DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M.Tech. 1st YEAR (SEMESTER– I) MECHANICAL ENGINEERING
Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teach-ing Schedule		Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
			L	P		Theory	Practical			
1	MEM 501B	COMPUTER AIDED ENGINEERING	4	-	25	75	-	100	4	3
2	MEM 503B	NUMERICAL & OPTIMIZATION METHODS	4	-	25	75	-	100	4	3
3	MEM 505B	PRODUCTION & OPERATIONS MANAGEMENT	4	-	25	75	-	100	4	3
4	MEM 507B	ADVANCED DESIGN OF MECHANICAL SYSTEMS	4	-	25	75	-	100	4	3
5	MEM 509B	ADVANCED FLUID MECHANICS	4	-	25	75	-	100	4	3
6	MEM 511B	COMPUTER AIDED ENGG. LAB	-	3	20	-	30	50	1.5	3
7	MEM 513B	NUMERICAL & OPTIMIZATION METHODS LAB	-	3	20	-	30	50	1.5	3
Total			**20**	**6**	**165**	**375**	**60**	**600**	**23**	

Note: Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M.Tech. 1st YEAR (SEMESTER – II) MECHANICAL ENGINEERING
Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teach-ing Schedule		Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
			L	P		Theory	Practical			
1	MEI 502B MET 502B	MODELING AND SIMULATION OF MANUFACTURING SYSTEM OR DESIGN OF THERMAL & ENERGY SYSTEMS	4	-	25	75	-	100	4	3
2	MED 506B	VIBRATION AND CONDITION MONITORING	4	-	25	75	-	100	4	3
3	MET 504B	ADVANCED HEAT TRANSFER	4	-	25	75	-	100	4	3
4		ELECTIVE – I	4	-	25	75	-	100	4	3
5		ELECTIVE – II	4	-	25	75	-	100	4	3
6	MEI 508B MET 508B	MANUFACTURING SIMULATION LAB OR DESIGN OF THERMAL & ENERGY SYSTEMS LAB	-	3	20	-	30	50	1.5	3
7	MED 508B	VIBRATION AND CONDITION MONITORING LAB	-	3	20	-	30	50	1.5	3
Total			**20**	**6**	**165**	**375**	**60**	**600**	**23**	

Elective – I		Elective– II	
MED 522B	COMPOSITE MATERIALS	MED 502B	SYSTEM DYNAMICS & CONTROL
MED 524B	ADVANCED MECHANICS OF SOLIDS	MED 526 B	ROBOTICS ENGINEERING
MEP 504B	ANALYSIS OF MANUFACTURING PROCESSES	MED 528 B	RELIABILITY BASED DESIGN
MEI 504B	QUALITY ENGINEERING	MET 520 B	COMPUTATIONAL FLUID DYNAMICS
MEI 506B	STATISTICS FOR DECISION MAKING	MET 524 B	ALTERNATIVE FUELS
MET 506B	ADVANCED THERMODYNAMICS	MEI 520 B	RELIABILITY AND MAINTENANCE ENGINEERING.
MET 601B	REFRIGERATION & AIR CONDITIONING SYSTEM DESIGN	MEP 502B	NON TRADITIONAL MACHINING & ADVANCED MANUFACTURING

Note:

1. Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.
2. The choice of students for any elective shall not be binding on the department to offer, if the department does not have expertise. The minimum strength of the students opting the particular subject shall not be less than 8.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M.Tech. 2nd YEAR (SEMESTER– III) MECHANICAL ENGINEERING
Credit Based Scheme w.e.f. 2013-14

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
			L	P		Theory	Practical			
1	MEP 601B	COMPUTER INTEGRATED MANUFACTURING SYSTEM	4	-	25	75	-	100	4	3
2	MEM 601B	MECHATRONICS	4	-	25	75	-	100	4	3
3		ELECTIVE – III	4	-	25	75	-	100	4	3
4	MEM 603B	MECHATRONICS & CIM LAB	-	3	20	-	30	50	1.5	3
5	MEM 605 B	DISSERTATION (PHASE – I)	-	6	100	-	-	100	6	-
6	MEM 607 B	SEMINAR	-	2	50	-	-	50	2	-
Total			**12**	**11**	**245**	**225**	**30**	**500**	**21.5**	

Elective – III	
MED 601B	MECHANISM AND MANIPULATOR DESIGN
MED 621 B	TRIBOLOGY
MEI 601B	ADVANCE OPERATION RESEARCH
MEI 627 B	TECHNOLOGY AND MANUFACTURING STRATEGIES
MET 621 B	HYDRAULIC & PNEUMATIC SYSTEMS
MET 623 B	I C ENGINES PROCESS MODELING

Note:

1. Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.
2. The choice of students for any elective shall not be binding on the department to offer, if the department does not have expertise. The minimum strength of the students opting the particular subject shall not be less than 8.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M.Tech. 2nd YEAR (SEMESTER– IV) MECHANICAL ENGINEERING
Credit Based Scheme w.e.f. 2013-14

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
			L	P		Theory	Practical			
1	MEM 602B	DISSERTATION	-	20	50	-	100	150	20	3
Total			**-**	**20**	**50**	**-**	**100**	**150**	**20**	

Dissertation coordinator will be assigned the load of 1 hour per week excluding his own guiding load. However, the dissertation guiding teacher will be assigned a load of one hour per candidate per week.

MEM 501B COMPUTER AIDED ENGINEERING							
M. Tech. Semester –I (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT I

OVERVIEW OF CAD/CAM SYSTEMS: CAD/ CAM contents and tools, CAD/ CAM market trends, definition of CAD/ CAM tools, Industrial look at CAD/ CAM, CAD/ CAM Hardware, CAD/ CAM Software, Microcomputer Based CAD/CAM

UNIT II

GEOMETRIC MODELING & GRAPHICS CONCEPTS: Types and Mathematical Representations of Curves, Parametric representation, Mathematical Representations of surfaces and Solids, Two and Three Dimensional Graphics Concepts: Geometrical Transformations, Visual Realism, CAD/ CAM Data Exchange

UNIT III

DESIGN APPLICATIONS: Introduction of Finite Element Modeling and Analysis, General procedure of FEM, Development of integral equations, Discretization, Elements equations and Assembly, Imposing boundary conditions and applied loads, Solution of Global Equations, Convergence of FE solutions, Isoparametric element matrices, shape functions, FE modeling, design and engineering applications

UNIT IV

CAD AND CAM INTEGRATION: Review of NC and CNC Technology, Part Programming and Manufacturing, Integration requirements, Process Planning: Manual, Variant, Generative and hybrid approach, Geometric modeling for Process Planning, Part Programming: fundamentals of NC, Basics of NC programming, NC programming languages, Tool Path generation and verification

BOOKS:

1. CAD/ CAM Computer-Aided Design and Manufacturing by M. Groover and E. Zimmer, Pearson.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Mathematical Elements for computer Graphics by David F. Rogers and J. Alan Adams, McGraw Hill, New York
4. CAD/ CAM (Principles, Practice & Manufacturing Management) by Chirs McMohan & Jimmie Browne, Published by Addison- Wesley.
5. CAD/CAM Principles and Applications by P N Rao, TMG

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 503B NUMERICAL & OPTIMIZATION METHODS

M.Tech. Semester –I (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT – I

ERRORS IN NUMERICAL CALCULATIONS: Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula.

