ME 501 With effect from the Academic Year 2003-2004

ADVANCED MATHEMATICS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Matrices and Linear Equations: Orthogonalization of vector sets, Quadratic forms, Equivalent matrices and transformations. Hermitian matrices, Multiple characteristics number of symmetric matrix. Discrimants and invariants. Functions of symmetric matrices. Numerical solution of characteristic value problems. Multiple characteristic numbers of non-symmetric matrices. Function space. Sturm-Liouville problems.

UNIT-II

Calculus of variations: Maxima and minima, Simplest case, Natural boundary conditions and transition conditions, variational notation, general case, Constraints and Language multipliers, Variable end points, Sturm-Liouville problems, Hamilton's principle, Lagrange's equation. Generalized dynamical entities, Constraints in dynamical systems.

UNIT-III

Fourier Transforms: Sine transform, Cosine Transform, Inverse Fourier Transforms and their simple problems. Laplace transforms. Application to differential equations with Laplace transform derivatives, convolution theorem. Problems on convolution theorem.

UNIT-IV

Application of partial differential equations for solutions of

1. One dimensional wave equation
2. One dimensional heat conduction equation
3. Laplace equation

With separation of variable method.

UNIT –V

Probability distributions: Chi-Square distribution, Gamma distribution, Normal distribution and their properties.

References:

1. B.S. Grewal, *Higher Engineering Mathematics,* Khanna Publishers, 25th Ed. 1999.
2. Sneddon, *Integral Transforms,* John Wiley and Company, 1987.

3. S.C. Gupta, V.K.Kapoor, *Fundamentals of Mathematical Statistics*, Sultanchand & Sons, 1987.
4. Francis B Hilderbrand, *Applied Mathematics*, Prentice Hall of India, New Delhi, 2nd ed., 1968.
5. A.S. Gupta, *Calculus of Variation with applications*, Prentice Hall of India, New Delhi, 2001.

ME 502 With effect from the Academic Year 2003-2004

AUTOMATION

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction : Basic principles of automation. Types of automated systems – degrees of automation – design the parts for automation. Bunikers and design- Automatic loading systems. Design of chutes and magazines - feeders – position orientation systems and per piece delivery systems.

UNIT-II

Control Systems: Relative advantages of various controls – Hydraulic, pneumatic and Electrical controls for automatic locating, loading and clamping – Automatic control devices. Transducers – Measuring circuits – Relay and amplifier – Actuators.

UNIT-III

Automated flow lines: Method of work transport – transfer mechanisms – buffer storage - control systems – design and fabrication consideration – Analysis of flow lines – General terminology and analysis of transfer lines without and with buffer storage. Partial automation – implementation of automatically flow lines,

UNIT-IV

Assembly systems and line balancing – Assembly process and systems assembly line. Line balancing methods. Ways of improving line balance. Flexible assembly lines. Designator automatical assembly. Analysis of multi station assembly. Automated material handling – Types of equipment and functions, analysis and design of material handling system. Conveyer systems. Automated guided vehicle systems.

Automated storage systems: Automated storage and retrieval systems work in process storage interfacing, handling and storage with manufacture.

UNIT-V

Automated inspection and testing: Automated inspection principles and methods – sensors techniques for automated inspection – techniques for automated inspection – contact and non contact inspection methods – in-processes automated measuring methods – machine vision – optical inspection methods. Automatic identification techniques: Shop floor control – Factory data Collection system – Bar code techniques Computer for local area networks – The future automated factory – Human workers in future automated factory – The impact on the society.

References:

1. Mikell P. Grover, *Automation, Production Systems and Computer Integrated Manufacturing,* Prentice Hall of India Pvt Ltd. , 1995.
2. A Troitsky *Principles of Automation and Automated Production,* Mir Publ., 1976.
3. C. Ray Astaihe, *Robots and Manufacturing automation,* John Wiley and Sons, New York.

ME 504 With effect from the Academic Year 2003-2004

ROBOTIC ENGINEERING

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction: Classification of robots. Degree of freedom of Robots, Workspace. Application of robots in industry. Robots in material handling, loading, unloading. Processing, Inspection and assembly. Robots used in welding, painting and in hazardous places. Specification of requirement of degrees of freedom for different applications.

UNIT-II

Rotation matrices, Euler angle and RPY representation. Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters.

UNIT-III

Trajectory planning, Jacobian, direct and inverse kinematics.

UNIT-IV

Static force analysis, Newton-Euler and Lagrangean formulations of dynamic equations, individual control of joints, control through computed torques.

UNIT-V

Mechanical, Hydraulic, Pneumatic grippers. DC and AC servomotors, Linear position measuring transducers, Optical encoders. Range and proximity sensing. Techniques used in robot vision, image acquisition and processing. Introduction to programming of Robots.

References:

1. Spong and Vidhyasagar, *Robot Dynamics and Control*, John Wiley and Sons.
2. Fu. K.S., Gonzalez, R.C., Lee. C.S.G, *Robotics, Control, Sensing, Vision and Intelligence*, McGraw Hill International, 1987.
3. Richard D. Clafter, Thomos A.Chmielwski and Michalnegin, *Robotic Engineering*, Prentice Hall of India, New Delhi.

FINITE ELEMENT TECHNIQUES

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach : Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

UNIT-II

Analysis of trusses and frames: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.

UNIT-III

Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy.

UNIT-IV

Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time dependent field problems: Application to one dimensional heat flow in a rod.

Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT-V

Finite element formulation of three dimensional problems in stress analysis.

Finite Element formulation of an incompressible fluid. Potential flow problems
Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.

References:

1. Tirupathi R Chandraputla and Ashok. D. Belegundu, *Introduction of Finite Element in Engineering,* Prentice Hall of India, 1997.
2. Rao S.S., *The Finite Element Methods in Engineering,* Pergamon Press, 1989.
3. Segerland. L.J., *Applied Finite Element Analysis,* Wiley Publication, 1984.
4. Reddy J.N., *An Introduction to Finite Element Methods,* Mc Graw Hill Company, 1984.

COMPUTER AIDED MODELLING & DESIGN

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction to CAD. Criteria for selection of CAD workstations. Hard copy technologies. Display technologies. Graphic Standards: GKS, CORE, PHIGS, IGES and other standards. 2D and 3D Geometric transformations : Translation, Scaling, Rotation, Reflection and Shearing.

UNIT-II

Wire Frame Modeling: Analytic and Synthetic curves, Cubic, Bezier, B-spine and NURBS curves.

UNIT-III

Surface Modeling: Analytic and Synthetic surfaces. Cubic, Bezier, B-spline, Quadric, Bilinear, Coons and Cycloid Surfaces.

UNIT-IV

Solid Modeling Techniques: Boundary Representation (B-rep) and Constructive Solid Geometry (CSG)

Animation: Introduction to Animation, Animation Languages, Motion Specifications, Methods of Controlling Animation and Basic Rules of Animation.

UNIT-V

Advanced Modeling Concepts: Feature based Modeling, Assembly Modeling, Behavioral Modeling, Conceptual Design and Top Down Design, Capabilities of Modeling & Analysis Packages such as Pro/ Engineer, Unigraphics, ANSYS, Hypermesh.

References:

1. Ibrahim Zeid, *CAD/ CAM, Theory and Practice*, McGraw Hill, 1998.
2. Foley, Van Dam, Feiner and Hughes, *Computer Graphics Principles and Practice*, 2nd Ed., Addison – Wesley, 2000.
3. Martenson. E. Micheal, *Geometric Modelling*, John Wiley & Sons, 1995.

COMPUTER INTEGRATED MANUFACTURING

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM : Product development cycle, concurrent engineering, implementation of concurrent engineering, soft and hard prototyping, characteristics of concurrent engineering. Introduction to FMS.

UNIT-II

CIM database and database management systems: Introduction, Database requirements of CIM, Database, Database management, Database models, DBMS Architecture, Query language, Structured query Language (SQL), SQL as a Knowledge Base Query Language, Product Data Management (PDM), Advantages of PDM.

UNIT-III

CNC Machine Tools: Principles of Numerical control, Types of CNC Machine tools, Features of CNC Systems, Direct numerical control (DNC), Elements of CNC viz. Ball screws, rolling guide ways, structure, drives and controls, standard controllers, Manual part programming with APT, Virtual machining. Machining Centers and Interpolators.

UNIT-IV

Robots in CIM: Definition of Robot, types of robots, programming robots, simulation robot operations, end of arm tooling, control system operation, integration of the industrial robot into CIM system, product design of automatic manufacture of robots, computer aided inspection using robots.

UNIT-V

Networking in CIM: Principles of networking, Network Techniques, Local area network (LAN), networking standards, Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking, Collaborative Engineering.

CIM Models: European Strategic Program for Research and Development in information Technology (ESPRIT) - CIM OSA Model, The National Institute of Standards and Technology (NIST)- AMRF Hierarchical model, Siemens Model, Digital Equipment Corporation Model, IBM Model.

References:

1. P. Radhakrishnan, S. Subramanyam; *CAD/CAM/CIM*; New Age.
2. S. Kant Vajpayee; *Principles of Computer Integrated Manufacturing.* Prentice-Hall India.
3. P.N. Rao, N.K. Tewari, T.K. Kundra; *Computer Aided Manufacturing,* Tata McGraw Hill.

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

State of stress and theories of failure, stresses in flat plates subject to bending, thermal stresses in plates, bending of circular plates of constant thickness.

UNIT-II

Stress around crack tip, stress intensity factory (SIF), Fracture toughness, SIF for important geometries, Elastic plastic analysis through J-integral method.

UNIT-III

Design of pressure vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cylinders, autofrettage of thick cylinders, thermal stresses and their significance. Fracture based design.

UNIT-IV

Eigenvalue Problems: Properties of Eigenvalues and Eigenvectors, Torsional, Longitudinal vibration, lateral vibration, Subspace iteration and Lanczo's method, component mode synthesis. Eigenvalue problems applied to Gyroscope, compressor disc and centrifuges.

UNIT-V

Dynamic analysis: Direct integration method, central difference method, Wilson-θ method, Newmark method, mode superposition, single degree freedom system response, multidegree freedom system response, Rayleigh damping, condition for stability, random vibrations. Torsional oscillations of a multi-cylinder engine.

(Note: The related algorithms and codes to be practiced by students)

References:

1. Prashant Kumar; *Elements of Fracture Mechanics*; Wheeler Publishing
2. John F.Harvey, *Pressure Vessel Design*, CBS Publications.
3. V. Ramamurti, *Computer Aided Mechanical Design and Analysis*; Tata McGraw Hill.
4. Bathe; *Finite Element Procedures*, Prentice Hall.

