ACADEMIC REGULATIONS

Applicable for students admitted into M.Tech. programme from 2014-15

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post graduate degree to candidates who are admitted to the Master of Technology Programmes and fulfill all the requirements for the award of the degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the competent authority for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualifying candidates at an Entrance Test conducted by the University or on the basis of GATE/PGECET score, subject to reservations or policies framed by the Government of Andhra Pradesh policies from time to time.

2. ADMISSION PROCEDURE:

As per the existing stipulations of AP State Council for Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made into the first year as follows

a) Category-A seats are to be filled by Convener through PGECET/GATE score.

b) Category-B seats are to be filled by Management as per the norms stipulated by Government of A. P.

3. SPECIALIZATION:

The following specializations are offered at present for the M.Tech. Programme.

Sl. No.	**Specialization**
1.	CAD/CAM
2.	Digital Electronics and Communication Systems
3.	Embedded Systems
4.	VLSI System Design
5.	Computer Science and Engineering
6.	Electrical Power Engineering
7.	Electrical Power Systems

and any other specialization as approved by the concerned authorities from time to time.

4. COURSE WORK:

4.1. A Candidate after securing admission must pursue the M.Tech. programme of study for four semesters duration.

4.2. Each semester shall be of 20 weeks duration including all examinations.

4.3. A candidate admitted in to the programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

5. ATTENDANCE

5.1. A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance aggregate in all subjects/courses in the semester.

5.2. Condonation of shortage of attendance up to 10% i.e., between 65% and above and less than 75% may be granted by the Institute Academic committee.

5.3. Shortage of attendance below 65% in aggregate shall in no case be condoned.

5.4. Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.5. A stipulated fee shall be payable towards condonation of shortage of attendance to the institute as per following slab system **1st Slab:** Less than 75% attendance but equal to or greater than 70% a normal condonation fee can be collected from the student. **2nd Slab** : Less than 70% but equal to or greater than 65%, double the condonation fee can be collected from the student.

5.6. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled for that semester.

5.7. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable.

5.8. A student detained due to shortage of attendance, will have to repeat that semester when offered next.

6. CREDIT SYSTEM NORMS:

	Period(s)/week	**Credits**
Theory	01	01
Practical	03	02
Seminar	01	01
Project	-	16

TABLE 1

7. EVALUATION:

7.1 Distribution of marks

S. No	Examination	Marks	Examination and Evaluation	Scheme of Evaluation
1.	Theory	60	Semester-end examination (External evaluation)	The question paper shall be of descriptive type with 5 questions with internal choice are to be answered in 3hours duration of the examination.
		40	Mid - Examination of 120 Min. duration (Internal evaluation). 4 descriptive type questions with internal choice are to be answered and evaluated for 30 marks, and the reaming 10 marks are to be allotted for 3-5 assignments (2 marks each) to be submitted by the student. The assignment marks are to be awarded based on the completeness of the assignment, correctness of the assignment and in-time submission, evaluated for 10 marks and average of the total assignment marks are rounded to the next integer.	Two mid-exams 30 marks each are to be conducted. Better one to be considered. **Mid-I:** After first spell of instructions (I&II Units). **Mid-II:** After second spell of instructions (III - V Units).
2	Laboratory	60	Semester-end Lab Examination (External evaluation)	**For laboratory courses: 3** hours duration. One External and One

S. No	Examination	Marks	Examination and Evaluation		Scheme of Evaluation
					Internal examiners.
		40	30	Day to Day evaluation (Internal evaluation)	Performance in laboratory experiments.
			10	Internal evaluation	Practical Tests (one best out of two tests includes viva-voce)
3	Seminar in each of the semesters. 2 hours /week	100	Internal Evaluation 20 Marks for Report 20 Marks for subject content 40 Marks for presentation 20 Marks for Question and Answers		Continuous evaluation during a semester by the Departmental Committee (DC)
4	Project work	100	60	External evaluation	Semester-end Project Viva-Voce Examination by Committee as detailed under sect. 9.
			40	Internal evaluation	Continuous evaluation by the DC. 20 Marks by Supervisor 20 Marks by D.C. as detailed under sect. 9.5

7.2 A candidate shall be deemed to have secured the minimum academic requirement in a subject/practical if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

7.3 A candidate has to secure a minimum of 50% to be declared successful.

7.4 In case the candidate does not secure the minimum academic requirement in any of the subjects/practical, he has to reappear for the Examination either supplementary or regular in that subject/practical along with the next batch students. A separate supplementary examinations will be conducted for the I semester students at the end of II semester.

7.5 **Revaluation / Recounting:** Students shall be permitted to request for recounting/ revaluation of the end theory examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records are updated with changes if any and the student will be issued a revised memorandum of marks. If there are no changes, the student shall be intimated the same through a letter or a notice.

8. RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS(for theory subjects only):

8.1 Out of the subjects the candidate has failed in the examination due to internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each theory subject and for a maximum of **Three** theory subjects for improvement of internal evaluation marks.

8.2 The candidate can re-register for the chosen subjects and fulfill the academic requirements. Re-registration shall not be permitted after the commencement of class work for that semester. The candidate can re-register for 1st semester subjects when he is in his 3rd semester and for 2nd semester subjects when he is in his 4th semester else the candidate can re-register after completion of 2 years course work.

8.3 For each subject re-registered, the candidate has to pay a fee equivalent to one third of the semester tuition fee.

8.4 In the event of re-registration, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for those subjects stand cancelled.

9. EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis/dissertation after taking up a topic approved by the Departmental Committee.

9.1 The Departmental Committee (DC) consisting of HOD, Project supervisor and two internal senior experts shall monitor the progress of the project work. A Project Review Committee (PRC) shall be constituted with Principal as Chair Person, Heads of the departments of the M.Tech Programs and Two other senior faculty members, as

members of the PRC. PRC will come into action when the DC is not able to resolve the issues.

9.2 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory, practical and seminar of I & II semesters).

9.3 After satisfying 9.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the DC for approval. Only after obtaining the approval of DC, the student can initiate the project work.

9.4 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of DC after 36 weeks from the date of registration at the earliest but not later than one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

9.5 The Internal Evaluation shall be made by the DC, on the basis of two seminars presented by the student on the topic of his project.

9.6 The student must submit status report at least in two different phases during the project work period. These reports must be approved by the DC before submission of the Project Report.

9.7 A candidate shall be allowed to submit the thesis / dissertation only after passing all the prescribed subjects (theory, practical and seminar).

9.8 A candidate has to prepare four copies of the thesis/dissertation certified in the prescribed format by the supervisor and HOD. Out of which three copies shall be submitted in the examination section.

10. CREDIT POINT AVERAGE AND CUMULATIVE CREDIT POINT AVERAGE:

10.1. CREDIT POINT AVERAGE (CPA):

$$\mathbf{CPA} = \frac{\sum_i C_i T_i}{10 \sum_i C_i}$$

Where C_i= Credits earned for Course i in any semester/year.

T_i= Total marks obtained for course i in any semester/year.

10.2. CUMULATIVE CREDIT POINT AVERAGE (CCPA):

$$\mathbf{CCPA} = \frac{\sum_n \sum_i C_{ni} T_{ni}}{10 \sum_n \sum_i C_{ni}}$$

Where ***n*** refers to the semester in which such courses were credited.

The CCPA is awarded only when a student earns all the credits prescribed for the programme.

10.3. OVERALL PERFORMANCE:

CCPA	Classification of Final Results
7.0 and above	First Class with Distinction
6.0 and above but below 7.0	First Class
5.0 and above but below 6.0	Second Class

11. TRANSCRIPTS:

After successful completion of the entire programme of study, a transcript containing performance of all the academic years will be issued as a final record. Duplicate transcripts will be issued if required, after payment of requisite fee. Partial transcript will also be issued up to any point of study to a student on request.

12. ELIGIBILITY:

A student shall be eligible for the award of M.Tech Degree if he fulfills all the following conditions:

i. Registered and successfully completed all the components prescribed in the programme of study to which he was admitted.
ii. Successfully acquired all **72 credits** as specified in the curriculum corresponding to the branch of his study within the stipulated time.
iii. No disciplinary action is pending against him.

13. AWARD OF DEGREE:

The Degree will be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Anantapur on the recommendations of the Principal, AITS (Autonomous) based on the eligibility as mentioned in clause 11.

14. WITHHOLDING OF RESULTS:

If the candidate has any dues to the Institute or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not

be allowed/ promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

15.TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered. Whereas, he continues to be in the academic regulations he was first admitted.

16. AMENDMENTS OF REGULATIONS:

The Chairman, Academic Council of Annamacharya Institute of Technology and Sciences, Rajampet (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations and/or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