INTERPOLATION AND CURVE FITTING: Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, Least squares line, curve fitting, Interpolation by spline functions.

UNIT – II

NUMERICAL DIFFERENTIATION AND INTEGRATION: Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cotes formula, Gaussion-Quadrature

SOLUTION OF LINEAR SYSTEMS AND NONLINEAR EQUATIONS: Direct Methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization, iterative methods for linear systems, Bracketing methods for locating a root, Initial approximations and convergence criteria, Newton-Raphson and Secant methods

UNIT – III

SOLUTION OF DIFFERENTIAL EQUATIONS: Introduction to differential equations, Initial value problems, Euler′s methods, Runge-Kutta methods, Taylor series method, Predictor- Corrector methods, Finite-difference method

PARTIAL DIFFERENTIAL EQUATIONS, EIGEN VALUES AND EIGEN VECTORS:
Solution of hyperbolic, parabolic and elliptic equations, eigen value problem, Power and inverse power methods, Jacobi′s method for eigen value problems.

UNIT – IV

OPTIMIZATION METHODS: Optimal problem formulation, Engineering optimization problems; optimization algorithms: Single-variable optimization algorithms, optimality criteria, Bracketing methods, Region-elimination methods, Point estimation method,

MULTI- VARIABLE OPTIMIZATION ALGORITHMS: optimality criteria, Uni-directional search, Direct search methods: Evolutionary methods, Simplex search method, Gradient based methods: Cauchy′s method, Newtons method, Application to Mechanical Engg. Problems, Non- traditional optimization algorithms, Genetic algorithms (GA), GA for constrained optimization, other GA operators, Multi objective Optimization, Concept of Pareto Optimality, Global optimization.

BOOKS:

1. Numerical Methods for Mathematics, Science and Engineering by John H.Mathews, PHI New Delhi.
2. Applied Numerical Methods – Carnahan, B.H., Luthar, H.A. and Wilkes, J.O., Pub.- J. Wiley, New York
3. Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York.
4. Introductory Methods of Numerical Analysis by S.D. Sastry, Published by Prentice Hall of India.
5. Numerical Methods – Hornbeck, R.W., Pub.- Prentice Hall, Englewood Cliffs, N.J.

6. Optimization for Engineering Design : Algorithms and Examples by Kalyanmoy Deb, PHI new Delhi
7. Numerical Optimization Techniques for Engineering Design: With Applications by Garret N. Vanderplaats,Mcgraw Hill Series in Mechanical Engineering
8. Genetic Algorithms and Engineering Optimization by Mitsuo Gen, Runwei Cheng, John Wiley & Sons
9. Global Optimization in Engineering Design, by Ignacio E. Grossmann, Kluwer Academic Publisher
10. Optimization Concepts and Applications in Engineering, by Ashok D. Belegundu , Tirupathi R. Chandrupatla, Cambridge University Press, USA

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 505B PRODUCTION & OPERATIONS MANAGEMENT
M.Tech. Semester –I (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT- I

INTRODUCTION: Definition of Production and Service systems, Operations management and its domain, Operations strategy and competitiveness, Measures of manufacturing performance, Productivity and its measurement; Types, characteristics and performance matrices of manufacturing systems; Brief review of performance requirement and chronology of developments in manufacturing systems

FACILITY PLANNING AND DESIGN: Objectives, parameters and methodology for plant location decision, Methodologies for Process and Product based layout design, Computerized layout Planning and SLP, Assembly line balancing, Group Technology and methodologies for GT based layout planning; Production flow analysis, Design of machining & assembly work cells, Economic analysis of facility alternatives, Numerical Problems

UNIT- II

PRODUCT DESIGN AND DEVELOPMENT: Strategies for new product introduction, Product development process, Modular product design and its advantages, product & process design, Concurrent engineering, Life cycle costs, Quality function development (QFD), Product-Process matrix and decision variables in selection of resources alternatives, Design for manufacture & assembly, Case study on QFD

DEMAND MANAGEMENT: Characteristics of Product demand and appropriate manufacturing control policies, Types of forecasting, Components of demand, quantitative technique in forecasting, time series analysis, Regression models, and focus forecasting, Forecasting and Strategic Capacity Planning

UNIT- III

OPERATIONS PLANNING: Different Operations Planning Activities, Aggregate planning: Objectives, strategies and models, Classification of Inventory systems, various Inventory costs, Master Production schedule (MPS) and methodologies for MPS, Different operations scheduling techniques, Materials Requirement Planning (MRP) and MRP II and ERP, Theory of constraint & OPT, Case example on simple MRP.

JUST IN TIME: JIT manufacturing philosophy, Simplification, Waste elimination, variation reduction, Pull systems, KANBANS – production, Withdrawn, Single card, Recorder point system, JIT system design, Pull Vs Push, CONWIP method, Implementation issues of JIT, Concept of lean, agile and leagile manufacturing

UNIT- IV

SUPPLY CHAIN MANAGEMENT: SC and its objectives, decisions domains and phases in SC, Process view of SC, Competitiveness and Supply Chain Strategies, Strategic Fit and Strategic Scope in SC, Obstacles to Achieving Strategic Fit, Drivers of Supply Chain Performance, SC Facilities: Inventory, Transportation, Information, Sourcing, Pricing, Role of Forecasting in Supply Chains, Managing Supply, Demand and product availability in SC

SC INITIATIVES: Cycle and Safety Inventory and their role in SC, Issues in SC Logistics, The Role of Sourcing in Supply Chain performance, Third- and Fourth-Party Logistics Providers, Coordination in Supply Chain and Bullwhip Effect, Continuous Replenishment and Vendor-Managed Inventories,