ME 503 With effect from the Academic Year 2003-2004

CONTROL OF DYNAMIC SYSTEMS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Mathematical modeling of dynamic systems, Transient response of second and higher order systems, Root locus and Bode plots, Lead, lag and lead lag circuits.

UNIT-II

State variables, Transition Matrix, Transformation of variables, Diagonalization of matrix, Canonical form.

UNIT-III

State variable feed back systems, Closed loop pole zero assignment, Observability and controllability.

UNIT-IV

Introduction to non linear systems, Phase plane method.

UNIT-V

Stability analysis, Routh-Hurwitz Criterion, Nyquist method, Lyapunov method of stability analysis.

References:

1. Gopal M, *Control Systems Principles and Design,* Tata McGraw Hill Company, 1998.
2. Francis Raven H., *Automatic Control Engineering,* 5th Edition, Tata Mc Graw Hill Company, 1995.
3. Franklin G.F. and Powell J.D., *Digital Control of Dynamic Systems,* Addison- Wesley, *1980.*

ME 511 With effect from the Academic Year 2003-2004

MICROPROCESSORS AND APPLICATIONS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

8086 Architecture CPU Architecture, Internal operations, Addressing modes, Machine Language Instructions. Instruction formats, Instruction execution Timing. Assembly Instruction Format: Data transfer instructions Arithmetic Instructions: Binary arithmetic packed BCD arithmetic, Unpacked BDC arithmetic. Branch Instructions: Conditional Branch Instructions, Unconditional Branch Instructions, Loop instructions. NOP and HLT instructions, Flag Manipulation Instructions, Logical Instructions. Shift and Rotate Instructions, Directives and Operators. Assembly Process, Translation and Assembly Instruction.

UNIT-II

Linking and Relocation, Stacks, procedures, Interrupts and Interrupt Routines, Macros, Program Design Byte and string manipulation, I/O programming.

UNIT-III

I/O Interface Serial Communication Interfaces , 8251 programmable communication interface, A/D and D/A example. Programmable Timers and Event counters, 8254 programmable Interval Timer, interval Application to A/D, DMA Controller (8237).

UNIT-IV

Peripheral Devices Keyboard and Display keyboard Design, LED Display Design, Keyboard / Display Controller (8279), CRT Controller and Interface (8275), Floppy Disk Controller (8272).

UNIT-V

Advanced processor Architecture 80386, 80486 and Pentiums' Register structure, Instruction set, Memory management protected and virtual modes, memory paging mechanism.

References:

1. Liu Yu-Cheng, Gibson GA, Microcomputer Systems: the 8086/8088 Family Architecture, programming and Design (2nd Edition), PHI, 1995.
2. Barry B. Brey The Intel Microprocessors, PHI, 1995.

PROGRAMMING METHODOLOGY AND DATA STRUCTURES

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Algorithms: Development, top down analysis, stepwise refinement, flow charts, decision tree, decision tables. Expressions: Storage representation, constants and variables, expressions and statements – Simple input / output statements, simple programs in C.

UNIT-II

Control statements - Compound statements, Interactive statements, conditional statements, loops, and Go To statements. Functions and procedures - Parameter passing, Local and Global variables, Modular Programming, Documentation and Maintenance.

UNIT-III

Arrays and Records - Storage structure Core arrays, Strings and string operations, Fields and Records. Linear Data Structures – Lists, stacks, sequential allocation and linked allocation lists.

UNIT-IV

Non linear Data Structures - Trees, Binary Trees, Multilinked Structure, representation of graphs.

UNIT-V

Sorting and Searching - Selection sort, Bubble sort, Partition exchange sort, Radix sort, Binary tree sort, heap sort, Binary search trees, hash table method.

References:

1. Trembly and Sorenson, *An Introduction to Data Structures with Application*, Mc Graw Hill, 1984
2. Balaguruswamy, E. *Programing in Ansi C*, McGraw Hill
3. Scheneider G.M., Weingoit D.M. and Perimaan, D.M. *Introduction to Programming and Problem Solving with PASCAL*, Wiley Eastern Ltd.

ME 515 With effect from the Academic Year 2003-2004

OPTIMIZATION TECHNIQUES

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Non Linear Programming, Unconstrained non linear optimization – Direct elimination procedures. Direct climbing procedures. Constrained non linear optimization.

UNIT-II

Integer Programming, Cutting – Plane Algorithims. Branch and Bound method. Zero-one implicit enumeration.

UNIT-III

Dynamic Programming, Elements of Dynamic Programming modal, Problem of dimensionality in Dynamic Programming, Solution of linear programs by Dynamic Programming.

UNIT-IV

Sequencing and scheduling. Project scheduling by PERT-CPM. Probability and cost consideration in Project scheduling.

UNIT-V

Queuing Theory, Basic elements of Queuing modal, poison and exponential distribution, Single server and multi server modals. Queues with combined arrivals and departures. Queues with priorities for service.

References:

1. Rao, S.S. *Optimization Theory and Application*, Wiley Eastern Ltd, 1992.
2. Sharma S.D, *Operations Research*, Sultan Chand, 1989.
3. Prem Kumar Gupta, *Linear Programming in theory of Games*

VIBRATION ANALYSIS AND CONDITION MONITORING

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Causes and effects of vibration. Vibrations of Single Degree, Two Degree and Multi Degree of freedom systems. Steady state and transient characteristics of vibration.