17. Any legal issues are to be resolved in Rajampet Jurisdiction.

18. GENERAL:

Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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Annamacharya Institute of Technology and Sciences, Rajampet.							
Curriculum for the Programmes under Autonomous Scheme							
Regulation	R 2014						
Department	Department of Mechanical Engineering						
Programme Code & Name	cc : M.Tech. CAD / CAM						
Semester I							
Course Code	Course Name	Hours/ Week		Credit	Maximum marks		
		L	P	C	Internal	External	Total
4PE511	Finite Element Analysis	4	0	4	40	60	100
4PE512	CNC Technology & Programming	4	0	4	40	60	100
4PE411	Geometric Modeling	4	0	4	40	60	100
4PE513	Advances in Manufacturing Technology	4	0	4	40	60	100
4PEC14	Computational Methods	4	0	4	40	60	100
	Elective – I	4	0	4	40	60	100
4PE517	Seminar – I	0	0	2	100	00	100
4PE518	Modeling and Analysis Laboratory	0	3	4	40	60	100
Total		24	3	30	800		
Semester II							
Course Code	Course Name	Hours/ Week		Credit	Maximum marks		
		L	P	C	Internal	External	Total
4PE521	Advanced Optimization Techniques	4	0	4	40	60	100
4PE412	Artificial Intelligence & Expert Systems	4	0	4	40	60	100
4PE522	Robotics	4	0	4	40	60	100
4PE523	Computer Integrated Manufacturing	4	0	4	40	60	100
4PE524	Mechatronics	4	0	4	40	60	100
	Elective – II	4	0	4	40	60	100
4PE528	Seminar – II	0	0	2	100	00	100
4PE529	CAD / CAM Laboratory	0	3	4	40	60	100
Total		24	3	30	800		
Semester III & IV							
Course Code	Course Name	Credit		Maximum Marks			
		C		Internal	External	Total	
4PE531	Project	16		40	60	100	

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET

(AN AUTONOMOUS INSTITUTION)

M.Tech (CAD/CAM) I SEMESTER

(4PE511) FINITE ELEMENT ANALYSIS

UNIT – I Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements, Variational methods-potential energy method, Raleigh Ritz method, Galerkin and weighted residual methods.

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.

UNIT – II Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, and 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. Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin, two-dimensional fin.

UNIT – IV Iso-parametric formulation: Concepts, sub parametric, super parametric elements, 2 dimensional 4 noded iso-parametric elements, and numerical integration.

Axi-Symmetric model: Finite element modeling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

UNIT – V Dynamic Analysis: Dynamic equations, eigen value problems and their solution methods, simple problems

Text Books:

1. Introduction to Finite elements in Engineering, Tirupathi.R. Chandrapatla and Ashok D. Belagondu, PHI.
2. Introduction of Finite Element Analysis,S Senthil, Laxmi Publications.
3. Introduction of Finite Element Analysis, SMD Jalaluddin, Anuradha Publications.

References:

1. Finite element procedures, K. J. Bathe, PHI.
2. The finite element method in engineering, SS Rao, Butterworth Heinemann.
3. An introduction to the Finite element method, J.N. Reddy, TMH.
4. Finite element methods: Basic concepts and applications, Chennakesava, R Alavala, PHI.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET

(AN AUTONOMOUS INSTITUTION)

M.Tech (CAD/CAM) I SEMESTER

(4PE512) CNC TECHNOLOGY & PROGRAMMING

Unit – I Introduction to CNC Machine tools: Evolution of computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.

Unit – II Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.
Accessories: Work tables, Spindles, Spindle heads, Bed and Columns, Tooling – Automatic Tool changer (ATC).

Unit – III
Feedback devices: Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.
Control Systems and interface: Open and closed loop systems, Micro processor based CNC systems, block diagram of typical CNC system, description of hardware and soft interpolation systems, Standard and optional features of CNC control systems.

Unit – IV
Fundamental of NC programming: Introduction: Development of part program, CNC words-Preparatory functions(G words), dimensional information words(X,Y,Z etc.,), Feed functions(S-word), Tool selection function(T-word), Miscellaneous function(M-word), End-of-Block(EOB), Programming formats-Fixed block format, Tab sequential format, Word address format.
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, control commands, Macro subroutines, Part programming preparation for typical examples.

Unit – V
Part programming for turning centers: Introduction, G-codes for turning centers, part development cycles, canned cycles. **Part programming for milling**

operations: Introduction, Milling operations, milling cutters, G & M codes for milling operations, Canned cycles.

Text Books:

1. Computer Numerical Control Machines, P.Radha Krishnan, New Central Book Agency.
2. CAD/CAM/CAE, N.K Chougule, SCITECH publishers, New Delhi.

References:

1. CAD/CAM, P.N.Rao, TMH.
2. CNC Machines, M. Adithan and B.S.Pabla, New Age Publishers.
3. Automation, Production systems and Computer Integrated Manufacturing System, Mikell P.Groover, PHI publications.
4. Numerical Control of Machine Tools, Yoram Koren, Bem-Uri J, Khanna Publishers.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES:: RAJAMPET

(AN AUTONOMOUS INSTITUTION)

M.Tech (CAD/CAM) I SEMESTER

(4PE411) GEOMETRIC MODELING

Unit – I Introduction to computer graphics: Definition, Color CRT raster scan monitors, Line drawing algorithms – DDA & Bresenham algorithms and polygon filling.
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 – II Introduction to geometric modeling: Definition, Explicit and implicit equations, parametric equations,
Cubic Splines-1: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve.
Cubic Splines-2: blending functions, four point form, reparametrization, truncating and subdividing of curves, Graphic construction and interpretation, composite pc curves.