Collaborative Planning, Forecasting, and Replenishment (CPFR), Role of IT in SC Coordination, core competence, customization, outsourcing and postponement as SC initiatives, other SC paradigms

BOOKS:

1. Production & Operations Management – R.B. Chase, N.J. Aquilano & F.R. Jacobs, TMH, New Delhi
2. Supply Chain Management – S. Chopra & P. Meindl, Pub. – Pearson Education Asia, New Delhi
3. Production and Operations Management – B. Mahadevan, Pearson Education Asia, New Delhi
4. Manufacturing Planning and Control Systems – T.E. Vollmann, W.L. Berry and D.C. Whybark; Irwin, Illionois, USA

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 507B ADVANCED DESIGN OF MECHANICAL SYSTEMS							
M.Tech. Semester –I (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT –I

APPRECIATIVE REVIEW OF MECHANICS OF SOLIDS: State of stress at a point and stress tensor; Transformation of stresses using elementary tetrahedran, principal stresses and 3D Mohr's circle; stress equations of equilibrium. Srain- displacement relations, srain tensor, transformation equations for strains; strain Rossetes; Compatibility – concept, need and physical significance, equations of compatibility; plane stress and plane strain.

UNIT –II

APPRECIATIVE REVIEW OF STRENGTH OF MATERIALS: Generalized Hook's law, elastic constants and their interrelationship; constitutive equations. Genesis of Factor of Safety and static failure theories with simple applications. Critical review of pure torsion, simple bending, buckling and deflection formulae with simple applications.

Ref:
1. **Mechanics of solids by Crandle and Dahl Mcgraw Hill**
2. **Solid Mechanics by Kazimi, TMH**
3. **Advance Mechanics of Solids by Srinath, TMH**
4. **Mechanics of Solids by Popov**

UNIT - III

DESIGN AGAINST FLUCTUATING LOAD: Fluctuating Stresses: S-N diagram and endurance limit; Modified endurance limit estimation- notch sensitivity, surface finish, size, reliability factors etc.

Design for finite and infinite life for reversed stresses as well as Fluctuating Stresses: Soderberg and modified Goodman diagrams; equivalent completely reversed stress for a given fluctuating load; cumulative fatigue damage and minor's equation.

Ref:
1. **Design of Machine Elements – V.B. Bhandari**
2. **Mechanical Engineering Design – Shigley, MH (SI Edition)**
3. **Machine Design by R L Norton, Pearson**

UNIT - IV

ENGINEERING DESIGN PHILOSOPHY: Definition of engineering design; design Vs discovery; phases of engineering design – problem identification and need analysis, feasibility analysis, preliminary and detailed design with simple illustrations depicting each phase; constraints, specifications and standardization in design, creativity and invention in design; brain storming, system design approach, concurrent engineering design.

Ref: Engineering Design by George Dieter, McHill (A material & processing approach)

Material Considerations in Design

- Material consideration: Performance characteristics of engineering materials, material selection process and evaluation techniques.

Ref: 1. Engineering Design by George Dieter, McHill (A material & processing approach)
2. Machine Design by R L Norton, Pearson

(i) Interaction of materials, processing, and design: Economics of manufacturing; Design for castings, design for forgings, design for machining, Design for assembly.

Ref: Engineering Design by George Dieter, McHill (A material & processing approach)

(iii) Specific Considerations: Design for strength, design for staffness, design for stability, design for aesthetics and design for ergomics.

Ref: Mechanical Engineering Design by Shigley SI edition Mcgraw Hill.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 509B ADVANCED FLUID MECHANICS
M.Tech. Semester –I (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT –I

REVIEW OF BASIC CONCEPT: Concept of continuum, Types of fluids

BASICS LAWS IN INTEGRAL FORM: Reynolds′s transport theorem, Integral form of continuity, momentum and Energy equations:

POTENTIAL FLOW: Uniform flow, Source & Sink, Free Vortex flow, Source & Uniform flow (flow past a half body), Source - Sink pair, Doublet, Flow past a Cylinder (Doublet & Uniform flow), Flow past a Rankine oval body (source, sink & a uniform flow), flow past a cylinder with circulation (Doublet , Vortex and uniform flow)

UNIT –II

TURBULENT FLOW: Introduction, growth of instability and transition from laminar to turbulent flow, effects of turbulence, classification of turbulence, Intensity and scale of turbulence, turbulent Intensity, scale of turbulence , Isotropic and Homogenous turbulence, Reynolds Equations of turbulence. Turbulence modeling; Boussinesq Eddy Viscosity concept, Prandtl mixing length concept, von - Karman similarity concept, Empirical correlations for coefficient of Friction, Average velocity distribution for smooth and rough pipes. Friction factor for smooth and rough pipes.

UNIT –III

COMPRESSIBLE FLOW: Introduction, Wave propagation and sound velocity, Mach number and compressible flow regimes. Mach Core, Mach angle and mach Line. Basic equations for one dimensional compressible flow: continuity equation, momentum equation, Energy equation, Isentropic flow relations. Compressibility correction factor, Flow from a reservoir. Variation of velocity with Area ratio. Discharge through a convergent nozzle. Nozzles of the design pressure ratio.

NORMAL SHOCK WAVES: continuity equation momentum equations & Energy equations. Flow with obligue shock wave: Nature of flow through oblige shock wave, Prandtls′s equation, Rankine- Hugoniot equation.

UNIT –IV

VISCOUS FLOW IN DUCTS: Stress deformation relations, Navier- Stokes equations**,** Reynolds number Regimes, Internal Vs. External Viscous flow, Flow in circular pipes, Alternate forms of Moody Charts, Flow in Non Circular ducts, Minor losses in pipe system, Fluid meters – venturi, nozzles and orifices meters.

Books:

1. Fundamentals of compressible flow- S.M. Yahya, New Age International Publishers
2. Fluid Mechanics– John F Douglas, Janusz M. Gasiorek, John A, Swaffield, Peason Education
3. Advanced Engineering Fluid Mechanics – K Muralidhar & G. Biswas
4. Fluid Mechanics – Frank M. White, McGraw Hill
5. Viscous Fluid Flow - Frank M. White, Tata McGraw Hill

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 511B	COMPUTER AIDED ENGINEERING LAB						
M.Tech. Semester –I (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**20Marks**
-		**3**	**1.5**		**Examination**	**:**	**30 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

The students will be required to carry out 8 to 10 experiments covering the theory courses **MEM 501B** Computer Aided Engineering.