UNIT-II

Introduction to Condition Monitoring, Failure types, investigation and occurrences. Causes of failure, Characteristics of vibration – SHM, Periodic motion, Displacement, Velocity and acceleration. Peak to peak & RMS, linear and logarithmic scales and phase angle.

UNIT-III

Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers.

UNIT-IV

Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques.

UNIT-V

Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis.

References:

1. Collacott, R.A., *Mechanical Fault Diagnosis and Condition Monitoring,* Chapman & Hall, London, 1982.
2. John S. Mitchell, *Introduction to Machinery Analysis and Monitoring,* Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.
3. Nakra, B.C. Yadava, G.S. and Thuested, L., *Vibration Measurement and Analysis,* National Productivity Council, New Delhi, 1989.
4. Pox and Zenkins, *Time Series Analysis.*
5. A.H. Search, *Vibration and Time Series Analysis.*

SYSTEM SIMULATION

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

System models: Concepts, continuous and discrete systems, system modeling, types of models, subsystems, corporate model, system study. System Simulation; Techniques, comparison of simulation and analytical methods, types of simulation, distributed log models, cobweb models.

UNIT-II

Continuous system simulation: numerical solution of differential equation, analog computer, hybrid computers, continuous system simulation languages CSMP system dynamic growth models, logistic curves.

UNIT-III

Probability concepts in simulation: Monte Carlo techniques stochastic variables and probability functions, random number generation algorithms. Queuing theory, Arrival pattern distribution, service time, queuing disciplines and measure of queues, mathematical solution of queuing problems .

UNIT-IV

Discrete systems simulation: Event generation of arrival patterns, simulation programming tasks, analysis of simulation output GPSS and SIMSCRIPT: General description of GPSS and SIMSCRIPT, Programming in GPSS.

UNIT-V

Simulation Programming Techniques: Data structure, implementation of activates, events and queues, even scanning, simulation algorithm in GPSS and SIMSCRIPT.

References:

1. Geofery Gordan, *System Simulation,* Prentice Hall Publication, 1978.

PRODUCTION SYSTEM DESIGN AND CONTROL

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Product development through Computer Integrated Manufacturing (CIM) concept, concurrent Engineering. Conceptual shape Design Geometry & Surface identification.

UNIT-II

CIM data base and data base management systems. Operating systems and environment. Automated process planning structure. CAD based process planning. Group technology, coding structures, methods of Computer Aided Process Planning (CAPP), implementation considerations. Planning of resources manufacturing through information systems CIM environment, major modules of MRP software. Entrepreneur resources planning {ERP}packages and selection.

UNIT-III

Flexible Manufacturing Systems (FMS): Elements, subsystems, benefits, layout examples, Indian scenario. Fundamental of Networking, Computer Integrated Manufacturing (CIM) models: ESPRIT-OSA, NIST AMRF, Siemens, DEC Enterprise optimization and present trends.

UNIT-IV

Computer Aided Quality Control (CAQC): Total Quality Management, Statistical process control, non-contact methods, coordinate measuring machine & robots in quality control, Flexible inspection systems. Short term forecasting, techniques, methods, comparison, monitoring.

UNIT-V

Shop floor data collection systems, its automation and data acquisition methods / processes.
Automation : Feasibility and non-technical issues.

References:

1. Radhakrishnan, Subramanyam & Raju. *CAD/CAM/CIM*, New Age International Publishers, 2000.
2. S. Brian Morris, *Automated Manufacturing Systems*, Mc Graw Hill International Editions, 1995.

3. Volman, Bery and Whybark: *Manufacturing Planning and Control Systems.* Galgotia Publications, Delhi 1998.
4. Groover & Zimmers, *Computer Aided Design and Manufacturing,* Prentice Hall of India, New Delhi.

ME 519 With effect from the Academic Year 2003-2004

NEURAL NETWORKS AND FUZZY LOGIC

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Concepts of fuzzy sets: Introduction – Crisps sets, notation of fuzzy sets, basic concepts of fuzzy sets, operation, fuzzy compliment, union, intersection, Binary relation, Equivalence and similarity relations, belief and plausibility measures, probability measures, computability, relations, ordering morphisms, possibility and necessary measures.

Uncertainty and information: Types of uncertainty, measures of dissonance, measures of confusion, measures of nonspecificity, uncertainty and information. Complexity, Principle of uncertainity.

UNIT-II

Adaptive fuzzy systems: Neural and Fuzzy intelligence, Fuzziness as multivalent, fuzziness in probabilistic world, randomness verses ambiguity.

UNIT-III

Fuzzy association memories: Fuzzy and neural function estimates, FAN mapping, neural verses fuzzy representation of structural knowledge, FAM as mapping, Fuzzy hebb FAM's Bidirectional FAM theorem, Super imposition FAM Rules, FA System architecture.

UNIT-IV

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

UNIT-V

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

Neural networks Paradigms: Perception meculloch and Pitts Model, back propagation algorithm and deviation, stopping criterion, Hopfield nets, Boldman's machine algorithm, Neural networks applications.

References:

1. Bart, Kosko, *Neural Networks and Fuzzy Systems,* Prentice Hall of India, 1994.

2. Limin Fu, *Neural Networks in Computer Intelligence*, McGraw Hill, 1995.
3. George J Klir and Tina A. Folger, *Fuzzy Sets Uncertainity an Information*, Prentice Hall of India, New Delhi, 2000.
4. James A Freeman, *Simulating Neural Networks*, Adison Publication, 1995.

