

ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR, GUNTUR – 522 510
ANDHRAPRADESH, INDIA



CHOICE BASED CREDIT SYSTEM

Regulations,
Scheme of Instruction,
Examination and Syllabi

for

CAD/CAM

2-Year M.Tech. Degree Course
in Mechanical Engineering
(Semester System)

w.e.f.: 2015-2016

ACHARYA NAGARJUNA UNIVERSITY :: NAGARJUNA NAGAR

REVISED REGULATIONS FOR TWO - YEAR M.TECH. DEGREE COURSE (CHOICE BASED CREDIT SYSTEM)

(With effect from the batch of students admitted during the academic year 2015-2016)

1.0 ELIGIBILITY FOR ADMISSION

- 1.1 The candidates, both non-sponsored and sponsored, for Admission into M.Tech programme shall have one of the following qualifications.

S.No.	Programme	Qualifications
1.	Chemical Engineering	Bachelor Degree in Chemical Engineering / Chemical Technology / Biotechnology or its equivalent Degree recognized by Acharya Nagarjuna University
2.	Civil Engineering	Bachelor Degree in Civil Engineering or its equivalent Degree recognized by Acharya Nagarjuna University
3.	Computer Science & Engineering	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
4.	Electrical and Electronics Engineering	Bachelor Degree in Electrical & Electronics Engineering / Electrical Engineering / Electrical Power Engineering / AMIE (Electrical Engineering) or its equivalent Degree recognized by Acharya Nagarjuna University.
5.	Electronics and Communication Engineering	Bachelor Degree in Electronics & Communication / Electronic & Instrumentation Engineering / AMIE or its equivalent Degree recognized by Acharya Nagarjuna University.
6.	Information Technology	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
7.	Mechanical Engineering	Bachelor Degree in Mechanical Engineering or its equivalent Degree recognized by Acharya Nagarjuna University.

- 1.2 Admission of Non-sponsored category students: Admission of non-sponsored category students is made on the basis of GATE/PGECET rank. When GATE/PGECET qualified candidates are not available, admission will be on the basis of merit in the qualifying examination. Students with or without GATE/PGECET rank should have obtained a minimum of 50% marks in the qualifying examination to become eligible for admission.

Reservation of seats to the candidates belonging to Scheduled Castes and Scheduled Tribes is as prescribed by the State Govt./University from time to time. If suitable candidates are not available to fill all the seats reserved for S.T category, they shall be filled by students S.C. Category and vice-versa.

If suitable candidates are not available for reserved seats, they shall be filled by the general category candidates.

- 1.3 Admission of Sponsored Category students: Sponsored category students should have at least 50% marks in the qualifying examination to become eligible for admission to the Post Graduate Programme. Preference will be given to those candidates who are GATE/PGECET qualified.

The candidates must have a minimum of two years of full time work experience in a registered firm / company/ industry / educational and research institutions / any government department or government autonomous organizations in the relevant field in which the admission is being sought.

A letter from the employer must be furnished stating that the candidate is being sponsored to get admission. The employer should also indicate that the candidate will not be withdrawn midway till the completion of course. The rule of reservation shall not apply to the admission of sponsored category students.

- 1.4 The total number of full time candidates admitted into a course with or without GATE/PGECET rank should not exceed the sanctioned strength.

2.0 MEDIUM OF INSTRUCTION, DURATION AND STRUCTURE

- 2.1. The medium of instruction shall be in English.
- 2.2. The minimum and maximum period for completion of the P.G. Programme is 4 Semesters for full time students.
- 2.3. Each Semester shall normally spread over sixteen weeks.

(a) The Programme may consist of

- i. Core Courses
- ii. Elective Courses
- iii. Seminars
- iv. Internship
- v. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects and 3 Lab courses + 1 Mini Project / Seminar (or) 2 Lab courses + 2 Seminars / Mini Project, followed by two semesters of Project work. In summer break, the student should undergo internship for four weeks duration. The student should present a seminar on the project work done at the end of the third semester. At the end of fourth semester the students should submit Project Thesis.

(c) Core subjects are fixed in each semester and a student must opt them without any choice. Whereas electives can be chosen by a student from the list of electives given (minimum 18 and maximum 24) according to his choice.

- 2.4. Project work shall be carried out under the Supervision of a Faculty Member in the concerned department.

- 2.5. A candidate may, however, in certain cases, be permitted to work on his Project/Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Project Work shall be jointly supervised by a member of the faculty and a person from the Organization holding a minimum of P.G. Degree in the concerned area of specialization.
- 2.6. Five copies of the Project Report certified by the Supervisor(s) and the Head of the Department concerned shall be submitted within one Calendar Year after completion of the second semester.
- 2.7. The student is eligible for the submission of M.Tech. Project Report at the end of fourth semester if he/she passed all the course work in the first & second semesters.
- 2.8. In a special case, if any candidate unable submit his/her Project Report at the end of fourth semester due to ill health or any other reason permitted by the head of the institution, he/she will be allowed submit at a later date and the viva-voce examination will be conducted, if clause 2.7 is satisfied.

3.0. ATTENDANCE

- 3.1 The candidate shall put up a minimum of 75% attendance in each subject.
- 3.2. Condonation of shortage in attendance up to 10% in any subject may be condoned by the University on the recommendations of the Principal of the concerned College for reasons of ill health and the application is submitted at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.
- 3.3. If the candidate does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the University examination in that subject and has to repeat that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.
- 3.4. Failure in securing minimum prescribed attendance in any subject of previous Semester (s) is no bar for enrollment to the next semester.