MEM 513B NUMERICAL & OPTIMIZATION METHODS LAB M.Tech. Semester –I (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**20 Marks**
-		**3**	**1.5**		**Examination**	**:**	**30 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

The students will be required to carry out the following exercise, that are based on the theory course MEM – 503B, Numerical & Optimization Methods, with the help of MatLab / C / C++ software, on personal computer.

List of exercises:

1. Write a programme that finds the solution of an equation in single variable using the method of successive bisection.
2. Write a programme that finds the solution of Non-Linear equation in single variable using the Newton Raphson/ Secant.
3. Write a programme that finds the solution of a system of simultaneous algebraic equations using the Gaussian elimination procedure.
4. Write a programme that finds the solution of a system of simultaneous algebraic equations using the Gauss – Seidel iterative method.
5. Write a programme that finds the numerical solution of an ordinary differential equation using the Euler′s method.
6. Write a programme that finds the numerical solution of an ordinary differential equation using the Runge – Kutta 4th order method.
7. Write a programme that finds the numerical Solution of an ordinary differential equation using the Predictor – corrector method.
8. Write a programme that finds the numerical solutions of Elliptic, Parabolic and Hyperbolic partial differential equations using the method of Finite Differences.
9. Write a programme that finds the minimum point of a single variable function in a specified interval using golden section search algorithm.
10. Write a programme that finds the minimum point of a multi variable function using Cauchý s steepest descent algorithm.
11. Write a programme that finds the minimum point of a constrained optimization problem using penalty function method.
12. Write a programme that finds the optimum point of a constrained optimization problem using genetic algorithm.

The students will be required to carry out the exercises from the above list and any other two experiments either from the above list or designed by the department based on the theory course MEM – 503B, Numerical & Optimization Methods.

MEI 502B MODELING AND SIMULATION OF MANUFACTURING SYSTEM
M.Tech. Semester –II (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT – I

INTRODUCTION: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic processes, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, Steps in a simulation study, Verification, validation and credibility of simulation models, Advantages, disadvantages and pitfalls of simulation,

STATISTICS IN SIMULATION: Review of basic probability and statistics, random variables and their properties, Statistical analysis for terminating simulation and steady state parameters

UNIT – II

MODELLING ELEMENTS IN MANUFACTURING SYSTEMS: Definition, Classifications and characteristics of production systems; measures of manufacturing systems performance, modelling elements in manufacturing systems: processes, resources, single and multi server queues, arrival processes, service times, downtime, manufacturing costs, resources selection rules, different manufacturing flexibilities

SIMULATION OF MANUFACTURING SYSTEMS: Simulation of Job shop, batch and Flexible manufacturing systems, Case studies for above systems.

UNIT – III

MODELLING OF MANUFACTURING SUPPLY CHAINS (SC): Introduction of SC, Modelling elements in SC, Measures of SC performance, brief review of bear game, SC initiatives and effect on SC performance

Modelling of Supply Chain Processes at different Supply chain nodes like: Retailer, assembler, distributor, and manufacturer; Modelling of different SC processes, inventory control policies like (s, S), (s, Q) systems, production control issues like Manufacturing-to-order, Manufacturing-to-stock, Assemble-to-order, Assemble-to-stock; Modelling of material transport system in SC, Development of Simple SC models

UNIT – IV

DESIGN OF SIMULATION EXPERIMENTS: Consideration for selecting length of simulation run, no of replication and warm-up period, elimination of initial bias, Finance Considerations of a simulation study, Variance reduction techniques, 2^k factorial design, fractional factorial design, factor screening, response surface, Meta-models and sensitivity, optimization procedures

SIMULATION LANGUAGES: Discussion of Continuous and discrete simulation languages, Salient features of important simulation packages like SIMSCRIPT, GPSS SIMULA, ARENA, PROMODEL etc., importance and limitations of special purpose languages.

BOOKS:

1. Simulation Modeling and Analysis, 3e, Law A.M. and Kelton W.D., TMH, New Delhi
2. Simulation with Arena - Kelton and Sadowski, 2003, (McGraw-Hill)
3. Analysis and Control of Production Systems, Printice Hall Publn, E.A. Elsayed and T.O. Boucher, 1994.
4. Modelling and Analysis of Dynamic Systems, C.M. Close and Dean K.F., Houghton Mifflin
5. Simulation of Manufacturing, Allan Carrie, John Wiley & Sons
6. System Simulation, Geoffrey Gordon, Prentice Hall, 1998
7. Modern Production /Operations Management, 8e, Buffa E.S. and Sarin R.K., John Wiley
8. Designing and Managing the Supply Chain, 3/e, Simchi-Levi D., Kaminsky P., Simchi-Levi E., Shankar R., TMH, New Delhi

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 502B DESIGN OF THERMAL AND ENERGY SYSTEMS							
M. Tech. Semester –II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT – I

INTRODUCTION: Thermal and Energy systems; basic characteristics of heat exchangers, condensers, evaporators, compressors, steam generators, gas turbines, gasifiers, combustors, IC engines, water heaters, pumps and fans, cooling ponds, re-circulating flow in enclosed spaces, fire induced flow in partial enclosures.

CONCEPT OF ENGINEERING DESIGN: Engineering design types- thermodynamic, thermal and mechanical; Engineering design process – Initial design, Conceptual design, Acceptable design and Optimal design; Material selection and its properties.

UNIT – II

STATISTICAL MODELING: Dimensional analysis; Curve interpolation; Best fit: Method of least squares; The art of curve fitting; Goodness of fit; Physical model; Relations among performance characteristics: Performance characteristics of system-components using curve fit; An overview of statistical modeling.

MATHEMATICAL MODELING: Basic principles of modeling**,** Governing equations, Boundary conditions, Solution procedure of simultaneous algebraic/ differential equations, and linear/ non-linear equations; Numerical modeling, Applications to thermal/energy systems - Heat Exchangers, Condensers, Evaporators, Compressors, Steam generators, Gas turbines, Biomass gasifier, Combustors, IC Engines, Water heater and prime movers.

SIMULATION OF THERMAL AND ENERGY SYSTEMS: Information flow diagrams; Classes of simulation-Numerical simulation, system simulation; Principles and methods of system simulation-Successive substitution, Newton′s method and Hardy-Cross approaches; application to thermal and energy systems, Overview of system simulation.

UNIT – III

ECONOMIC CONSIDERATIONS: Calculation of interest; Time value of money; Raising capital; Taxes; Economic factor in design; Application to of thermal/energy systems, problems.

OPTIMIZATION METHODS: Conventional optimization techniques: Lagrange multiplier methods, Search methods, geometric and dynamic programming; Stochastic methods – Genetic Algorithms, Simulated annealing and Monte-Carlo methods.