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Artificial Intelligence: Definition, Study of AI techniques, problems and Problems space, AI characteristics, Heuristics.

Problem solving Methods: Forward and backward reasoning, problem trees, problem graph, hill climbing, search method, problem reduction, constraint satisfaction, means and analysis, game playing, mini max algorithms, alphabetic heuristics.

UNIT-II

Computer Vision: Perception, early processing, representation and recognition of scenes, Guzman's algorithms of spurting objects in a scene, Waltz algorithm.

UNIT-III

Neural Language understanding problems, syntactic analysis, semantic analysis, augmented transition networks.

UNIT-IV

Knowledge representation (Logic): Representing facts in logic predicate logic, resolution, unification, question answering, mathematical theorem proving.

Knowledge representation (Structured): Declarative representation, Semantic nets, procedural representation.

UNIT-V

Learning: Learning as induction, failure drive learning, learning by teaching, learning through examples (Winston's program) skill acquisition.

References:

1. Elaine Rich, *Artificial Intelligence,* Mc Graw Hill, 1985.
2. Nilson, *Principles of Artificial Intelligence.*
3. Winston, *The Psychology of Computer.*

PRODUCT DESIGN AND PROCESS PLANNING

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Product design and process design functions, selection of a right product, essential factors of product design, Morphology of design, sources of new ideas for products, evaluations of new product ideas. Product innovation procedure-Flow chart. Qualifications of product design Engineer. Criteria for success/failure of a product. Value of appearance, colours and Laws of appearance. Industrial ergonomics: Man-machine considerations, ease of maintenance Types of models developed by industrial design engineers.

UNIT-II

Product reliability, Mortality Curve, Reliability systems, Manufacturing reliability and quality control.

Patents: Definitions, classes of patents, applying for patents. Trademarks and copyrights. Cost and Quality sensitivity of products, Elements of cost of a product, costing methods, cost reduction and cost control activities. Economic analysis, Break even analysis Charts. Value engineering in product design, creativity aspects and techniques. Procedures of value analysis – cost reduction, material and process selection.

UNIT-III

Various manufacturing processes, degree of accuracy and finish obtainable, process capability studies. Methods of Improving tolerances. Basic product design rules for Casting, Forging, Machining, Sheet metal and Welding. Physical properties of engineering materials and their importance on products. Selection of plastics, rubber and ceramics for product design.

Taguchi approaches for product optimization, robust design, concept of manufacturing tolerances and loss functions.

UNIT-IV

Ergonomic considerations in product design-Anthropometry, Design of controls, man-machine information exchange. Process sheet detail and their importance, Advanced techniques for higher productivity. Just-in-time and Kanban System. Modern approaches to product design, concurrent design, quality function development, Rapid prototyping.

UNIT-V

Role of computer in product design and management of manufacturing, creation of manufacturing data base, Computer Integrated Manufacturing,

communication network, production flow analysis, Group Technology, Computer Aided product design and process planning. Integrating product design, manufacture and production control.

References:

1. Niebel, B.W., and Draper, A.B., *Product design and process Engineering*, McGraw Hill – Kogalkusha Ltd., Tokyo, 1974.
2. Chitale, A.K, and Gupta, R.C., *Product Design and Manufacturing*, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Mahajan, M. *Industrial Engineering and Production Management*, Dhanpath Rai & Co, 2000.
4. Tapan P Bagchi, *Taguchi methods explained*, *Practical steps to Robust design*, Prentice Hall of India, Delhi, 1993.

DATA BASE MANAGEMENT SYSTEMS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction and E.R. Model: Purpose of database systems, Data abstraction Data models, data independent DDL, DML, DBA. Entities and entity sets. Relationships and relationship sets Mapping constraints, Primary Keys E-R diagrams, reducing E-R Diagram to tables.

UNIT-II

Relational model and relational database design: Structure of relational database, former query languages, commercial query languages. Modifying the database views. Pitfalls in relational database design and normalization.

UNIT-III

Network data model and hierarchical data model: data structure diagram, the DBTCCODASYL. Model data retrieval Update and set processing facility, Three structure diagram, data retrieval and update facility, virtual records.

UNIT-IV

File and System Structure, Indexing and Hashing: Physical storage media – file organization, buffer management, Mapping relations, networks and hierarchies to files – Index – sequential files. Bi-tree indexed files.

UNIT-V

Distributed database, security and integrity: Design, transparency and autonomy, query processing, recovery, concurrency control, deadlock handling and coordinator selection. Security and integrity, near database application**.**

References:

1. Korth, H.F. Silbenhatz, A., *Database Concepts,* Mc Graw Hill, 1986.
2. Gio Wiederhold, *Database Design,* Mc Graw Hill, 1983.
3. Jefferey O Ullman, *Principles of database systems.*
4. C.J. Date, *An Introduction to database systems,* Addison Wisely, 1980.
5. Trembley and Soreson, *An Introduction to Data structures with applications,* Mc Graw Hills.

SYSTEM SOFTWARE DESIGN

Instruction	3 Periods/week
Duration of University Examination	3 Hrs.
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Machine Structure: Machine language and assembly language. Assembler's general procedures, design of assemblers, label processing, cross assemblers.

UNIT-II

Marco language and Microprocessor: Feature of macro facility and implementation of the macro facility.

UNIT-III

Loaders: Loaders schemes, Design of the absolute loader, Design of a direct linking loader.

