# ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR, GUNTUR – 522 510

ANDHRAPRADESH, INDIA

## Regulations,
## Scheme of Instruction,
## Examination and Syllabi

for

# CAD / CAM

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

## w.e.f.: 2011-2012

**ACHARYA NAGARJUNA UNIVERSITY:: NAGARJUNA NAGAR**
**REVISED REGULATIONS FOR**
**TWO - YEAR M.TECH. DEGREE COURSE**
**(CREDIT BASED SYSTEM)**

(With effect from the batch of students admitted during the academic year 2011-2012).

## 1. 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 and Engineering | B.Tech/B.E Computer Science and Engineering/Information Technology/M.C.A/M.Sc. Computers/M.Sc. Eletronics/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 | 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 MEADIUM 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 and 8 Semesters respectively 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. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects plus (3 Labs + 1 Seminar) or (2 Labs + 2 Seminar) followed by two semesters of Project work. In the third semester the student should give a project seminar. At the end of fourth semester the students should submit Project Thesis.

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 latter date.and the viva-voce examination will be conducted separately.

## 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 be taken into account.

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 the best of the performances in the two mid term examinations one held in the middle of the semester and another held immediately after the completion of the instruction. 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 account.

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 | 30 | 70 |
| Practicals | 30 | 70 |
| Seminar | 100 | -- |
| Project work | 50 | 150 (Viva voce) |

## 5. 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. 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 toS 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 fallowing 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. 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. WITH-HOLDING OF RESULTS

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

i. The candidate has not paid dues to the institution

ii. A case of indiscipline is pending against the candidate

iii. A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases

## 9. GENERAL

8.1 The University reserves the right of altering the regulations as and when necessary.

8.2 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

8.3 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.

**ACHARYA NAGARJUNA UNIVERSITY : NAGARJUNA NAGAR**

**SCHEME OF EXAMINATION AND INSTRUCTION FOR**

**I/II M.TECH (CAD/CAM) :: FIRST SEMESTER**

| Sl. No | Code No & Subject | Hours / Week | | Credits | Evaluation of Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Practical | | Internal | External | | Total |
| | | | | | | Theory | Practical | |
| 1. | MT/ME/CC-511 Computer Aided Design | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 2 | MT/ME/CC-512 FEM | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 3 | MT/ME/CC – 513 CNC & PP | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 4 | MT/ME/CC - 514 **Elective- I** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 5 | MT/ME/CC - 515 **Elective – II** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 6 | MT/ME/CC - 516 **Elective-III** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 7 | MT/ME/CC – 551 CAD Lab | -- | 6 | 2 | 30 | -- | 70 | 100 |
| 8 | MT/ME/CC – 552 CAM Lab | -- | 6 | 2 | 30 | -- | 70 | 100 |
| TOTAL | | 24 | 12 | 28 | | | | 800 |

**Elective-I**

| | |
|---|---|
| MT/ME/CC-514/A | Design of Mechanisms & Manipulators |
| MT/ME/CC-514/B | Design for Manufacturing |
| MT/ME/CC-514/C | Computer Graphics |

**Elective-II**

| | |
|---|---|
| MT/ME/CC-515/A | Mechanical Vibrations |
| MT/ME/CC-515/B | Nanotechnology |
| MT/ME/CC-515/C | Advances in Manufacturing Technology |

**Elective – III**

| | |
|---|---|
| MT/ME/CC-516/A | Computer Aided Process Planning |
| MT/ME/CC-516/B | Computational Fluid Dynamics |
| MT/ME/CC-516/C | Computational Methods |

**ACHARYA NAGARJUNA UNIVERSITY : NAGARJUNA NAGAR**

**SCHEME OF EXAMINATION AND INSTRUCTION FOR**

**I/II M.TECH (CAD/CAM) :: SECOND SEMESTER**

| Sl. No | Code No & Subject | Hours / Week | | Credits | Evaluation of Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Practical | | Internal | External | | Total |
| | | | | | | Theory | Practical | |
| 1. | MT/ME/CC-521 Computer Integrated Manufacturing | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 2 | MT/ME/CC-522 Robotics | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 3 | MT/ME/CC -523 Optimization Techniques | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 4 | MT/ME/CC-524 **Elective- IV** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 5 | MT/ME/CC-525 **Elective – V** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 6 | MT/ME/CC-526 **Elective-VI** | 4 | -- | 4 | 30 | 70 | -- | 100 |
| 7 | MT/ME/CC – 561 Automation Lab | -- | 6 | 2 | 30 | -- | 70 | 100 |
| 8 | MT/ME/CC – 562 Seminar | -- | 6 | 2 | 100 | -- | -- | 100 |
| TOTAL | | 24 | 12 | 28 | | | | 800 |