Unit –III Bezier Curves: Bernstein basis, equations of Bezier curves, properties and derivatives.
B-Spline Curves: B-Spline basis, equations, knot vectors, properties and derivatives.

Unit – IV Surfaces: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

Unit – V Rendering: Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.
Solid modeling concepts: Tricubic solid, Algebraic and geometric form, Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

Text Books:

1. Computer Graphics, Donald Hearn and M.P. Bakers, PHI.
2. CAD/CAM, Ibrahim Zeid, Tata McGraw Hill.

References:

1. Mathematical Elements of Computer Graphics, Roger and Adams, Tata McGraw Hill.
2. Procedural elements for computer graphics, D.F.Rogers, Tata McGraw-Hill.
3. Geometric Modeling, Micheal E. Mortenson, McGraw Hill Publishers
4. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET
(AN AUTONOMOUS INSTITUTION)
M.Tech (CAD/CAM) I SEMESTER

(4PE513) ADVANCES IN MANUFACTURING TECHNOLOGY

Unit – I

Introduction to Digital Manufacturing: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, , Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing ,advantages and limitations.

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

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. Magnetic Abrasion Finishing(MAF), Introduction and working principle of MAF.

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. 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. Dry Sink EDM, CNC EDM, Analysis, Material Removal Rate in RC circuit.

Unit – IV

Un-conventional Machining Methods-III: 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 – V

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

Quality Inspection and Testing methods: (Elementary treatment) Statistical methods of quality control, Statistical process control, The ISO and QS standards, Total Quality Management (TQM), Taguchi methods, Non-Destructive testing, destructive testing and automated inspection.

Text Books:

1. Welding Engineering and Technology, R.S, Parmar, Khanna Publishers.
2. Manufacturing Engineering and Technology, Serope Kalpakjain and Stephen Schmid, Prentice Hall.
3. Advanced Machining process, Vijay. K.Jain, Allied Publishers - Mumbai.
4. Manufacturing Technology, P. N. Rao, TMH Publishers.
5. Nanomaterials, A.K.Baindyo Padhay, New Age Publications.
6. Fundamentals of Modern Manufacturing,, Mikell P. Groover, John Wiley & Sons Publishers

References:

1. Collaborative Design and Planning for Digital Manufacturing, Springer, 2009
2. Production Technology, R.K.Jain, Khanna Publishers.
3. Production Technology, HMT, Tata McGrawhill.
4. Manufacturing Science, Amitabha Ghosh and Asok Kumar Mallik, Ellis Horwood.
5. Introduction to Nanotechnology, Poole and Owens, Wiley.

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M.Tech. (CAD/CAM) I SEMESTER
(4PEC14) COMPUTATIONAL METHODS

UNIT I

Solving sets of Linear equations – Matrix notation – Iterative methods – Relaxation methods – System of non-linear equations.

Numerical integration: Newton-Cotes integration formulae – Simpson's rules, Romberg Integration, Gaussian quadrature.

UNIT II

Boundary value problems: Finite difference method,TheShooting method, the cubic spline method

Numerical solutions of partial differential equations: Laplace's equation – Representation as a difference equation – Iterative methods for Laplace's equation – Poisson equation – Examples– ADI method.

UNIT III

Parabolic partial differential equations: Explicit method – Crank-Nickolson method — Stability and convergence criteria –

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method –Derivative boundary condition.

UNIT IV

Finite element method- introduction, methods of approximation, Rayleigh Ritz method, Galerkin method, Application to two dimensional problems.

UNIT V

Programming in MATLAB: Basics- Script files – Graphics, 2D Plots, 3D Plots – input/output in Matlab.

Numerical Methods Using MATLAB: Gauss Elimination method, Gauss Seidel Method, Gauss Jacobi Method.

Text Books:

1. Introductory methods of numerical analysis, SS Sastry, PHI
2. MATLAB: An introduction with applications, Rao V. Dukkipati, New Age International.