UNIT – IV

KNOWLEDGE BASED DESIGN: Introduction to knowledge based system, Expert knowledge, material data base and design methodologies, Knowledge Based design to thermal and energy systems

APPLICATION TO THERMAL/ENERGY SYSTEMS: Optimum speed of a tanker, Solar collector and storage tank, Optimum thickness of insulation, Optimization of water chilling plant, Liquefied natural gas facility; Natural-convection air cooled condenser, Heat pump for pasteurizing milk, Optimization with more than one degree of freedom: Heat Exchanger.

Text Books:

1. Design of Thermal Systems – Stockers WF, McGraw Hill, New York.
2. Design & Optimization of Thermal Systems – Yogesh Jaluria, McGraw Hill, New York.
3. Analysis & Design of Energy Systems – Hodge BK, Prentice Hall, 1990, New Jersey.

4. Optimization Methods for Engineering Design– Fox RL, Addison-Wersley, Reading, MA.

Reference Books:

1. Conceptual Design for Engineers - Michael French, 3rd Ed., Springer
2. Thermal Design and Optimization – Bejan A., Tsatsaronis G., and Moran M., Wiley, New York
3. Elements of Thermal-Fluid System Design – Burmeister LC, Prentice Hall, 1998.
4. Principles of Design – N.P. Suh, Oxford Univ. New York.
5. Applied Numerical Methods – Carahan, B.H. Luther, H.A. and wilkes, J.O. Wiley, New York.
6. Numerical Methods – Hornbeck, R.W., PH, Anglewood, New York.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 506B VIBRATION AND CONDITION MONITORING
M.Tech. Semester –II (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT - I

BASIC CONCEPTS AND ONE DEGREE FREEDOM SYSTEM:

Concept of free and forced vibration using spring mass model, governing equation and response to an initial disturbance for an undamped spring mass system; Concept of linear and non-linear vibratory system.

Natural frequency and its determination using the concept of equivalent system and energy methods - Average energy principle, principle of conservation of energy; principle of virtual work - Hamilton's principle and Lagrange ′s equation.

UNIT - II

DAMPED SINGLE DEGREE FREEDOM SYSTEM- FREE AND FORCED VIBRATIONS:

Damping models with stress on viscous damping; Governing equation and response for over damped, critically damped and under damped systems; Logarithmic decrement and its practical significance; negative damping – self exited vibration.

Governing equation under harmonic excitation and response using technique of calculus and phasor diagram; Active and passive vibration isolation, transmissibility; bending critical speeds of simple staffs;

Support motion; seismometer, accelerometer;

UNIT -III

MULTI DEGREE FREEDOM SYSTEM AND NUMERICAL TECHNIQUES:

Concept of mode shape through 2- DOF system – governing equations and response under general initial conditions; vibration absorber; Eigen value problems – close coupled system and far coupled system; orthogonality of mode shapes.

Dunkerieys lower bound approximation, Rayleigh′s upper bound approximation; Myklestad- Prohl method for far coupled system; finite element method for far coupled system as well as closed coupled system.

UNIT -IV

VIBRATION MEASUREMENT AND CONDITION MONITORING

Basic vibration measuring set up – amplitude and phase measurement; vibration pick- ups – general construction and working principle of piezoelectric accelerometer and eddy current based displacement probe; filters- unfiltered and filtered signals; Display devices- vibration analyzer and oscilloscope; general construction and working principle of electro-dynamic vibration shaker.

Fourier series &Fourier Transforms, Fast Fourier Transform (FFT), concept of time domain and frequency domain.

Condition Monitoring Philosophy – its need and types; concept of 1X, 2X, 3X, ---vibration signals in a rotating machines; Time domain analysis- time waveform, orbit analysis, phase analysis; Frequency domain analysis: frequency spectrum, bode plot, cascade plot; Recent techniques of condition monitoring.

Reference Books:

Theory and Practice of Mechanical Vibrations by Rao J S and Gupta K; New Age Publication.
Theory of Vibration with applications by William T Thomson
Mechanical Vibrations by S S Rao (2008)
Fundamental of Vibration by L Meirowitch (2008)

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 504B ADVANCED HEAT TRANSFER							
M.Tech. Semester –II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4			**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT- I

INTRODUCTION: Reviews of basic laws of Conduction, Convection and Radiation

STEADY STATE HEAT CONDUCTION: Thermal insulation problem, Extended surfaces- Fins with uniform cross-sectional area, Fins variable cross-sectional area- circumferential, triangular and parabolic shape, Fin effectiveness and efficiency, thermal contact resistance.

Methods for the solution of the Multi-Dimensional heat conduction problem: Analytical Method, Graphical Method, Electrical Analogy, Numerical Methods, Numericals.

UNIT- II

EXTERNAL FLOW AND FORCED CONVECTION: Introduction, Exact and approximate integral solutions for the flow over flat plate, hydrodynamic & thermal boundary layer, boundary layer thickness, drag coefficient , mean drag coefficient, The local & average heat transfer coefficient, mass flow through the boundary, Turbulent flow over flat plate, Reynolds analogy, Reynolds-Colburn analogy, Drag & heat transfer in mixed boundary layer, Flow over curved surfaces, Cylinder, Sphere, Cross flow over banks of tubes, Numericals.

UNIT – III

INTERNAL FLOW AND FORCED CONVECTION: Introduction, Entrance region, Fully developed region, Mean velocity, Mean temperature, Governing differential equation and velocity profile for fully developed laminar tube flow, Hagen-Poiseuille equation, Fanning friction coefficient, Heat transfer for fully developed laminar tube flow: Governing differential equation, heat transfer coefficient for constant wall temperature and constant wall heat flux boundary conditions, Velocity distribution in turbulent flow through pipe, Fluid friction, Convection Correlations for turbulent flow in tubes: Reynolds Analogy, Reynolds-Colburn analogy, Dittus- Boelter equation, Sieder and Tate equation, Petukhov expression, Numericals.

TWO PHASE HEAT TRANSFER: Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Nucleate and film boiling, Heat pipe.

UNIT – IV

HEAT EXCHANGERS: Classification and selection of heat exchangers, Some important definitions, Heat Exchanger Analysis: Use of LMTD, Multipass heat exchangers, Effectiveness – NTU Method, Plate heat exchanger, evaporative tubular heat exchanger, Evaporative Effectiveness, Dryout heat flux, Design of Shell and Tube Heat Exchanger, Simulation of heat exchangers, Pressure drop and Pumping power, Optimisation of heat exchanger size, Numericals.