4.0. EVALUATION

- 4.1 The performance of the candidate in each semester shall be evaluated subject wise. The maximum marks for each subject, seminar etc, will be as prescribed in the curriculum. The Internal Evaluation for Theory subjects shall be based on two mid-term examinations and two assignments. In every theory subject, out of 40 sessional marks, 30 marks are allotted to mid-term examination and 10 marks for assignments. The best of the performances in the two midterm examinations, one held in the middle of the semester and another held immediately after the completion of the instruction, will be considered. The internal evaluation for practical subjects is based on the day-to-day performance and semester end

internal practical Examination.

- 4.2 The marks for Seminar will be awarded by internal evaluation made by two staff members of the faculty of the department concerned.
- 4.3 For taking the University examination in any theory or practical subject, candidates shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he/she shall be required to repeat the course in that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.
- 4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he or she secures a minimum of 50% marks in internal evaluation.
- 4.5 In case the candidate does not secure the minimum academic requirement in any subject he/she has to reappear in the University examination in that subject or any equivalent subject prescribed.
- 4.6 Failure to attain the minimum academic requirement in any subject of previous semester (s) is no bar for enrollment to the next semester.
- 4.7 The performance of the students in each semester shall be evaluated subject wise. The distribution of marks between sessional work (based on internal assessment) and University Examination will be as follows:

Nature of the subject	Sessional Marks	University Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Project Seminar	100	--
Project work	50	150(iva voce)

5.0 AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Project Subjects. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Project seminar in III Semester is awarded 8 credits and Project Viva-voce at the end of IV Semester is awarded 16 credits.

6.0 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥85%	S	10.0
2	75%-84%	A	9.0
3	65%-74%	B	8.0
4	60%-64%	C	7.0
5	55%-59%	D	6.0
6	50%-54%	E	5.0

7	≤49%	F(Fail)	0.0
8	The grade 'W' represents withdrawal/absent (subsequently changed into pass or E to S or F grade in the same semester)	W	0.0

A Student securing 'F' grade in any subject there by securing 0 grade points has to reappear and secure at least 'E' grade at the subsequent examinations in that subject

'W' denotes withdrawal/absent for a subject:

- After results are declared and Grade sheets will be issued to each student which will contain the following details:
- The list of subjects in the semester and corresponding credits and Grade obtained
- The Grade point average(GPA) for the semester and
- The Cumulative Grade Point Average(CGPA) of all subjects put together up to that semester from first semester onwards

GPA is calculated based on the following formula:

$$\frac{\text{Sum of [No.Credits X Grade Point]}}{\text{Sum of Credits}}$$

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester onwards.

7.0 AWARD OF DEGREE AND CLASS

A candidate who becomes eligible for the award of the degree shall be placed in the following three divisions based on the CGPA secured by him/her for the entire Programme

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

8.0 WITH-HOLDING OF RESULTS

The result of a candidate may be withheld in the following cases

- The candidate has not paid dues to the institution
- A case of indiscipline is pending against the candidate
- A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases

9.0 GENERAL

- 9.1. The University reserves the right of altering the regulations as and when necessary.
- 9.2 The regulations altered will be applicable to all the candidates on the rolls Irrespective of the fact that the regulations at the time of admission of the student to the programme are different.
- 9.3 The Academic Regulations should be read as a whole for purpose of any Interpretation Whenever there is a dispute regarding interpretation of regulations, the decision of the Vice-Chancellor is final.

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ACHARYA NAGARJUNA UNIVERSITY: NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (CAD/CAM) :: FIRST SEMESTER

S. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	MT/ME/CC/MD -511 Computer Aided Design	4	--	4	40	60	--	100
2	MT/ME/CC/MD-512 Finite Element Analysis	4	--	4	40	60	--	100
3	MT/ME/CC – 513 CNC & PP	4	--	4	40	60	--	100
4	Elective Subject-1	4	--	4	40	60	--	100
5	Elective Subject-2	4	--	4	40	60	--	100
6	Elective Subject-3	4	--	4	40	60	--	100
7	MT/ME/CC-551– CAD LAB	--	3	2	40	--	60	100
8	MT/ME/CC-552– CAM LAB	--	3	2	40	--	60	100
TOTAL		24	6	28				800

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (CAD/CAM) :: SECOND SEMESTER

S. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	MT/ME/CC -514 : Computer Integrated Manufacturing	4	--	4	40	60	--	100
2	MT/ME/CC -515: Robotics	4	--	4	40	60	--	100
3	MT/ME/CC/MD -516: Optimization Techniques	4	--	4	40	60	--	100
4	Elective Subject-4	4	--	4	40	60	--	100
5	Elective Subject-5	4	--	4	40	60	--	100
6	Elective Subject-6	4	--	4	40	60	--	100
7	MT/ME/MD-561 Automation Lab	--	3	2	40	--	60	100
8	MT/ME/CC -562 Mini Project/ Seminar	--	3	2	100	--	--	100
TOTAL		24	6	28				800

ACHARYA NAGARJUNA UNIVERSITY: NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (CAD/CAM) :: THIRD SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	MT/ME/CC -711 Internship / Seminar	---	---	2	100	--	100
2	MT/ME/CC -712 Project Seminar	--	---	6	100	--	100

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (CAD/CAM) :: FOURTH SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	MT/ME/MD -713 Project Viva	--	---	16	50	150	200

LIST OF SUBJECTS

ELECTIVE SUBJECTS:

Subject Code	Subject Title
MT/ME/CC/MD -611	Computational Methods
MT/ME/CC/MD -612	Advanced Mechanisms Design
MT/ME/CC -613	Design of Mechanisms & Manipulators
MT/ME/CC/MD -614	Design for Manufacturing
MT/ME/CC -615	Mechanical Vibrations
MT/ME/CC -616	Advances in Manufacturing Technology
MT/ME/CC -617	Computer Aided Process Planning
MT/ME/CC -618	Mechatronics
MT/ME/CC -619	Computer Graphics
MT/ME/CC -620	Concurrent Engineering
MT/ME/CC/MD -621	Mechanics of Composite Materials
MT/ME/CC/MD -622	Computational Fluid Dynamics
MT/ME/CC -623	Artificial Intelligence & Expert Systems
MT/ME/CC -624	Design of Material Handling Equipment
MT/ME/CC/MD -625	Reliability Engineering
MT/ME/CC/MD -626	Quality Engineering
MT/ME/CC/MD -627	Fluidics & Control Systems
MT/ME/CC/MD -628	Nanotechnology

LAB COURSES:

MT/ME/CC -551	:	Computer Aided Design Lab
MT/ME/CC -552	:	Computer Aided Manufacturing Lab
MT/ME/CC -561	:	Automation Lab
MT/ME/CC -562	:	Mini Project / Seminar

- ❖ 24 credits have to be achieved from Core Subjects.
- ❖ 24 credits have to be achieved from Elective Subjects.
- ❖ 8 credits have to be achieved from Labs.
- ❖ 2 credits have to be achieved from internship.
- ❖ 22 credits have to be achieved from Project.
- ❖ Total 80 credits required for Awarding the M.Tech Degree.

CORE SUBJECT

MT/ME/CC/MD 511 :: COMPUTER AIDED DESIGN

M.Tech. (CAD/CAM / Machine Design): First Semester

Lectures / Tutorials : 4 Periods / week Sessional Marks : 40

University Exam. : 3 hrs. University Exam. Marks : 60

UNIT – I

Typical Product Cycle, Implementation of a typical CAD process, Application of CAD and their Advantages

3D modeling and viewing: Introduction, Modeling Approaches, Types of Geometric Models, Coordinate System, sketching and Sketch Planes, Parameters and Dimensions, Basic Features, Datum Features, Geometric Constraints, Modeling Operations and Strategies

Modeling Aids and Tools: Introduction, Geometric Modifiers, Layers, Colors, Grids, Groups, Dragging and Rubbering, Clipping, Entity Selection methods, Geometric Arrays, Transformations, Editing.

UNIT – II

Geometric Modeling: Types of Curves and Curve Manipulations, Types of Surfaces and Surface Manipulations, *Solids:* Introduction, Geometry and Topology, Solid Entities, Fundamentals of Solid Modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG) – examples, Sweeps and Solid Manipulations

Feature based Modeling: Introduction, Feature Entities, Parametrics, Feature Manipulations **Rapid**

Proto Typing: Introduction, RP activities, RP applications, RP techniques: Stereo-lithography, Selective Laser Sintering, 3 – D Printing, Fused Deposition Modeling and Laminated Object Manufacturing.

UNIT – III

Visualization: Introduction, Model clean up, Hidden-Line Removal, Hidden Surface Removal, Hidden Solid Removal, Shading, Colors. **Computer Animation:** Introduction, Animation Types, Key Frame Technique **Product Data Exchange:** Introduction, Types of Translators, IGES, Processors

UNIT – IV

Assembly Modeling: Introduction, Assembly Modeling, Assembly Tree, Assembly Planning, Mating Conditions, Bottom – Up and Top – Down Assembly Approaches with examples

Tolerance Analysis and Mass Property calculations

Collaborative Design: Traditional design, Collaborative Design, Principles and Approaches

Product Lifecycle Management: Introduction, Product Information, PLM Frame Work, Benefits

TEXT BOOK:

1. “Mastering CAD/CAM” by Ibrahim Zeid, Tata McGraw-Hill Edition, New Delhi

REFERENCES:

1. CAD/CAM by PN Rao, PHI
 2. CAD/CAM – Theory and Practice by Ibrahim Zeid, MGH International
- CAD/CAM – Computer Aided Design and Manufacturing by Mikell P Groover and Emory W Zimmers Jr., Prentice Hill, International

CORE SUBJECT

MT/ME/CC/MD 512 :: FINITE ELEMENT ANALYSIS

M.Tech. (CAD/CAM / Machine Design): First Semester

<i>Lectures / Tutorials</i>	<i>: 4 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

UNIT – I

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements, Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT – II

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects. **Beams and Frames:** Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT – III

Two dimensional problems: CST, LST, four noded and eight noded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration. Higher order Elements

UNIT – IV

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems. **Convergence:** Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

TEXT BOOK:

1. Finite element methods by Chandrupatla & Belagondlu.

REFERENCES:

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994
2. Zienkiewicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill, 1983.
3. J. N. Oden, Finite Element of Nonlinear continua, McGraw-Hill, New York, 1971
4. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996

CORE SUBJECT

MT/ME/CC 513 : CNC & PART PROGRAMMING

M.Tech. (CAD/CAM) :: First Semester

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

Introduction: NC, DNC, CNC, Programmed Automations, Machine control unit, Part program, NC tooling.

NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers.

UNIT II

Machine control unit & tooling: Functions of MCU, NC actuation systems, Part program to command signal, MCU organization, Computerized numerical control, Transducers for NC machine tools, Tooling for NC machining centers and NC turning machines, Tool presetting.