References:

1. Numerical Methods for Engineers, Steven C.Chapra, Raymond P.Canale, Tata Mc-Graw hill
2. Applied Numerical Methods with MATLAB for engineers and scientists, Steven Chapra, Tata McGrawHill.
3. Applied numerical analysis, Curtis F.Gerald, partick.O.Wheatly, Addison-wesley,1989
4. Numerical methods, Douglas J..Faires,Riched Burden, Brooks/cole publishing
   Company, 1998.Second edition.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET

(AN AUTONOMOUS INSTITUTION)

M.Tech (CAD/CAM) I SEMESTER

(4PE514) DESIGN FOR MANUFACTURING
(Elective-I)

UNIT I:

INTRODUCTION: Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of design Ling for economical production - creativity in design. Materials: Selection of Materials for design Developments in Material technology - criteria for material selection - Material selection interrelationship with process selection process selection charts.

UNIT II:

MACHINING PROCESS: Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT III:

METAL CASTING: Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting.

UNIT IV:

METAL JOINING: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies–drop forging die design – general design recommendations.

UNIT V:

EXTRUSION & SHEET METAL WORK: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

PLASTICS: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Text Books:

1. Design for Manufacture, John Cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

References:

1. ASM Hand book Vol.20

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M.Tech (CAD/CAM) I SEMESTER

(4PE515) COMPUTER AIDED PROCESS PLANNING

(Elective - I)

Unit – I: Introduction to CAPP: Process planning definition, The need for process planning, approaches to CAPP-Variant, Generative and Automatic process planning, Historical background of CAPP development, future trend of CAPP, expert process planning systems for industry.

Process planning: Information requirement for process planning system, advantages of conventional process planning over CAPP, Structure of automated process planning system.

Unit – II: Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation and applications.

Unit – III: Selection of manufacturing sequence: Significance, alternative manufacturing processes.

Determination of machining parameters: Reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality.

Determination of manufacturing tolerances: Design tolerances, manufacturing tolerances.

Unit – IV: Implementation techniques for CAPP: MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system, benefits of CAPP, Computer integrated planning systems and Capacity planning system.

Unit –V: Production Planning & Control systems: Aggregate production planning, Master production schedule (MPS), Material requirement planning (MRP), Capacity planning, Shop floor control, Inventory control, Manufacturing resources planning (MRP-II), Just-In-Time production systems.

Manufacturing system simulation: Introduction, definition of simulation, manufacturing systems, types of simulation, need for simulation, simulation structure, elements of simulation, activity cycle diagram (ACD), simulation of process, simulation methodology.

Text Books:

1. Automation , Production systems and Computer Integrated Manufacturing System – Mikell P.Groover ,PHI Publications.

2.Computer Aided Design and Manufacturing – Dr.Sadhu Singh.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::RAJAMPET

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M.Tech (CAD/CAM) I SEMESTER

(4PE516) PRODUCT ENGINEERING

(Elective - I)

Unit - I:

Introduction: Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behaviour analysis

Understanding Customer: promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification.

Unit - II:

Concept Generation And Selection: Task – Structured approaches – Clarification – Search – Externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

Product Architecture: Implications – Product change – variety – component standardization – product performance – manufacturability.

UNIT - III:

PRODUCT DEVELOPMENT MANAGEMENT – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT –I V:

INDUSTRIAL DESIGN : Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process.

INVESTIGATION OF CUSTOMER NEEDS – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT – V:

DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity.

PROTOTYPE BASICS – Principles of prototyping – planning for prototypes – Economic analysis – Understanding and representing tasks – baseline project planning – accelerating the project execution.

TEXT BOOKS:

1. Product Design and Development, Kari T. Ulrich and Steven D. Eppinger, McGraw Hill International Edns. 1999.
2. Tool Design – Integrated Methods for Successful Product Engineering , Staurt Pugh, Addison Wesley Publishing, New York, NY, 1991, ISBN 0-202-41639-5.
3. Effective Product Design and Development, Business One Orwin, Stephen Rosenthal, Homewood, 1992, ISBN, 1-55623-603-4.

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M.Tech (CAD/CAM) I SEMESTER

(4PE518) MODELING & ANALYSIS LAB

A – MODELING

Typical tasks of Modeling using PRO/E, IDEAS, CATIA solid modeling packages for Surface modeling, Solid Modeling, Drafting and Assembly

1. 2-D sketching of given machine components
2. Part modeling of given machine components
3. Surface modeling of given machine components.
4. Sheet metal design of given machine components.
5. Assembling of individual parts of machine components into a final assembly.
6. Application of drafting features on 2-D drawing for final documentation.

B – ANALYSIS

Finite Element Analysis using ANSYS Package for different structures that can be discretised with 1-D, 2-D & 3-D elements to perform the following analysis: Static Analysis, Modal Analysis, Thermal Analysis and Transient analysis

1. Structural analysis of 2-D truss.
2. (a) Effect of self-weight on a cantilever beam.
   (b) Application of distributed loads.
3. Dynamic analysis of 1-D bar element
   a) Harmonic analysis of a cantilever beam.
   b) Transient analysis of cantilever beam.
4. Heat flux analysis of a composite modular wall.
5. Temperature distribution in a 3-D fin cooled electronic component.