**Elective-IV**

| | |
|---|---|
| MT/ME/CC-524/A | Advanced Mechanisms Design |
| MT/ME/CC-524/B | Reliability Engineering |
| MT/ME/CC-524/C | Quality Engineering |

**Elective-V**

| | |
|---|---|
| MT/ME/CC-525/A | Fluidics & Control Systems. |
| MT/ME/CC-525/B | Design of Material Handling Equipment |
| MT/ME/CC-525/C | Mechanics of Composite Materials |

**Elective – VI**

| | |
|---|---|
| MT/ME/CC-526/A | Mechatronics |
| MT/ME/CC-526/B | Artificial Intelligence & Expert Systems |
| MT/ME/CC-526/C | Concurrent Engineering |

**ACHARYA NAGARJUNA UNIVERSITY : NAGARJUNA NAGAR**

**SCHEME OF EXAMINATION AND INSTRUCTION FOR**

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

| Sl. No | Code No & Subject | Hours / Week | | | Credits | Evaluation of Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | Internal | External | Total |
| 1. | MT/ME/CC-651 Project Seminar | - | --- | 24 | 8 | 100 | -- | 100 |

**ACHARYA NAGARJUNA UNIVERSITY : NAGARJUNA NAGAR**

**SCHEME OF EXAMINATION AND INSTRUCTION FOR**

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

| Sl. No | Code No & Subject | Hours / Week | | | Credits | Evaluation of Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | Internal | External | Total |
| 1. | MT/ME/CC-661 Project Viva | -- | -- | 24 | 16 | 50 | 150 | 200 |

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

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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, Transformat**ions**, 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
3. CAD/CAM – Computer Aided Design and Manufacturing by Mikell P Groover and Emory W Zimmers Jr., Prentice Hill, International

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

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 nodded 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 & Belagondu.

**REFERENCES:**

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press,1994
2. Zienckiwicz 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

# MT/ME/CC513 :: CNC & PART PROGRAMMING

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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.

*ELECTIVE-I*

## MT/ME/CC-514/A :: DESIGN OF MECHANISMS & MANIPULATORS

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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-I*

## MT/ME/CC-514/B :: DESIGN FOR MANUFACTURING

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 from 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., 1963.
2. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co., 1986.
3. Swift K.G., "Knowledge based design for manufacture, Kogan Page Ltd., 1987.

*ELECTIVE-I*

## MT/ME/CC-514/C :: COMPUTER GRAPHICS

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 sub division 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-II*

## MT/ME/CC 515/A :: MECHANICAL VIBRATIONS

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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:**

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

## ELECTIVE-II

# MT/ME/CC 515/B :: NANOTECHNOLOGY

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**UNIT – I**

**Introduction:** Size and shape dependence of material properties at the nanoscale, why is small good? limits to smallness, scaling relations, can nanorobots walk and nanoplanes fly? Nanoscale elements in conventional technologies

**Top-down and bottom-up nanofabrication:** The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: nano imprinting and micro contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

**Unit-III**

**Self assembly and self-organization**

Functional coatings with self assembled monolayers of molecules and nanoparticles Langmuir-Blodgett films, layer-by-layer growth.

**Imaging/characterization of nanostructures**

General considerations for imaging, Scanning probe techniques: SEM, STM, AFM, NSOM.

**UNIT – III**

**Metal and semiconductor nanoparticles: S**ynthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nanoparticles, bioengineering applications, Catalysis.

**Semiconductor and metal nanowires:** Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

**UNIT – IV**

**Carbon Nanotubes :** Structure and synthesis, Electronic, vibrational, and mechanical properties, How can C Nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement

**Mechanics at nanoscale:** Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, Nanomachines, Nanofluidics, Filtration, Sorting, Molecular motors

**Text Books:**

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

**References:**

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006)

## *ELECTIVE-II*

### MT/ME/CC 515/C :: ADVANCES IN MANUFACTURING TECHNOLOGY

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 - Steriolithography, 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-III*

## MT/ME/CC 516/A :: COMPUTER AIDED PROCESS PLANNING

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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
5. Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

*ELECTIVE-III*

## MT/ME/CC 516/B :: COMPUTATIONAL FLUID DYNAMICS

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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-III*

## MT/ME/CC 516/C :: COMPUTATIONAL METHODS

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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.

# MT/ME/CC-551 :: CAD LAB

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 6 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

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
2. Non-Linear (Geometrical Non-linearity)

## MT/ME/CC 552 :: CAM LAB

*I Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 6 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

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.