UNIT III

Manual part programming: Part program instruction formats, Information codes: Preparatory function, Miscellaneous functions, Tool code and tool length offset, Interpolations, Canned cycles. Manual part programming for milling operations, Turning operations, Parametric subroutines.

UNIT IV

Computer aided part programming

APT programming: APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to- point motion commands, continuous path motion commands. Post processor commands, complication control commands. Macro subroutines, Part program preparation for typical examples.

REFERENCES:

1. CAD/CAM by Groover and Zimmers,
2. CAD/CAM , P.N. Rao Tata McGraw-Hill Company Limited, New Delhi.
3. Numerical Control of Machine Tools by Yoram Koren and Joseph Ben-Uri, Khanna Publishers, Delhi.

CORE SUBJECT

MT/ME/CC 514 : COMPUTER INTEGRATED MANUFACTURING

M.Tech. (CAD/CAM) :: Second Semester

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

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

Computer Aided Planning And Control : Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology-automated data collection system

UNIT II

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

UNIT III

Integrated manufacturing system: Definition - application - features - types of manufacturing systems-machine tools-materials handling system-computer control system - DNC systems manufacturing cell

Flexible manufacturing systems - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM

UNIT IV

Material Handling In Manufacturing Systems: Material handling function, Types of material handling equipment, AGV Systems, Automated Storage/ Retrieval Systems, Interfacing handling and storage with Manufacturing

TEXT BOOKS:

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 1998.

REFERENCES:

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi,
 2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
 3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International
 4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.
- PN RAO , “ CAD/CAM “, (PHI)

CORE SUBJECT

MT/ME/CC 515 : ROBOTICS

M.Tech. (CAD/CAM) :: Second Semester

<i>Lectures / Tutorials</i>	<i>: 4 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

UNIT-I

Fundamentals of Robots: Introduction to Robotics, major component so a robot, robotic like devices, classification of robots – Classification by coordinate system and by control method, Basic components of robot system, functions and specifications of robot, fixed versus flexible automation, overview of robot application.

Robot end Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices.

UNIT-II

Actuators: Types, Characteristics of actuating system: weight, Power-to-weight ratio, Operating pressure, Stiffness vs. compliance, Use of reduction gears, Comparison of hydraulic, Electric, pneumatic, actuators, Hydraulic actuators, Proportional feedback control, Electric Motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors-structure and principle of operation, Stepper motor speed-torque characteristics.

Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Velocity sensor- encoders, tachometers, Force and Pressure sensors - piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, Optical, Ultrasonic, Inductive, Capacitive, Eddy-current proximity sensors.

UNIT-III

Robot Kinematics: Robots as mechanism, Matrix representation- representation of point, vector in space, representation of frame at origin and in reference frame. Homogeneous transformation Matrices, Representation of transformations – pure translation, pure rotation, combined transformations. Forward solution – Denavit Hartenberg procedure. Problems on simple 2R and 3R manipulator, Puma manipulator, SCARA manipulator, Inverse or backward solution – techniques, problems involved of 2R, 3R manipulator.

UNIT-IV

Velocity and Statics of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocities of links in serial 2R manipulators Jacobian of serial manipulator, Singularities.

Dynamics of Manipulators: Equation of motion of 2R manipulators using Lagrangian, Newton-Euler formulation. Introduction to trajectory planning, basics of trajectory planning.

TEXT BOOKS:

1. Robotic Engineering- an integrated approach - Richard D.Klafter, PHI
2. Introduction to Robotics Analysis - Niku, S. B., Systems, Applications, Pearson Education.

REFERENCE BOOKS:

1. Robotics and Control – R K Mittal and I J Nagrath
2. Introduction to Robotics: Mechanics and Control - 2nd Edition - Craig, J.J.
3. Fundamentals of Robotics, Analysis and Control - Schilling R. J., PHI, 2006.

CORE SUBJECT

MT/ME/CC/MD 516 :: OPTIMIZATION TECHNIQUES

M.Tech. (CAD/CAM / Machine Design): Second Semester

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints - Classification of optimization problems and applications.

Single variable and multivariable optimization, Techniques of unconstrained minimization Golden Section, Fibonacci and gradient search methods – Quadratic Interpolation method.

UNIT II

Optimization with equality and inequality constraints - Direct methods - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming, Linear programming using simplex approach.

UNIT III

Introduction to Genetic Algorithms, Simulated Annealing , Neural networks and fuzzy logic techniques..

UNIT IV

Integer programming: Introduction – formulation – Gomory cutting plane algorithm – Zero - One algorithm, branch and bound method.

Design application - Structural applications - Design of simple truss members. Design of simple axial, transverse loaded members for minimum cost and /or weight, - Design of shafts and torsionally loaded members for minimum weight.

TEXT BOOKS:

1. A.Ravindran, K.M.Ragsdell & G.V.Reklaitis “Engineering Optimization Methods and Applications”, 2nd edition, Wiley publications
2. Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers, 2000.

REFERENCES:

1. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1981.
2. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India, 1995.
1. R. Pannerselvam , “Operations Research “, Prentice Hall of India , 2nd Edition, 2006

LAB COURSE

MT/ME/CC-551 : CAD LAB
M.Tech. (CAD/CAM) :: First Semester

<i>Practicals</i>	<i>: 3 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

Exercises will be given on Modeling & Analysis of mechanical Components using packages like PRO-ENGINEER/UNIGRAPHICS/CATIA/SOLID WORKS/Autodesk INVENTOR & ANSYS, etc..