THERMAL RADIATION: Review of basic laws for radiation-, Black body concept, gray body radiation, Solar radiations, Radiation between surfaces- Shape factor and correlations, Radiation exchange between

surfaces in black enclosure, Network representation, Radiation exchange in gray enclosure, apparent emissivity of a cavity, Radiation shields, Radiations in emitting and absorbing media.

Books:

1. Fundamentals of Heat and Mass Transfer– Sarit K. Dass, Narosa Publishing House, New Delhi.
2. Fundamentals of Heat and Mass Transfer – Frank P. Incropera, Published by John Wiley & Sons, New York.
3. Heat & Mass Transfer – P.K. Nag, Published by Tata-McGrawhill, New Delhi.
4. Heat Transfer – J.P. Holman, Tata McGraw Hill, New Delhi.
5. Fundamentals of Engineering Heat and Mass Transfer – R C Sachdev, Published by New Age International (P) Limited, New Delhi.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
3. The use of properties (water, air, steam etc) tables, heat transfer tables, charts is permitted

MEI 508B MANUFACTURING SIMULATION LAB							
M.Tech. Semester –II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**20 Marks**
-		**3**	**1.5**		**Examination**	**:**	**30 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

LIST OF EXPERIMENTS

1. Simulation of a single server system
2. Simulation of 2 machine n-job system for Johnson job sequencing rules
3. Simulation of a multi server system with different dispatching rules
4. Simulation of an FMS
5. Simulation of Manufacturing system for different scheduling rules
6. Simulation of a simple supply chain
7. To generate Random variates using C
8. To apply Linear programming model for an industrial scenario
9. To evaluate material flow in Facilities layouts
10. Simulation of manufacturing systems with different Inventory control policies

Books:

1. Simulation Modeling and Analysis, 3e, Law A.M. and Kelton W.D., TMH, New Delhi
2. Simulation with Arena - Kelton and Sadowski, 2003, (McGraw-Hill)
3. Analysis and Control of Production Systems, Printice Hall Publn, E.A. Elsayed and T.O. Boucher, 1994
4. Modelling and Analysis of Dynamic Systems, Charles M Close and Dean K. Frederick Houghton Mifflin
5. Simulation of manufacturing, Allan Carrie, John Wiley & Sons
6. System Simulation, Geoffrey Gordon, Prentice Hall, 1998
7. Modern production /Operations Management, 8e, Buffa E.S. and Sarin R.K., John Wiley
8. Designing and Managing the Supply Chain, 3/e, Simchi-Levi D., Kaminsky P., Simchi-Levi E., Shankar R., TMH, New Delhi

The students are required to perform experiments on at least one of the simulation packages among ARENA, PROMODEL, GPSS etc and on generic packages like Ms Excel and C, C++ for the above simulation experiments

MET 508B DESIGN OF THERMAL AND ENERGY SYSTEMSLAB							
M.Tech. Semester –II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**20 Marks**
-		**3**	**1.5**		**Examination**	**:**	**30 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

The students will be required to carry out at least 8 simulation projects as given below based on theory course Design of Thermal and Energy Systems (MET 502B)

Projects:

1 To plot the graphs in 2-dimensional on Microsoft Office Excel spreadsheet/MATLAB tool
2 To perform exercises on equation fit and testing the goodness of fit.
3 Exercise on IC Engine Simulation code (FIRE & BOOST software)
4 To simulate the given configuration of a thermal system
5 To simulate a given energy system
6 To simulate the piping system using Hardy-Cross method of simulation
7 To optimize typical thermal system
8 To optimize typical energy system
9 To develop knowledge based system for optimization Shell and Tube Heat Exchanger/Plate Heat Exchanger.

MED 508B VIBRATION AND CONDITION MONITORING LAB							
M.Tech. Semester –II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**20 Marks**
-		**3**	**1.5**		**Examination**	**:**	**30 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

LIST OF EXPERIMENTS:

1. To determine transient and forced response of a vibratory system.
2. To determine structural damping of rotor system.
3. To determine critical speed of an actual rotor system using bode a plot.
4. To study the rotor behaviour during its start up period.
5. To determine the rotor behaviour during its shut-down period.
6. To diagnose the bearing fault using bearing fault kit.
7. To diagnose rotor behaviour after introducing commonly noticed faults.
8. To determine bearing stiffness in x and y directions.
9. To carry out two-plane rotor balancing calculations using vibratory response.

MED 522B COMPOSITE MATERIALS							
M. Tech. Semester – II (Mechanical Engineering - Elective I)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

FIBER – REINFORCED COMPOSITE MATERIALS: Background and brief overview, Strength of Fibers, Laminate and laminates, Types of fibers, Matrices, Fiber surface treatments, fabrication of composite, laminates, Processing, Forming structural shapes, non-autoclave curing, Manufacturing defects.

UNIT - II

LINEAR ELASTIC STRESS-STRAIN CHARACTERISTICS OF FIBER-REINFORCED MATERIALS: Stresses and deformation in fiber-reinforced materials, Maxwell-Betti reciprocal theorem, Relationship among material properties, Typical material properties, Important interpretation of stress-strain relations for plane stress, Stress-strain relations considering the effects of free thermal strains and free moisture strains.

UNIT - III

PLANE STRESS-STRAIN IN A GLOBAL CO-ORDINATE SYSTEM: Transformation relations, Transformed reduced compliance, Transformed reduced stiffness, Engineering properties in a global co-ordinate system, Free thermal and free moisture strains, Plane stress and stress-strain relations including the effects of free strains and free moisture strains in a global co-ordinate system.

UNIT - IV

CLASSICAL LAMINATION THEORIES: Laminate nomenclature, The Krichhoff hypothesis and its Implications, Laminate strains and stress, Laminate stiffness matrix– The ABD matrix, Classification of laminates and their effect on the ABD matrix, Effective engineering properties of a laminate.

FAILURE THEORIES FOR FIBER-REINFORCED MATERIALS: Maximum stress failure criterion, The Tsai-Wu criterion, Failure examples of laminate subjected to axial loading per unit characteristic length, and laminate subjected to moment per unit characteristic length in the light of maximum stress failure criterion and Tsai-Wu criterion.

