban safety – Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT IV:

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

UNIT V:

Safety, Health, Welfare &Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety– pressure vessel act- Indian boilers act- The environmental protection act – Electricity act - Explosive act.

Text Books:

1. John V. Grimaldi and Rollin H. Simonds, " Safety Management" , All India Travellers bookseller, New Delhi – 1989
2. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, 1996,

References:

1. Occupational safety manual BHEL.
2. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum
3. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety security and risk management by U.K. Singh & J.M. Dewan, A.P.H. Publishing company, New Delhi, 1996.

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Open Elective – II	**3**	**0**	**3**

(CAD41) CONCURRENT ENGINEERING

Course Prerequisites: Industrial Engineering, Product development, Manufacturing Engineering.

Course Objectives:

- Understand the concepts of concurrent engineering with respect to its trends, methodologies and design aspects.
- To study the role of computers in implementing concurrent engineering.
- To achieve the objectives of reduced cost, better quality, and improved delivery performance.
- Design and develop the product, the associated manufacturing equipment and processes.

Course Outcomes:

Students will be able to:

- Identify the trends, techniques of concurrent engineering.
- Apply the use of IT in concurrent engineering.
- Analyze concurrent function deployment, metrics and measures.
- Understand Framework and architecture of concurrent engineering.

UNIT I:

Introduction : Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, organizing for CE, CE tool box, Collaborative product development.

UNIT II:

Use of Information Technology: IT supports, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence, expert systems, Software hardware component design.

UNIT III:

Design Stage: Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, Automated analysis Idealization control, CE in optimal structural design, Real time constraints.

UNITIV:

Concurrent Function Deployment: Components of CFD, limitations concurrent product development, concurrent function development, CFD methodology application

CE Metrics and Measures: Metrics of measurement, life cycle measurement, simulation and analysis, design for X-ability assessment Product quality assessment.

UNIT V:

Total Value Management: TQM, Total value management, methodology for TVM, major elements of TVM, TVM in product development process.

Framework and Architecture: Product information management, CE architecture.

Text Books & References:

1.	Integrated Product Development	M.M.Anderson and L Hein	IFS Publications
2.	Design for Concurrent Engineering	J. Cleetus	CE Research Centre, Morgantown
3.	Concurrent Engineering Fundamentals: Integrated Product Development	Prasad	Prentice hall India
4.	Concurrent Engineering in Product Design and Development	I. Moustapha	New Age International

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I Year – I Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
Open Elective – II	**3**	**0**	**3**

(CAD42) COMPUTER AIDED PRODUCTION PLANNING

Course Pre-requisites: CAD, PPC Techniques

Course Objectives:

- To provide an overview of production Planning, focusing on the computer aided tools applicable in managing automated production.
- It comprehends about the production systems, facility location and layout, production planning and control, Materials resource planning, scheduling, shop floor control, Simulation of Machine shop and modern approaches.

Course Outcomes:

Students will be able to:

- Understand relevance and importance of the Different Production and operations planning techniques and their applications.
- Capable to design, analyse and assess production planning and control systems, including those operating within distributed manufacturing environment.

UNIT I:

Computer Aided Forecasting : Nature and use of forecast, sources of data, demand patterns, forecasting models, selection of forecasting technique, measurement of forecast Accuracy, Adoptive methods. Computerized relative allocation of facility technique, automated layout design program and computerized relationship layout planning for facility location and layout

UNIT II:

Group Technology: - Introduction, objectives part families, algorithms and models for G.T. -Rank order clustering, Bond energy, mathematical model for machine – component cellormation. Design and manufacturing attributes. Parts classification and coding, concept of composite job machine group, cell group tooling, design rationalization, CAD/CAM and GT benefits.

UNIT III:

Computer Aided Process Planning, Operation Management, Computer Aided Inspection-Computer Aided Testing, Contact type, non contact type

UNIT IV:

MRP: Introduction, Objective, Input, Computational procedure, information provided by the system. Detailed capacity planning, manufacturing resources planning

UNIT V:

ERP: Introduction, main features, generic model of ERP system, selection of ERP, proof of concept approach, analytic hierarchy approach, ERP implementation. Job Sequencings, scheduling, Shop floor control- data collection, computer generated time standard.

Simulation – Major activities, purpose, simulation process, types methodology, simulation packages, process quality simulator, computer requirements trends, applications simulation of manufacturing systems.

Text Books & References:

1. An introduction to Automated Process Planning – Tien – Chien Chang and Richard Awysk/Prentice hall
2. M.P. Groover, Automation production systems and computer aided mfg.-
3. P. N. Rao, N. K. Tewari, T.K. Kundra, Computer aided manufacturing
4. G.T. in the engineering industry Bur bridge
5. MRP – by Orlikey
6. Buffa & Sarin, Modern Production Management
7. P. B. Mahapatra, Computer Aided production management
8. Averill M Law & David Kelton, Simulation modeling and analysis, Tata McGraw Hill

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I Year – II Sem. M.Tech. (CAD/CAM)	**L**	**P**	**C**
	0	**3**	**2**

(CAD52) COMPUTER AIDED MACHINING LAB

Course Prerequisite: Automation and Robotics, Machine Tools.

Course Objectives:

- Summarize features of CNC machines and machining centers.
- Formulate steps and commands in part programming and tool selection
- Analyze the use of various CAM softwares

Course Outcomes:

Students will be able to:

- Demonstrate part programming for CNC lathe and execute the same for the part production.
- Integrate CAD and CAM to manufacture components
- Show the manufacturing of components through CAM Software

.

1. Features and selection of CNC turning and milling centers.
2. Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles.
3. Tool planning and selection of sequences of operations & tool setting on machine.
4. Practice in APT based NC programming.
5. Machining of simple components on NC lathe and Mill by transferring NC Code from a CAM package through RS 232.

Software: ***EdgeCAM, GibbsCAM, MasterCAM, Offline Simulation*** *softwares*

I Year – II Sem. M.Tech. (CAD/CAM)	L	P	C
	0	0	4

(CAD62) MINI PROJECT – II

A mini project work shall be carried out on any topic of CAD/CAM and a seminar should be given on the same along with a brief report.

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I Year – II Sem. M.Tech. (CAD/CAM)	L	P	C
	0	0	4

(CAD63) COMPREHENSIVE VIVA-VOCE

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I Year – II Sem. M.Tech. (CAD/CAM)	L	P	C
	0	0	8

(CAD71) INTERNSHIP / DISSERTATION PHASE- I

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I Year – II Sem. M.Tech. (CAD/CAM)	L	P	C
	0	0	18

(CAD72) DISSERTATION PHASE - II