I. Modeling

1. Surface Modeling
2. Solid Modeling
3. Drafting
4. Assembling

II. Structural Analysis using any FEA Package for different structures that can be discretised with 1-D, 2-D & 3-D elements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites

III. Thermal Analysis using any FEA Package for different structures that can be discretised with 1-D, 2-D & 3-D elements

1. Steady state thermal analysis
2. Transient thermal analysis

IV. Transient analysis using any FEA Package for different structures that can be discretised with 1-D, 2-D & 3-D elements

1. Linear
Non-Linear (Geometrical Non-linearity)

LAB COURSE

MT/ME/CC 552 : CAM LAB

M.Tech. (CAD/CAM) :: First Semester

<i>Practicals</i>	<i>: 3 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

1. Practice in part programming and operation of a turning center
2. Practice in part programming and operations of a machine center
3. Tool planning and selection for machining center/turning center.
4. Programming using CAD based software.
5. Practice in APT based NC programming languages.
6. Preparation of various reports and route sheets
7. Integration of CAD/CAM.

LAB COURSE

MT/ME/CC-561 : AUTOMATION LAB

M.Tech. (CAD/CAM) :: Second Semester

<i>Practicals</i>	<i>: 3 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

Minimum TEN experiments related to the following should be performed:

1. Robot Programming
2. Simulation of a Manufacturing System.
3. Simulation of Linear and Rotary actuators.
4. Programming of Micro Processors using 8085 instructions.
5. Programming of Mechatronics system.
6. Programmable logic controller.
7. Simulation Exercises using MAT Lab
8. Simulation of Mass Dynamic System using MAT Lab

MT/ME/ CC - 562: MINI PROJECT/SEMINAR

M.Tech. (CAD/CAM) :: Second Semester

<i>Practicals</i>	<i>: 3 Periods / week</i>	<i>Sessional Marks</i>	<i>: 100</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: --</i>

- Report has to be submitted and a presentation has to be given at the end of semester for mini project.
- Six presentations have to be given on research topics for evaluation of Seminars.
- ***Internal assessment is done based on the seminar presentations.***

ELECTIVE SUBJECT

MT/ME/CC/MD 611 :: COMPUTATIONAL METHODS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT – I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations, Matrix notation, Determinants and inversion, Iterative methods, Relaxation methods, System of non-linear equations, computer programs

Numerical integration: Newton-Cotes integration formulas, Simpson's rules, Gaussian quadrature. Adaptive integration

UNIT – II

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrained optimization

Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples, Derivative boundary conditions, Irregular and non, rectangular grids, Matrix patterns, sparseness, ADI method, Finite element method.

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

UNIT – IV

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method, method of characteristics-wave equation in two space dimensions-computer programs.

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares, regression analysis, multiple linear regression, non linear regression - computer programs.

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw hill
- 2.Curtis F.Gerald, partick.O.Wheatly, "Applied numerical analysis" Addison-wesley,1989
- 3.Douglas J.Faires,Riched Burden "Numerical methods" Brooks/cole publishing company,1998.

REFERENCES:

- 1.Ward cheney &David Kincaid "Numerical mathematics and computing" Brooks/cole publishing company1999,fourth edition.
- 2.Riley K.F.M.P.Hobson&Bence S.J, "mathematical methods for physics and engineering" Cambridge university press,1999.

ELECTIVE SUBJECT

MT/ME/CC/MD 612 :: ADVANCED MECHANISMS DESIGN

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT – I

Introduction: Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematic chains, network formula – Gross motion concepts.

Kinematic Analysis: Position Analysis – vector loop equations for four bar, slider crank, inverted slider crank, geared five bar, and six bar linkages. Analytical solutions for velocity and acceleration analysis – human tolerance for acceleration. Plane complex mechanisms – auxiliary point method

UNIT - II

Path Curvature Theory: Fixed and moving centroids, inflection points and inflection circle, Euler savary equation.

Synthesis of Mechanisms: Type synthesis – case study of casement window mechanisms Number synthesis – Associated linkage concept Dimensional synthesis – function generation, path generation, motion generation - Graphical methods – two, three positions, circle point and centre point circles – order synthesis of four bar function generation – four positions, special cases of four position synthesis – Finite Ball's point – five positions – cognate linkages

UNIT - III

Coupler curve synthesis, design of six bar mechanisms for different applications including dwell. Algebraic methods – using vector loop equations and complex algebra, synthesis of multi loop linkage mechanisms, geared linkages, application of instant centre in linkage design. Practical considerations in mechanism design, mechanism defects.

UNIT - IV

Dynamics of Mechanisms: Static force analysis with friction – inertia force analysis – slider crank mechanism, four bar mechanism, crank – shaper mechanism – combined static and inertia force analysis, shaking force, kinetostatic analysis of a card bunch – time response of a four bar linkage, modification of the time response of a mechanism – virtual work. Introduction to force and moment balancing of linkages

Spatial Mechanisms and Robotics: Kinematic analysis of spatial RSSR mechanism – Denavit - Hartenberg parameters - Forward and inverse kinematics of robotic manipulators

REFERENCE BOOKS:

1. Sandor G.N, and Erdman A.G. Advanced Mechanism Design : Analysis and Synthesis, PHI, 1984.
2. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, EWLP, Delhi, 1994
3. Shigley, J.e., and Vicker, J.J. Theory of Mechanisms, McGrawHill, 1995.
4. Norton R.L. Design of machinery, McGrawHill, 1992.