Text Books:

1. Stress Analysis of Fiber-Reinforced Composite Materials by Michael W. Hyer, Pub.- McGraw- Hill, New York.

Reference Books:

1. Principle of Composite Materials Mechanics – Gibon, R.F., Published by McGraw Hill, New York.
2. Mechanics of Composite Materials, Jones, R.M., Published by McGraw –Hill, New York, 1975.
3. Handbook of Composites – Lubi, G., ed. Published by Van Nostrand Reinhold, New York, 1982.
4. Composite Materials: Mechanical Behaviour and Structural Analysis – Bertholet, J.M., Published by Springer.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 524B ADVANCED MECHANICS OF SOLIDS							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

THREE DIMENSIONAL STRESS & STRAINS: State of stress at a point, Determination of stresses on plane of general position, Principle axes and principle stresses, Various types of state of stress, state of strain, Generalized Hook's law – geometric representation, the three dimensional Mohr's circle, stress-strain relationship.

STRESS CONCENTRATION : Stress concentration in tension and compression members, Stresses in a plate with a circular hole, Stress concentration in torsion and bending, Circular shafts of variable diameter, investigation of stress concentration, Geometric stress raisers and the mitigation of stress concentration.

UNIT - II

TORSION: Pure shear and its characteristics, Torsion of rods of non-circular and hollow cross-sections, Membrane analogy, Thin walled tubes and rectangular sections, Thin walled open sections, Warping of sections.

THEORY OF FATIGUE : General considerations, Basic characteristics of a cyclic loading and the fatigue limit, Effects of stress concentration on fatigue strength, Effect of surface finish and dimensions of a part on fatigue strength, Factor of safety in cyclic loading, Goodman diagrams.

UNIT - III

PLATES AND SHELLS: Determination of stress in symmetrical shells by the membrane theory, bending of symmetrically loaded circular and rectangular plates, Bending of cylindrical shells under symmetrical loading.

THIN WALLED BARS: Typical features of thin walled bars, shear stresses in thin walled bars under transverse bending, Shear center, General loading case of thin walled bars.

UNIT - IV

PLASTIC THOERY OF BENDING: Assumptions in plastic theory, Collapse load and load factor, Plastic moment of resistance, Plastic modulus and shape factor, Derivation of formulae and their application for simply supported beams, Cantilevers and fixed beams.

BEAMS ON ELASTIC FOUNDATIONS: The infinite beam, Bending moments and deflections with concentrated forces and couples, Non- uniformly distributed loads, Semi-infinite beams, Finite beams, Applications to rail-road tracks.

Reference Books:

1. Advanced Strength of Materials, Vol. II by S. Timoshenko, Published by Van Nostrand and Co. U.K.
2. Advanced Mechanics of solids by L.S. Srinath, Published by T.M.H., New Delhi.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEP 504B ANALYSIS OF MANUFACTURING PROCESSES							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

CUTTING TOOL MATERIAL: Characteristics of tool material, advances in cutting tool material, role of coating.

MACHINABILITY AND ECONOMICS OF MACHINING: Need for rational approach to the problem of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers,Machinability, evaluation of Machinability, mechanism of tool failure, tool wear mechanism, tool life and tool life equation, factors affecting Machinability surface finish and surface integrity.

Economics of machining, cost of turning operation, optimum cutting speed for minimum cost and maximum rate of production.

UNIT - II

BULK DEFORMATION PROCESS : Stress-Strain relations in Elastic and plastic deformations, Yield criteria for ductile metals, work hardening and anisotropy in yielding Flow curves. Slip Line Field Theory,Effects of temperature and strain rate in metal working, friction and Lubrication in Hot and Cold working.

Technology and analysis of important metal forming processes - Forging, Rolling, Extrusion, Wire drawing, Sheet metal forming processes

UNIT - III

CASTING: Introduction, Features of Casting problems, Survey and Scope of Foundry Industry, Solidification of pure metals, Nucleation and growth in alloys, Solidification of actual casting, Progressive and directional solidification, Centreline feeding resistance, Rate of solidification, Chvorinov's rule.

GATING AND RISERING SYSTEMS: Gating systems and their characteristics, Effects of gates on aspiration, Turbulence and dross trap, recent trends, Riser design, Risering curves, NRL method of riser design, Feeding distance, Risering of complex casting, Risering of alloys other than steel, Riser design by geometrical programming.

UNIT - IV

WELDING METALLURGY: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, cast iron and aluminium and alloys, Weld testing standards, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament,

TEXT BOOKS

1. Metal Cutting Principles M.C. Shaw Oxford Clarendon Press
2. Metal Cutting Theory and Practice Bhattacharya New Central Book Agency

3. Fundamentals of Metal Cutting andMachine Tools B.L. Juneja and G.S. Sekhon New Age International
4. Metal Forming Analysis Avitzur McGraw Hill
5. Mathematical Simulation and Computer analysis of Thin
6. Strip Rolling Mill Polukhin MIR Publications
7. Principles of Manufacturing Materials & Processes– Campbell J. S., Publisher – Mc Graw Hill.
8. Principle of Metal casting - Rosenthal, Tata McGraw Hill, New Delhi
9. Meta Casting: Principles and Practice TV Rammana Rao New Age International
10. Welding and Welding Technology, Richard L. Little Tata McGraw Hill Ltd.
11. Manufacturing Processes and Systems: Ostwald Phillip F., Munoz Jairo, John Wiley & Sons
12. Plasticity for Mechanical Engineers Johnson & Mellore Van Nostrand

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEI 504B QUALITY ENGINEERING							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

Basic of Quality, Quality objective, Quality Attributes, Evolution of Quality Management Philosophy, Quality Costs.

UNIT-II:

Quality Assurance, Quality Control, Tools for Quality, Quality Gurus and their philosophies – Deming, Juran, Crosby, Ishikawa.

UNIT-III

Technical Tools for quality, seven charts for QC, QFD, SQC charts-X, R, P and C Charts, Acceptance sampling coefficient of process capability, Taguchi Method, Brief of Six Sigma Approach.

UNIT-IV:

Strategic Quality Planning, Service Quality, Quality implementation system, Benchmarking, ISO-9000, Quality Audit, Organizational issues in TQM Environment Kaizen.

BOOKS.