UNIT-IV

Compilers: Statement of the problem, Recognizing basic elements, syntactic units, Intermediate form, Storage allocation, Code generation, General model of compilers.

UNIT-V

C-Language programming, Data structures in C, Control structures of C, Parameter mechanism in C, I/O in C language, programming exercises.

References:

1. Donovan. J.J., *Systems Programming*, Tata Mc Graw Hills.
2. Kernighan & Richie, *The C Programming Language*, PHI, 1986.

ME 583 With effect from the Academic Year 2003-2004

ENTREPRENEURSHIP DEVELOPMENT

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Entrepreneurship and Economic growth. Types and forms of enterprises. Indian Industrial Environment – competence, Opportunities and Challenges. Small Scale Industry in India – Objectives. Linkage among Small, Medium and heavy industries.

UNIT-II

Emergence of First generation entrepreneurs. Identification and characteristics of entrepreneurs. Environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology – Collaborative interaction for Technology development.

UNIT-III

Project formulation – Analysis of market demand. Financial and profitability analysis and Technical analysis. Project financing in India.

UNIT-IV

Management of Projects: Project organization, Project planning and control using CPM & PERT techniques. Human aspects of project management. Entrepreneurs resources planning network and computerization. Assessment of tax burden.

UNIT-V

Organisational behavior: Personality – determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behavior. Time management. Various approaches of time management, their strengths and weaknesses, the time management matrix. Interpersonal relations & Assertive training & counseling skills.

References:

1. Vasant Desai. *Dynamics of Entrepreneurial Development and Management,* Himalaya Publishing House, 1997.
2. Prasanna Chandra, *Project - Planning, Analysis, Selection, Implementation and .Review,* Tata McGraw Hill Publishing Company Ltd. 1995.

3. Stephen R. Covey and Roger Merrill A. *First Things First*, Simon and scheuster Publications 1994.
4. Sudha G.S. *Organizational Behavior*, National Publishing House, 1996.

EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Measurement of Cutting Forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and strain measurements by photoelasticity. Holography, interferometer, Moir techniques, strain gauge rosettes.

UNIT-II

Temperature Measurement: Circuits and instrumentation for different transducers viz, bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers.

Flow Measurement : Transducers for flow measurements of Non-compressible and compressible fluids. Obstruction and drag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schlieren photography. Interferometer.

UNIT-III

Metallurgical Studies: Optical and electron microscopy, X-Ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses. Electron spectroscopy, electron microprobe.

Surface Measurements: Micro hardness, roughness, accuracy of dimensions and forms. 3-D co-ordinate measuring machines.

UNIT-IV

Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization.

Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

UNIT-V

Taguchi Methods: Experiment design and planning with Orthogonal arrays and linear graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors. Performance evaluation and

Optimization by signal to noise ratios. Concept of loss function and its application.

References:

1. Holman, J.P.: *Environmental Methods for Engineers,* McGraw Hill Int., New York.
2. Venkatesh, V.C., and Chandrasekharan, *Experimental Methods in Metal Cutting*, Prentice Hall of India, Delhi.
3. Davis, O.V.; *The Design and Analysis of Industrial Experiments*, Longman, London.
4. Box and Jenkins; *Time Series analysis, Forecasting and control*, Holden Day, Sanfrancisco.
5. Dove and Adams, *Experimental stress analysis and motion measurement*, Prentice Hall of India, Delhi.
6. Tapan P. Bagchi, *Taguchi Methods Explained*, Prentice Hall of India, Delhi.

MECHANICS OF COMPOSITE MATERIALS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites carbon fibre composites.

UNIT-II

Micromechanics of Composites:

Mechanical properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses.

Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT-III

Macromechanics of Composites:

Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

UNIT-IV

Strength, fracture, fatigue and design:

Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength.

Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

UNIT-V

Analysis of plates and stress:

Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite materials. Analysis of composite cylindrical shells under axially symmetric loads.

References:

1. Jones, R.M., *Mechanics of Composite Materials, Mc Graw Hill Co., 1967*.
2. Calcote, L.R., *The Analysis of Laminated Composite Structures,* Van Nostrand, 1969.
3. Whitney, I.M. Daniel, R.B. Pipes, *Experimental Mechanics of Fibre Reinforced Composite Materials,* Prentice Hall, 1984.
4. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials,* Mc Graw Hill Co., 1998.
5. Carl. T. Herakovich, *Mechanics of Fibrous Composites,* John Wiley Sons Inc., 1998.

ME 545 With effect from the Academic Year 2003-2004

ADVANCED METROLOGY

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

End & line standards for length, Airy & Bessel points, desirable features of end standards, slip gauge manufacture, calibration of end standards by interferometry. NPL gauge interferometer, calibration of line standards by micrometer microscope – superposition, coincidence and symmetric straddling, photoelectric microscope and Moir fringe techniques, measurement of large displacements using lasers, calibration of Tomlinson gauges by interferometry. Photoelectric Autocollimator, calibration of polygons & circular scales. Types of interchangeability, dimensional chains.

UNIT-II

Fixed & Indicating Gauges: Taylor's principles of gauge design, limitations of ring & plug gauges, position and receiver gauges, types of indicating gauges.

Comparators: Multirange Sigma comparator, Back pressure and free flow type pneumatic comparators, Differential back pressure gauge, usage of different types of jets, contact & non contact tooling. Amplification selection. Air to electric transducer, Differential transducer, Variation transducer, Pre process, In-process & Post process gauging, computation & match gauging. Usage of LVDT & Capacitive type gauge heads, Automatic inspection.