ELECTIVE SUBJECT

MT/ME/CC 613: DESIGN OF MECHANISMS & MANIPULATORS

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT - I

Mobility analysis – Degree of freedom (DOF), mixed mobility, total, partial and fractional DOF. Closed and open chain systems, structural analysis and synthesis of mechanisms.

UNIT - II

Alternative design solutions, coding, evaluation and selection of optimum mechanism, type synthesis, number synthesis and design of mechanisms.

UNIT - III

Indexes of merit, graphical, algebraic and optimization techniques, matrix methods of design and analysis, design of function, path and motion generators, structural and mechanical error, design.

UNIT - IV

Manipulators – Classification, actuation and transmission systems, coordinate transformation – DH notations, inverse and forward kinematics, manipulator dynamics from Lagrangian and Newtonian point of view.

REFERENCES:

1. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 1, PHI, 1988
2. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 2, PHI, 1988
3. Mechanisms & Mechines (Analysis & Syntheis)by Arthur Erdman
4. . Klafter R.D., Cmielewski T.A. and Negin M ., "Robot Engineering An Intergrated approach", Prentice Hall of India,New Delhi,1994
5. Deb S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd.,1994

ELECTIVE SUBJECT

MT/ME/CC/MD-614 :: DESIGN FOR MANUFACTURING

M.Tech. (CAD/CAM / Machine Design)

<i>Lectures / Tutorials</i>	<i>: 4 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

UNIT- I

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

UNIT- II

Factors Influencing Form Design: Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on form design - from design of welded members, forgings and castings.

UNIT –III

Component Design-Machining Consideration: Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area - simplification by separation - simplification by amalgamation - Design for machinability .

Component Design - Casting Considerations: Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores.

UNIT -IV

Design for Manufacture and Case Studies: Identification of uneconomical design, Design for economy , Design for clampability - Design for accessibility - Modifying the design , Design for assembly , Group technology - Computer Applications for DFMA

TEXT BOOK:

Harry Peck, "Design for Manufacture", Pittman Publication, 1983.

REFERENCES:

1. Robert Matousek, "Engineering Design - A systematic approach", Blackie & sons Ltd.
2. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co.
3. Swift K.G., "Knowledge based design for manufacture, Kogan Page Ltd., 1987.

ELECTIVE SUBJECT

MT/ME/CC 615 : MECHANICAL VIBRATIONS

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

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

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

UNIT II

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

UNIT III

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

UNIT IV

Experimental methods in vibration analysis Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of Vibration tests - Industrial case studies

REFERENCES:

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

ELECTIVE SUBJECT

MT/ME/CC 616 : ADVANCES IN MANUFACTURING TECHNOLOGY

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT – I

Welding Processes: Fusion and Solid state welding process, Automation in Welding, Design aspects of welds, Weldability of aluminium alloys, titanium alloys and High strength low alloy steels, Non destructive testing of welds, Residual stresses and distortion in weldments.

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT – II

Un-conventional Machining Methods-I: Abrasive jet machining - Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations. Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT – III

Un-conventional Machining Methods-II: Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM. Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes. Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations. Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.

UNIT – IV

Rapid Prototyping: Working principle, methods - Stereolithography, Laser sintering, Fused deposition method, applications and limitations.

Nano Technology: Nano milling processes, wet milling, dry milling, nano materials, fabrication of nano tubes, advantages of nano tubes, mechanical properties.

TEXT BOOKS:

1. Manufacturing Technology - P. N. Rao, TMH Publishers
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers

References:

1. Production Technology – HMT
2. Manufacturing Science – Cambel
3. Welding Technology - R.S, Parmar,
4. Introduction to Nanotechnology - Poole and Owens, Wiley (2003).

ELECTIVE SUBJECT

MT/ME/CC 617: COMPUTER AIDED PROCESS PLANNING

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

Introduction : Product Life cycle, The Place of Process Planning in the Manufacturing cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Group Technology , GT Coding-The OPITZ system- The MICLASS System

UNIT II

Part Design Representation: Design Drafting-Dimensioning-Conventional Tolerance-Geometric Tolerance-CAD-input/output devices-Topology- Geometric transformation-Perspective transformation-Data Structure-Geometric modeling for process planning.

UNIT III

Process Engineering And Process Planning: Experience based planning-Decision table and Decision trees-Process capability analysis-Process planning-Variant process planning-Generative approach-Forward and backward planning, Input format, Artificial Intelligence.

UNIT IV

Computer Aided Process Planning Systems : Logical Design of process planning-Implementation considerations-Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

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

REFERENCES:

1. Gideon Halevi and Roland D. Weill, "Principle of process planning- A Logical Approach", Chapman & Hall, 1995
 2. Chang T. C. & Richard A.Wysk, "An Introduction to automated process planning systems", PrenticeHall1985
 3. Chang,T.C., "An Expert Process Planning System", Prentice Hall,1985
 4. Nanua Singh, "Systems Approach to Computer Intergrated Design and Manufacturing", John Wiley & Sons,1996
- Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

ELECTIVE SUBJECT

MT/ME/CC 618 : MECHATRONICS

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT-I

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

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

UNIT-II

Actuators and Drive systems : Mechanical, Electrical, hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

System models: Mathematical models:- mechanical system building blocks, electrical system building blocks, thermal system building blocks, electromechanical systems, hydro-mechanical systems, pneumatic systems.

UNIT-III

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

UNIT-IV

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

Design and Mechatronics

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

Text Books:

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

ELECTIVE SUBJECT

MT/ME/CC 619: COMPUTER GRAPHICS

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT – I

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.

Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

UNIT – II

Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point subdivision algorithm.