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M.Tech (CAD/CAM) II SEMESTER

(4PE521) ADVANCED OPTIMIZATION TECHNIQUES

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

UNIT -II Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications**Assignment problem**: Hungarian's algorithm, applications, unbalanced problems, traveling salesman problem.

UNIT – III Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

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

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

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

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

Text Books:

1. Engineering Optimization, S.S.Rao, New Age Publishers.
2. Optimal design, Jasbir Arora, Mc Graw Hill (International) Publishers.
3. Multi objective Genetic algorithms, Kalyanmoy Deb, PHI Publishers.
4. Genetic Programming, John R Koza, The MIT Press.

References:

1. Optimization for Engineering Design, Kalyanmoy Deb, PHI Publishers.

algorithms in Search, Optimization, and Machine learning, D.E.Goldberg, Genetic

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M.Tech (CAD/CAM) II SEMESTER

(4PE412) ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

Unit-I Artificial Intelligence: Introduction, AI problems, underlying assumption, Applications of AI, AI & related fields. **State space representation**, Defining a problem, production system and its characteristics, control strategies, Problem characteristics, issues in the design of search programs, Examples of Search problems.

Unit-II Heuristics Search: Uniformed(Blind Search) and Informed Search, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search- OR Graphs, A* Algorithm, Problem reduction- AND-OR Graphs, AO* Algorithm, Constraint satisfaction, Means- Ends Analysis.

Unit III Knowledge Representation: Issues-Representations and Mapping, Approaches, Issues in Knowledge Representation, **Representing Knowledge using Rules** -Procedural Vs Declarative knowledge , Logic programming, Forward Vs Backward reasoning, Matching, Control knowledge.
Introduction to Knowledge Acquisition: Types of learning, General learning model and performance measures.

Unit-IV Use of Predicate Logic: Representing simple facts and logic, Instance and is a relationship, Syntax and Semantics for Propositional logic, FOPL, properties of Wffs, conversion to clause form, Resolution for Propositional Logic and predicate logics, Unification Algorithm , Natural deduction.
Symbolic reasoning under uncertainly: Introduction to Nonmonotonic Reasoning, Logics for Nonmonotonic reasoning ,Implementation of DFS and BFS , **Statistical Reasoning**- Probability and Bayes' theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic.

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

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

TEXT BOOKS

1. Artificial Intelligence, Elaine Rich & Kevin Knight**,** Tata McGraw-Hill , Second Edn.
2. Artificial Intelligence in Business, Wendry B.Ranch**,** Science & Industry – Vol -II application, PHI.
3. A Guide to Expert System **,** Waterman, D.A., Addison,**–** Wesley inc.
4. Building expert system, Hayes, Roth, Waterman, D.A (ed), AW 1983.
5. Designing Expert System, S.M. and Kulliknowske, Weis, London Champion Hull.

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M.Tech (CAD/CAM) II SEMESTER

(4PE522) ROBOTICS

Unit – I

Fundamentals of Robots: Introduction, definition of robot, classification of robots, History of robotics, robot components, degree of freedom, robot joints, robot coordinates, reference frames, programming modes, robot characteristics, robot work space, robot languages, advantages, disadvantages and applications of robots.

End Effectors: Grippers-Types, operation, mechanism, Force analysis, Tools as end effectors, Considerations in gripper selection and design.

Matrix transformations: Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis, representation of combined transformations, transformations relative to the rotating, inverse of transformation matrices.

Unit – II

Robot kinematics: Forward and inverse kinematics of robots-forward and inverse kinematic equations for position, forward and inverse kinematic equations for orientation, forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, The inverse kinematic solution and programming of robots, Degeneracy and Dexterity, simple problems with D-H representation.

Unit – III

Differential motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator.

Dynamic analysis and forces: Introduction, Lagrangian mechanics, Effective moments of inertia, dynamic equations for multi-degree of freedom robots-kinetic enrgy,potential energy, the Lagrangian robot’s equations of motion.

Unit – IV

Trajectory planning: Introduction, path Vs trajectory, basics of trajectory planning, joint space trajectory planning-third order polynomial trajectory planning, fifth order polynomial trajectory planning, Cartesian-space trajectories.

Sensors-Desirable features, Tactile, Proximity and Range sensors, Position sensors, velocity sensors. Uses of sensors in Robotics.

Unit – V

Robot Programming: Lead through programming, Robot programming as a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitations. **Robot Languages**: Textual Robot languages, generations, Robot language structures, Elements in functions.