UNIT-III

Measuring Machines: Floating carriage diameter measuring m/c. Universal measuring m/c. Matrix internal diameter measuring machine. Optical dividing head. Coordinate measuring machine, Optical projector-light beam systems, Work tables, measurement techniques, fixturing & accessories. Sources of error in measurement. Design principles of measuring machines Abbe's rule, Kelvin coupling, flexible steel strip, advantages & limitations of hydrostatic & aerostatic bearings.

UNIT-IV

Form Errors: Evaluation of straightness & flatness, usage of beam comparator, evaluation of roundness – intrinsic & extrinsic datums. Talyrond. PGC, RGC, MZC & LSC, methods, roundness evaluation for even & odd number of lobes. Surface Finish: stylus instrument (TALYSURF). M & E Systems, numerical assessment, vertical & horizontal descriptors, profile as a random process, usage of interferograms. Plastic replica technique.

UNIT-V

Screw Threads: Measurement of thread elements for internal & external threads, progressive periodic, drunkenness and irregular pitch errors. NPL pitch measuring machine, virtual effective diameter, thread gauging.

Gears: measurement of tooth thickness, involute profile, pitch, concentricity and alignment, rolling gear test.

References:

1. R.K.Jain, *Engineering Metrology*, Khanna Publishers
2. ASTME, *Hand Book of Industrial Metrology*, Prentice Hall of India Pvt Ltd.
3. I.C. Gupta, *A Text Book of Engineering Metrology*, Dhanpat Rai & Sons.

ADVANCED FINITE ELEMENT TECHNIQUES

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Stability Analysis: Eigen Value analysis – subspace, Blocklonkzo's, Power Dynamics and Guyan Reduction Techniques Harmonic analysis: Mode superposition and reduced method.

Spectrum analysis, Single and multipoint response spectrum. Power spectral density, Eigen buckling.

UNIT-II

Theory of plates and shells: Kirchoff's and Mindline formulations, Rectangular element with 2 Rotational Degrees of Freedom (RDF) and 1 Translational Degrees of Freedom, Introduction to higher order plate and shell elements. Composite material models and layered elements, Numerical integration to plate element, Incompatible elements.

UNIT-III

Structural Axis and rotational symmetry, substructure. Formulation of super elements, Cyclic symmetric problems, Solids: Formulation of 3–Dimensional Tetrahedron and Brick elements. Numerical Integration, Patch test.

UNIT-IV

Material and geometric non-linearity, Mohr- Coulomb, Drucker Prager, Plasticity, Elasto-Plastic, Visco Plasticity, Tangent-stiffness, Newton Raphson full and modified methods. Incremental theory and Deformation theory.

UNIT-V

Finite element formulation of incompressible fluid, potential flow problems, laminar and turbulent flow analysis. Formulation of 1D and 2D triangular elements, boundary conditions, Fluid structure interaction, particle tracking, stress analysis. Introduction to CFD Analysis. Introduction to FEA Software.

References:

1. Zienckwicz O.C., *Introduction to FEM*, Tata McGraw Hill, 1985.
2. Bathe J. *Introduction to FEM*, Prentice Hall of India, 1985.
3. Cook, R.D. *Concepts of FEM*, Wiley International, 1984.

4. Rao S.S., *The Finite Element Methods in Engineering*, Pergamon Press, 1989.
5. Segerland L J, *Applied Finite Element Analysis*, Wiley Publication, 1984.

ME 543 With effect from the Academic Year 2003-2004

THEORY OF ELASTICITY & PLASTICITY

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Basic Concepts – Stress, strain, invariants of stress and strain, principle stress and principal strain equation of compatibility, generalized Hooke's Law – stress-strain relationships for an isotropic body - plane stress and plane strain.

UNIT-II

Airys stress function. St.Venants principles – Application to simple two dimensional problems. Theories of strength and theories of failures.

UNIT-III

Yield conditions, the yield surface in three dimensional stress space, stress strain relation in the plastic range – St. Venants theory of plastic flow, work of plastic deformation or specific energy. Specific power of deformation, plasticity conditions, typial effective stress effective strain curves.

UNIT-IV

Problems in plastic flow of ideally plastic materials, problems in plastic flow of strain hardening materials, general methods of solution of plasticity problems illustration by an example slip line solutions, construction of sheareets-slip line solutions applied to an extrusion problems.

UNIT-V

Analysis of metal forming processes(by application of theory of plasticity): Examples of deep drawing extrusion and simple shearing operations.

References:

1. Timoshenko and Goodieer, *Theory of Elasticity*
2. Wang, *Theory of Elasticity*
3. Lov A.E.H, *Theory of Elasticity*
4. G. Sacks, *Introduction to the theory of plasticity for engineers.*

DESIGN OF PRESS TOOLS

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Classification of Mechanical, Hydraulic, and pneumatic presses: Press Characteristics, safety devices in presses. Principles of stretch forming machines, principles of feeding and unloading equipment. Design principles of presses.

UNIT-II

Design of Dies: Introduction terminology shearing dies – analysis process shearing clearance –size and tolerances of die opening and punch – force, power, energy in shearing – loading center, shearing with inclined edges – strip layouts, economical stock – Utilization.