UNIT – III

Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

Transformations: Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

UNIT – IV

Rendering: Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Zbuffer algorithm.

Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

TEXT BOOKS:

- 1.Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
- 2.Computer Graphics-Donald Hearn & M.P. Bakers.
- 3.Computer graphics-Harrington.

ELECTIVE SUBJECT

MT/ME/CC 620 : CONCURRENT ENGINEERING

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

UNIT II

Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods – Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

UNIT III

Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

Assembly workstation design: Strategic issues - Technical issues analysis.

UNIT IV

Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.

Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

REFERENCES:

1. Concurrent Design of Product and Processes by James L. Nevins and Daniel E. Whitney, McGraw-Hill Publishing Company, 1989.
2. Anderson MM and Hein, L. Berlin, "Integrated Product Development", Springer Verlag, 1987
3. Cleetus, J, "Design for Concurrent Engineering", Concurrent Engg. Research Centre, Morgantown, WV, 1992
4. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology", John Wiley and Sons Inc., 1992
5. Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development", Prentice Hall, 1996
6. Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", John Wiley and Sons Inc., 1999

ELECTIVE SUBJECT

MT/ME/CC/MD 621 :: MECHANICS OF COMPOSITE MATERIALS

M.Tech. (CAD/CAM / Machine Design)

<i>Lectures / Tutorials</i>	<i>: 4 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

UNIT I

Introduction to Composite Materials: Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants

UNIT II

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.

Strength Failure Theories of an Angle Lamina: Maximum stress theory, Maximum strain theory, Tsa-Hill theory, Tsai-Wu tensor theory.

UNIT III

Macro Mechanical Analysis of Laminate: Introduction, Lamination code, Stress-strain relations for a laminate, In-plane and Flexural modulus of a laminate.

Manufacturing: Lay-up and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Blow moulding.

UNIT IV

Application Developments: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites.

Metal Matrix Composites: Re-inforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.

Text Books:

1. Composite Materials handbook, Mein Schwartz Mc Graw Hill Book Company, 1984.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

Reference Books:

1. Mechanics of Composite Materials, Rober M. Joness Mc-Graw Hill Kogakusha Ltd.
2. Stress analysis of fiber Reinforced Composite Materials, Michael W, Hyer MGH International.
3. Composite Material Science and Engineering, Krishan K. Chawla Springer.

ELECTIVE SUBJECT

MT/ME/CC/MD 622 :: COMPUTATIONAL FLUID DYNAMICS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations- explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with ridiagonal matrix algorithm.

UNIT II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

UNIT III

Treatment of compressible flows: potential equation, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.

Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – IV

Standard variational methods: Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOK:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.

REFERENCE:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.

ELECTIVE SUBJECT

MT/ME/CC 623: ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT-I

Artificial Intelligence : Introduction, definition, underlying assumption, Important of AI, AI & related fields State space representation, defining a problem, production systems and its characteristic, search and control strategies –Introduction, preliminary concepts, examples of Search , problems.

Uniformed or preliminary Concept: Examples of search problems, Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search, Problem reduction, Constraint satisfaction, Means- Ends Analysis.

UNIT II

Knowledge Representation Issues: Representations and Mapping, Approaches, Issues in Kr, Types of knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.

Use of Predicate Logic: Representing simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution, Natural deduction

Unit-III

Statistical and Probabilistic Reasoning: Symbolic reasoning under uncertainly, Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic

Expert Systems: Introduction, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.

Unit-IV

Introduction to Knowledge Acquisition: Types of learning, General learning model, and performance measures.

Typical Expert Systems: MYCIN, Variants of MYCIN, PROSPECTOR DENDRAL, PRUFF etc.

Introduction to Machine Learning: Perceptons, Checker Playing examples, Learning, Automata, Genetic Algorithms, Intelligent Editors.

TEXT BOOKS

1. Elaine Rich & Kevin Knight, “ **Artificial Intelligence**” , M/H 1983
 2. Wendry B.Ranch, “**Artificial Intelligence in Business**”, Science & Industry –Vol -II
 3. Waterman, D.A., Addison, “ **A Guide to Expert System**” – Wesley inc. 1986.
 4. Hayes, Roth, Waterman, “**Building expert system**” D.A (ed), AW 1983.
- S.M. and Kulliknowske, “**Designing Expert System**”, Weis, London Champion Hull 1984.

ELECTIVE SUBJECT

MT/ME/CC 624: DESIGN OF MATERIAL HANDLING EQUIPMENT

M.Tech. (CAD/CAM)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT –I

Materials Handling Equipment

Material handling equipment: fixed path equipment - conveyors, sorting consolidating and diverting devices, cranes-Automatic Storage and Retrieval System - Magnetic handling systems, AGV, robotics and mobile material handling , etc.,Types, selection and applications.

UNIT- II

Design Of Hoists

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

UNIT –III

Drives of Hoisting Gear

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

UNIT- IV

Conveyors

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

Elevators

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

TEXT BOOKS:

1. N. Rudenko, “Materials handling equipment”, ELnvee Publisher
2. A. O. Spivakovsy and V. K. Dyachkov, “Conveying Machines”, Volumes I and II, MIR Publishers, 1985.
3. M. Alexandrov, M., Materials Handling Equipments, MIR PUblishers, 1981.
- 4.A. Boltzharol, “Materials Handling Handbook”, The Ronald Press Company, 1958.