Text Books:

1. Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI
Publications
2. Industrial Robotics – Mikell P. Groover & Mitchell Weiss, Roger N. Nagel,Nicholas
G.Odrey – Mc Graw Hill, 1986
3.Industrial bobotics_ V.Ganeshan&Hedge
4. Industrial Robotics_R.k.mittal.

References:

1. Robotics and control**:**Tata Mc Graw-Hill – R.K.Mittal and I.J.Nagarath
2. Fundamentals of Robotics: Analysis and control, Robert J. Schilling, Prentice Hall, 1990
3. Robotics: Control, sensing, vision, and intelligence – K.S. FU, R.C. Gonzalez and C.S.G Lee. McGraw Hill, 1987.

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M.Tech. (CAD/CAM) II SEMESTER

(4PE523) COMPUTER INTEGRATED MANUFACTURING

Unit – I

Introduction: Fundamental concepts in manufacturing and automation, Automation Strategies, fundamentals of CAD / CAM, product cycle and CAD/CAM, Automation and CAD/CAM, CIM components, Evolution of CIM, needs of CIM,Scope of CIM, Benefits of CIM, Integration of CAD/CAM/CIM. Automated flow lines, Transfer mechanisms, methods of Line balancing.

Unit – II

Numerical control machines: Basic components of NC system-the NC procedure- NC coordinate system, NC motion control system- Computer controls in NC: NC controller's technology - Computer Numerical Control (CNC), Direct Numerical control (DNC)-Machining Centers.

Computer integrated manufacturing**:** Adaptive control machining systems, adaptive control optimization system, Adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing and computer process control.

Unit – III

Cellular Manufacturing, Quantitative analysis in Cellullar Manufacturing. Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

Unit – IV

Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling Systems and Computer Control system, FMS layout configurations and benefits of FMS. Tool Management systems-Tool monitoring, Work holding devices- Modular fixturing, flexible fixturing ,

.flexibility, automated material handling system –AGVs, Guidance methods, AS/RS

Lean and Agile Manufacturing **–**Lean production, Main Elements of Lean production (Six Sigma, JIT, 5S, Kaizen, Total Productive Maintenance) – Agile Manufacturing, agility versus mass production – comparison of Lean and Agile.

UNIT V

Manufacturing system simulation: Introduction, definition of simulation, manufacturing systems, types of simulation, need for simulation, simulation structure, elements of simulation, activity cycle diagram (ACD), simulation of process, simulation methodology.

Text books:

1. Automation, Production systems and Computer Integrated Manufacturing Systems – Mikel P.Groover, PHI Publishers.
2. Computer Aided Design and Manufacturing – Dr.Sadhu Singh.

References:

1. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers.
2. Discrete-Event System Simulation, Fourth Edition, Jerry Banks, Barry L. Nelson, Prentice Hall, 2010
3. http://www.strategosinc.com/ - Lean Manufacturing Strategy.

(4PE524) MECHATRONICS

UNIT-I **Mechatronic system design:** Introduction, what is mechatronics, systems, measurement systems, control systems, Role of various engineering disciplines in mechatronics, Mechatronics design elements, Scope of mechatronics, applications of mechatronics.

UNIT-II **Sensors and Transducers:** Sensors and transducers, performance terminology, displacement, position and proximity, velocity and motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors, selection of sensors.

UNIT-III **Actuators and drive systems:** Mechanical, Electrical, Hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

UNIT-IV **Control system components:** Introduction, classification of control system-open loop control system, Linear and non linear control systems, Linear-time varying and time invariant systems, Continuous-time and discrete-time control systems, Lumped parameter and distributed parameter control system, Determistic and stochastic control system, classification of control systems on the basis of control signal used, Adaptive control system, Process control systems

Process control : Introduction, concept of process control, Automatic controllers-Analog and Digital- analog controller, digital controller, Electronic controllers-control modes, composite mode electronic controller, Pneumatic controllers-pneumatic ON-OFF controller, pneumatic proportional controller, P-I controller ,P-D controller, P-I-D controller, Hydraulic controllers, Fuzzy Logic Controller(FLC)

UNIT-V

Microcontroller programming: Microcontrollers, Microprocessor systems, Intel 8051, applications, programmable logic controls and identification of systems, Basic structure of PLC, selection of PLC. **Digital electronics:** Introduction, logic gates, Arithmetic circuits, Multiplexers, De-multiplexers, Encoders and Decoders, flip-flops.

Applications of computers in mechatronics: Introduction, Data communication in industries, computer networks, CAD, CAM, CAPP, CIM, CAPC, CNC machine, PLC.