UNIT-III

Elements of shearing dies – die plates – split dies, rules of development for split dies, inserts, types of punches, punch holders, punches – strippers – calculation of springs and rubber ejectors, shedders, stops-pilots – stock guides –alignment system design for press tools.

UNIT-IV

Compound dies, progressive dies, stock feeding devices – cam actuated dies, horn dies (type, sub-press dies) – precision shearing dies, shaving dies, lamination dies – Bending dies, theory of bending, development of blank, spring back, curling, flanging and press brake dies, bending on press brake.

UNIT-V

Drawing and forming dies : Theory of drawing, blank development, strain factor, calculation of force, construction of drawing and drawing dies - Drawing of rectangular components (development, stages draw beeds) – Ironing (application of rubber and hydraulic system) Defects in deep drawing – Modern Metal forming techniques – Discussion of various computer software for sheet metal design.

References:

1. *Fundamentals of tool Design* –ASTME, Prentice Hall, New Delhi, 1987.
2. *Die design Hand Book* – AISME, Mc Graw Hills, New York, 1965.

3. Geoffrey Rowe W., *An Introduction to the Principles of Metal Working*, Edward Arnold, 1977.
4. Serope Kalpakjain, *Mechanical Processing in Materials*, 1967.
5. Heinrich Makelt, *Mechanical Presses*, Edward Arnold, London, 1968.
6. Javoronkov V.A. and Chaturvedi R.C., *Rolling of Metals.*
7. Eary and Redds, *Shear Working of Metals*, Prentice Hall, New Delhi, 1969.
8. Honeyeeme R.W.K, *The Plastic Deformation of Metals*, Edward Arnold, London, 1968.
9. Kamenschikov, *Forging Practice*, Mir Pub., Mascow, 1968.
10. *High Velocity Forming of Metals* - ASME, Michigan, 1968.
11. Bhattacharya A, *New Technology*, Institute of Engineers, Calcutta, 1973.

DESIGN OF DIES

Instruction	3 Periods /Week
Duration of University Examination	3 Hrs
University Examination	80 Marks
Sessional	20 Marks

UNIT-I

Design principles for dies of thermo plastic and thermo setting components. Impression core cavities, strength of cavities, guide pillars and bushes, ejection systems, cooling methods, bolster types. Split moulds, methods of actuating the splits, moulds of threaded components, internal and external under cuts, moulds with under feed systems. Design principles and standards for Transfer and compression moulding dies.

Design of Tools: Mould for spindle component with sleeve, pin ejection. Mould with splits Multi cavity mould with stripper plate, inserts, ejectors.

UNIT-II

Design of dies for metal mould Castings, Die casting, Shell moulding.

Design of casing cavity, sprue, slug, fixed and movable cores, finger cam, core, pin, draft, ejector pins, ejector plate, gate, goose neck nozzle, over flow, platen plunger, runner, slot, slide, vent, water line. Design of hot chamber, cold chamber machines, vertical, horizontal, die locking machines, toggle and hydraulic systems, injection systems, rack and pinion, knockout pins and plates, hydraulic ejection, other parts of die casting machines.

UNIT-III

Design of various types of dies - Single cavity, multi cavity, combination, unit dies. Alignment of dies with sprue. Design approach for die elements. Selection of materials and heat treatment for die casting dies and elements – die casting alloys – types of die casting alloys, case studies on executed dies and design details. Finishing, Trimming and inspection. Gravity die casting – Die design with cores and inserts – Bulk forming tools.

UNIT-IV

Open die forging, Advantages of open die forging over closed forging. Calculation of allowances and tolerances. Methods of open die forging. Design of dies. Closed die forging. Preparation of material for forging. Calculation of raw stock, cutting off, heating in furnaces. Allowances and tolerances for closed die forging as per IS: 3469 1974.

UNIT-V

Die blocks for forging operations. Design of fuller impression, Roller impression, Bender impression, Blocker impression, Finisher impression., Swaging tools. Planning layout of multi impression dies. Flash and cutter

calculations – additional operations on forging, piercing and trimming dies, coining dies. Horizontal forging machines. Design of upsetting dies. Calculations on upsetting dies – Press forging reducers rolls. Forging equipment, Layout of forge shop. Roll forming, wire drawing, forward and backward extrusion.

References:

1. Rusinoff S.E., *Forging & Forming Metals*, Taraporewala, Bombay, 1952.
2. Dochlar H.H, *Die Casting Dies*, Mc Graw hill, 1951.
3. I.S. Standards, BSL, New Delhi
4. Pye R.G.W., *Injection Mould Design*, Longman Scientific & Technical Publishers, London, 1989.

ME 600 With effect from the Academic Year 2003-2004

Instruction: 3 Periods/week
Sessional: 50 Marks

COMPUTATION LABORATORY

List of Experiments:

1. Introduction to Finite Element Analysis Software
2. Static analysis of a corner bracket.
3. Statically indeterminate reaction force analysis.
4. Determination of Beam stresses and deflection
5. Bending analysis of a Tree shaped beam
6. Analysis of cylindrical shell under pressure
7. Bending of a circular plate using axisymmetric shell element
8. Stress analysis in a long cylinder.
9. Solidification of a casting.
10. Transient Heat transfer in an infinite slab.
11. Transient Thermal stress in a cylinder.
12. Vibration analysis of a simply supported beam.
13. Natural frequency of a motor generator.
14. Thermal structural contact of two bodies.
15. Drop test of a container (Explicit Dynamics).