## MT/ME/CC 521 :: COMPUTER INTEGRATED MANUFACTURING

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | | | |
|---|---|---|---|---|---|
| *Lectures / Tutorials* | *:* | *4 Periods / week* | *Sessional Marks* | *:* | *30* |
| *University Exam.* | *:* | *3 hrs.* | *University Exam. Marks* | *:* | *70* |

**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.
5. PN RAO , " CAD/CAM ", (PHI)

# MT/ME/CC 522 :: ROBOTICS

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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: Mechanica and Control - 2nd Edition - Craig, J.J.
3. Fundamentals of Robotics, Analysis and Control - Schilling R. J., PHI, 2006.

# MT/ME/CC 523 :: OPTIMIZATION TECHNIQUES

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 -Interpolation methods.

**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**

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.
Operations and planning applications, Analysis and Data Reduction applications, Classical Mechanics applications.

**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.

*ELECTIVE-IV*

## MT/ME/CC 524/A :: ADVANCED MECHANISMS DESIGN

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 – four bar linkage jerk analysis. Plane complex mechanisms – auxiliary point method

**UNIT - II**

**Path Curvature Theory:** Fixed and moving centroids, inflection points and inflection circle, Euler savary equation, graphical constructions – cubic stationary curvature.

**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**

Geared five bar and parallelogram six bar cognates, six bar parallel motion generator – 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

**Study and use of Mechanism Software Packages**

**REFERENCE BOOKS:**


1. Sandor G.N, and Erdman A.G. Advanced Mechanism Design : Analysis and Syntheis, 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-IV*

## MT/ME/CC 524/B :: RELIABILTY ENGINEERING

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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-IV*

## MT/ME/CC 524/C :: QUALITY ENGINEERING

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 Responsibilites 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-V*

## MT/ME/CC 525/A :: FLUIDICS & CONTROL SYSTEMS

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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 Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987

## *ELECTIVE-V*

### MT/ME/CC 525/B :: DESIGN OF MATERIAL HANDLING EQUIPMENT

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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-V*

## MT/ME/CC 525/C :: MECHANICS OF COMPOSITE MATERIALS

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | | | |
|---|---|---|---|---|---|
| *Lectures / Tutorials* | *:* | *4 Periods / week* | *Sessional Marks* | *:* | *30* |
| *University Exam.* | *:* | *3 hrs.* | *University Exam. Marks* | *:* | *70* |

**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 - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

**UNIT II**

**Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.
**Biaxial Strength Theories:** Maximum stress theory, Maximum strain theory, Tsa-Hill theory, Tsai, Wu tensor theory, Numerical problems.

**UNIT III**

**Macro Mechanical Analysis of Laminate:** Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Numerical problems.
**Manufacturing:** Lay up and curing - open and closed mould processing, Hand lay, Up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance, Introduction, material qualification, Types of defects, NDT methods.

**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-VI*

## MT/ME/CC-526/A :: MECHATRONICS

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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, AJ., " 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-VI*

### MT/ME/CC 526/B :: ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | | | |
|---|---|---|---|---|---|
| *Lectures / Tutorials* | *:* | *4 Periods / week* | *Sessional Marks* | *:* | *30* |
| *University Exam.* | *:* | *3 hrs.* | *University Exam. Marks* | *:* | *70* |

**UNIT-I**

**Artificial Intelligence :** Introduction, definition, underlying assumption, Important of Al, Al & 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.
**5.** S.M. and Kulliknowske, **"Designing Expert System"**, Weis, London Champion Hull 1984.

*ELECTIVE-VI*

## MT/ME/CC 526/C :: CONCURRENT ENGINEERING

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Lectures / Tutorials* | *: 4 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

**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.

**UNITIII**

**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 Verlog, 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

## MT/ME/CC-561 :: AUTOMATION LAB

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 3 Periods / week* | *Sessional Marks* | *: 30* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 70* |

*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 :: SEMINAR

*I Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 3 Periods / week* | *Sessional Marks* | *: 100* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: --* |

***Internal assessment is done based on the seminar presentations.***

## MT/ME/CC 651 :: PROJECT SEMINAR

*II Year M.Tech. (CAD/CAM) :: First Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 24 Periods / week* | *Sessional Marks* | *: 100* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: --* |

***Internal assessment is done based on the seminar presentations.***

## MT/ME/CC 661 :: PROJECT VIVA

*II Year M.Tech. (CAD/CAM) :: Second Semester*

| | | | |
|---|---|---|---|
| *Practicals* | *: 24 Periods / week* | *Sessional Marks* | *: 50* |
| *University Exam.* | *: 3 hrs.* | *University Exam. Marks* | *: 150* |

***Assessment is done based on the seminar presentation and Project Viva-voce examination***