Text books:

1. Mechatronics, W.Bolton, Pearson Education,Asia.
2. Mechatronics, M.D. Singh and J.G. Joshi, PHI.

Reference Books:

1. Mechatronics, D.A. Bradley, D. Dawson, N.C. Buru and A.J. Loader, Chapman Hall.
2. Microprocessor Architecture, Programming & Applications, S. Ramesh, Gaonkar, Wiley Eastern.
3. The Mechatronics Handbook with ISA– The Instrumentation, Systems, Automation, Robert H. Bishop. Ed.-in-chief., CRC Press.

(4PE525) RAPID PROTOTYPING

(Elective - II)

Unit-I

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

RP Processes : Process overviews, STL file Generation, File Verification & Repair, Build

File Creation, Part Construction, Part Cleaning and finishing, Process Strength & limitations.

Unit –II

Liquid-based Rapid Prototyping Systems - Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

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

Unit III

Solid-based Rapid Prototyping Systems - Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.

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

Unit IV

Powder Based Rapid Prototyping Systems : Selective laser sintering (SLS): Introduction to LASER, LASER generation methods, LASER applications, SLS process, process details, process parameters, Applications.

Concepts Modelers: Principle, Thermal jet printer, Sander's model maker, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

Unit –V

LASER ENGINEERING NET SHAPING (LENS) Principle of operation, Machine details, Applications.

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling, Spray metal tooling, Direct Rapid Tooling Direct. Quick cast process, Rapid Tool, Prometal, Sand casting tooling, soft Tooling vs hard tooling.
Allied Process: Vacuum casting, surface digitizing, Surface generation from point cloud, Surface modification- Data transfer to solid models.

TEXT BOOKS:

1. Rapid Prototyping Technology, Kenneth G. Cooper, Marcel Dekker,INC.
2. Rapid Manufacturing, Flham D.T & Dinjoy S.S, Verlog London 2001.
3. Frank W. Liou, Rapid Prototyping & engineering applications, CRC Press, ISBN 978-0-8493-3409-2
4. Rapid Prototyping theory & practice, Manufacturing System Engineering Series, Ali K.Kamarani, Springer Verlag

REFERENCES:

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.

(4PE526) INTELLIGENT MANUFACTURING SYSTEMS

(Elective - II)

UNIT I: Computer Integrated Manufacturing Systems, Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM.

Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top-down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing – System Components, System Architecture and Data Flow, System Operation.

UNIT II: Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

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

UNIT III: Automated Process Planning – Variant approach, Generative approach, Expert Systems for Process Planning, Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, Equipment Selection Problem.

UNIT IV: Group Technology Models and Algorithms – Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method.

Knowledge Based Group Technology - Group Technology in Automated Manufacturing System, Structure of Knowledge based system for group technology (KBSGT)

UNIT V: Elementary treatment of Lean manufacturing, Agile Manufacturing, Digital Manufacturing and e-Manufacturing – Scope – Advantages- limitations.

Text Book:

1. Intelligent Manufacturing Systems, Andrew Kusaick, Prentice Hall.

Reference Books:

1 Artificial Neural Networks, Yagna Narayana, PHI.
2 Automation, Production Systems and CIM, Mikell P Groover M.P, Prentice Hall.
3 E-Manufacturing: Fundamentals And Applications, K. Cheng, , WIT Press.

(4PE527) MECHANICS AND MANUFACTURING METHODS OF COMPOSITES

(Elective II)

Unit – I Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

Unit – II Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Unit – III Coordinate transformations: Hooke's law for different types of materials, constitutive relations, Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites.
Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

Unit – IV Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro mechanical predictions of elastic constants.

Unit – V Analysis of laminated composite plates

Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

Text Books:

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

References:

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

(4PE529) CAD / CAM LABORATORY

1. NC Code generation for a simple component using EDGECAM Software.
2. NC Code generation for a contoured component using EDGECAM Software.
3. Write a manual part program for simple turning operation.
4. Write a manual part program for linear & circular contoured operation.
5. Write a manual part program for multiple facing operations.
6. Write a manual part program for circular interpolation.
7. Write a manual part program for external simple threading operation.
8. Write a manual part program on a CNC Milling machine using G00 & G01 codes.
9. Write a manual part program for linear (G01) interpolation
10. Write a manual part program for linear (G01) and circular (G02) interpolation.
11. Write a manual part program for Clockwise (G02) & Counter Clockwise (G03) Interpolation.
12. Write a manual part program on a CNC Milling machine using G17, G18, G19 codes.
13. A case study on simulation of manufacturing system using Pro-model and arena software.
14. Pick and Place experiment on 5-axis Robotic Trainer.

Note: Experiments No 3 to 12 shall be conducted on CNC Trainer Lathe and Milling Machines