ELECTIVE SUBJECT

MT/ME/CC/MD 625 :: RELIABILITY ENGINEERING

M.Tech. (CAD/CAM / Machine Design)

<i>Lectures / Tutorials</i>	<i>: 4 Periods / week</i>	<i>Sessional Marks</i>	<i>: 40</i>
<i>University Exam.</i>	<i>: 3 hrs.</i>	<i>University Exam. Marks</i>	<i>: 60</i>

UNIT I

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

UNIT II

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

UNIT III

Reliability prediction models

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

UNIT IV

Reliability testing and monitoring:

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards, Reliability growth monitoring-Non parametric methods Reliability and life cycle costs -Reliability allocation - Replacement model.

Risk assessment

Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

TEXT BOOKS:

1. L.S. Srinath "Reliability Engineering", Fourth Edition, East-West Press
2. E. Balagurusamy "Reliability Engineering", Tata McGraw-Hill

REFERENCES:

1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.
2. Smith C.O." Introduction to Reliability in Design ", McGraw Hill, London, 1976.

ELECTIVE SUBJECT

MT/ME/CC/MD 626 :: QUALITY ENGINEERING

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.

Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT-II

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, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-III

Design of Experiments: Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description.

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.

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT-IV

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean

ISO-9000 Quality system, BDRE, 6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.

TEXT BOOKS:

1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition,1995.

REFERENCES:

1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl.Edition, 1989.
2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.

ELECTIVE SUBJECT

MT/ME/CC/MD 627 :: FLUIDICS & CONTROL SYSTEMS

M.Tech. (CAD/CAM / Machine Design)

*Lectures / Tutorials : 4 Periods / week
University Exam. : 3 hrs.*

*Sessional Marks : 40
University Exam. Marks : 60*

UNIT I

Hydraulic Pumps & Pressure Regulation:

Pressure regulation, pump types: Gear Pump, Vane Pump, Piston Pump, Combination Pumps. Selection and specification of pumps pump characteristics

UNIT II

Hydraulic & Pneumatic Actuators:

Linear and Rotary Actuators-Selection, Specification and Characteristics, Hydraulic and pneumatic accessories

UNIT III

Control and Regulation elements:

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

Hydraulic Circuits

Reciprocation, quick return, sequencing synchronizing circuits-accumulator circuits-industrial circuits-press circuits.

UNIT IV

Pneumatic Systems and Circuits

Pneumatic fundamentals, Control elements, Sequential circuits, Cascade methods, Mapping Methods, Step counter method, Compound circuit design, Combination circuit design

TEXT BOOK:

1. Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999

REFERENCES:

1. Antony Esposito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudley A. Pease and John J. Pippenger, "Basic Fluid Power", Prentice Hall, 1987

ELECTIVE SUBJECT

MT/ME/CC/MD 628 :: NANOTECHNOLOGY

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week

Sessional Marks : 40

University Exam. : 3 hrs.

University Exam. Marks : 60

UNIT – I

Nanotechnology: Introduction, History of Nano Technology, Biomimetics, Definition of Nanotechnology, Nanoscience and NanoTechnology, Feynman predictions on NanoTechnology, Moore's law. NanoTechnology applications in various fields.

Classification of Nano Structures: Introduction to Zero dimensional-Nanoparticles, One Dimensional-Nanowires, Two dimensional Nano structures-Thin films.

Introduction to Nano materials and Nano composites

UNIT-II

Top-Down Nanofabrication: Definition: Top-Down fabrication methodology- **Deposition** (or) Growing-Physical Vapour deposition methods, Chemical Vapour deposition methods.

Lithography-PhotoLithography, Electron Beam Lithography, Soft lithography-Nano imprinting, Microcontact printing. **Etching**-Dry, Wet-Physical and Chemical Etching.

Material modification: Bottom-up Fabrication Methodology-Definition. Building block Fabrication-Colloidal chemistry, Physical fabrication approaches-Nanoparticles. Chemical Vapour growth (VLS Mechanism). Nano wires-preparation, control of size and applications.

Characterization of Nano Structures: Electron microscopy- SEM, TEM Scanning Probe Microscopy- STM, AFM, NSOM.

UNIT – III

Self Assembly and Self Organization-Chemical Self assembly (SAMs), Physical self assembly, Biological Self assembly-examples, Quantum dots applications. Longmuir-Blodgett films, layer-by-layer growth.

Carbon Nanotubes: Structure and synthesis of CNTs, Electronic, Adsorption, Optical and Mechanical properties, Fullerenes.

UNIT – IV

Micro electromechanical systems-MEMs and Nanoelectromechanical systems-NEMs-Preparation and applications. **Mechanics at nanoscale:** Enhancement of mechanical properties with decreasing size, Nanomachines, Nanofluidics.

Text Books:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
2. Nanostructures & Nanomaterials, Synthesis Properties and applications by Guozhong Cao. IPC London
3. Hand Book of NanoTechnology Bharat Bhushan, Springer

References:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing
3. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

MT/ME/ CC -711 :: INTERNSHIP

M.Tech. (CAD/CAM) :: Third Semester

Practicals : --- Sessional Marks : 100

Internal assessment is done based on Internship certificate for a period of minimum 4 weeks and presentation.

MT/ME/CC-712 :: Project Seminar

M.Tech. (CAD/CAM) :: Third Semester

Practicals : --- Sessional Marks : 100

Internal assessment is done based on the minimum six seminar presentations of their project.

MT/ME/ CC 713 :: Project Viva

M.Tech. (CAD/CAM) :: Fourth Semester

Practicals : --- Sessional Marks : 50

University Exam. : 3 hrs. University Exam. Marks : 150

Assessment is done based on the seminar presentations and Project viva-voce examination.