1. Essence of TQM -Bank (PHI)
2. Total Quality, Management - Oakland (Hainmann)
3. Fundamental of Quality Control & Improvement -Mitra (PHI, New Delhi)
4. Quality Problem Solving - Smith (PHI, New Delhi)
5. Total Quality Management - Suganthi & Samuel (PHI, New Delhi)
6. Statistical Quality Control- E.L.Trant and Leavensworth (Mcgraw Hill, 1984)
7. Taghuchi Techniques for Quality Engineering – Philips J. Ross (Mcgraw Hill, New york,1998)

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEI 506B STATISTICS FOR DECISION MAKING							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

Data collection and Analysis: Collection of data, Presentation of data, Measures of central tendency, Measures of variation and skewness

Probability and Probability Distributions: Basic concepts of Probability, Discrete Probability Distributions, Continuous Probability Distributions , Decision Theory

UNIT - II

Sampling Fundamentals , Testing of Hypothesis(Parametric and Nonparametric tests)

Chi square Test

UNIT - III

Forecasting Methods : Business forecasting, Correlation, Regression ,Time series Analysis

UNIT - IV

Analysis of Variance and Co variance, Multivariate Analysis Techniques

Text books

1. Research Methodology - C.R. Kothari - Wiley Eastern Limited
2. Statistics for Management - Richard L Levin and David S. Rubin– PHI
3. Quantitative Methods for Management – Levin et al (McGraw Hill)
4. Quantitative Analysis for Management – Render, PHI
5. Quantitative Techniques for decision Making – Gupta & Khanna (PHI)

Reference books:

1. Business Statistics - G V Shenoy, U K Srivastava, S C Sharma – Wiley Eastern Limited
2. Management Research Methodology - K N Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan – Pearson Eductaion

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 506B ADVANCED THERMODYNAMICS							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT - I

RECAPITULATION OF FUNDAMENTALS: Introduction to Microscopic thermodynamics; thermodynamic limitations and properties, Basic definitions and concepts.

Laws Of Thermodynamics: Steady and Transient flow analysis, Entropy balance, Entropy generation and Applications in thermal engineering.

UNIT - II

SINGLE PHASE SYSTEMS: Simple system, Equilibrium conditions, Fundamental relation, Relation between thermodynamic properties, Ideal gas mixture and Real gas mixtures.

EXERGY ANALYSIS: Closed Systems, Open systems, Generalized exergy analysis - Power cycles and Air-Conditioning applications.

UNIT - III

MULTI-COMPONENT SYSTEMS: Energy minimization principle, Instability, Clapeyron relation, Phase diagrams – Gibbs phase rules, Single-component substances, Two component mixtures and Corresponding states.

GENERAL CONDITIONS FOR THERMODYNAMIC EQUILIBRIUM: Criteria for equilibrium, Stability conditions.

UNIT - IV

THERMODYNAMICS OF REACTIVE MIXTURES: Chemical reactions and combustion, Thermochemistry, First and second law analysis of chemically reacting systems, reaction direction and chemical equilibrium.

AVAILABILITY ANALYSIS OF REACTING SYSTEMS: Introduction, Entropy generation through chemical reactions, Availability, Adiabatic combustion, Maximum work using Heat exchanger and Adiabatic combustor.

Text Books:

1. Advanced Thermodynamics Engineering – Kalyan Annamalai and Ishwar K Puri, CRC Press.
2. Advanced Engineering Thermodynamics – Bejan Adrian, John Wiley & Sons, New Jersey.
3. Advanced Engineering Thermodynamics– Wark K, Mc Graw Hill.

Reference Books :

1. Engineering Thermodynamics - A generalized approach – Dhar PL, Elsevier, New Delhi.
2. Engineering Thermodynamics –Moran MJ and Shapiro HN, John Wiley & Sons, Singapore.
3. Thermodynamics: An Engineering Approach –Çengel YA, Boles MA, TMG Hill, New Delhi.

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 601B REFRIGERATION & AIR CONDITIONING SYSTEM DESIGN

M. Tech. Semester – II (Mechanical Engineering)

L	P	Credits			
			Class Work	**:**	**25 Marks**
4	**--**	**4**	**Examination**	**:**	**75 Marks**
			Total	**:**	**100 Marks**
			Duration of Examination	**:**	**3 Hours**

UNIT – I

REFRIGERATION AND AIR CONDITIONING LOAD CALCULATIONS: Solar heat gains through structures, ASHRE simplified calculation procedure.
REFRIGERATION: Environmental impact of HVAC system and Refrigerants. Properties and relation of pure mixed refrigerants, Analysis of VCR cycle-multistage, multi-evaporator and cascade systems.

UNIT – II

THERMAL DESIGN: Compressors, different evaporators –DX type etc, Condenser – water and air cooled, Capillary, Absorber and Generator of vapour absorption system, Analysis of vapour absorption cycles – Aqua ammonia and LiBr-water cycles.

UNIT– III

AIR CONDITIONING: Psychometric process, air conditioning calculation, comfort scale, design conditions, solar heat gains. Cooling and heating load calculations. Design of air conditioning equipments-cooling and dehumidifying coils. Air distribution systems - duct design, air handling units, Energy recovery and thermal storage, Indore air quality, various dehumidification technologies, commercial software used for air conditioning load calculations.

UNIT – IV

REFRIGERATORS AND CONDITIONING TECHNOLOGIES: Vertex tube, thermoelectric, acoustics, desiccant cooling, solid and liquid systems, steam jet refrigeration.

Text books:

1. Refrigeration and Air-conditioning –CP Arora, Tata-Mc Graw Hill.
2. Refrigeration and Air-conditioning – W.F. Stockers, Tata-Mc Graw Hill.
3. Design of Thermal Systems – W.F. Stockers, MH, New York.

Reference books:

1. ASHRE Handbook, American Society of heating, refrigerating and Air-Conditioning Engineers (ASHRE) .

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 502B SYSTEM DYNAMICS & CONTROL							
M. Tech. Semester – II (Mechanical Engineering)							
L		P	Credits		Class Work	:	25 Marks
4		--	4		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

UNIT - I

System Model, State-Determined system, Dynamic Models, Linear and nonlinear system, Engineering Multi ports, Ports, Bonds, Power, Bond Graph, Basic 1-Port, 2-Port elements, 3-Port Junction elements, Causality and Block Diagram, Pseudo-Bond Graph, Modeling of Mechanical, Electrical and Thermal system.

UNIT - II

STATE SPACE EQUATIONS AND AUTOMATED SIMULATION: Standard form of system equations, Augmenting the bond graph, Basic formulation and reduction, deriving system equations from the bond graph model.

UNIT - III

LINEAR SYSTEM ANALYSIS: Solution Techniques for Ordinary differential equations, Free response and Eigenvalue of first order, second order, undamped and damped oscillator, Forced and Frequency response function, Transfer function, Block diagram.

UNIT - IV

MULTI PORTS AND JUNCTION STRUCTURE: Energy storing field, C-field, I-field, Mixed energy storing field, Resistive field, Modulated two ports elements, Junction structure, Multiport transformer

Books:

1. SYSTEM DYNAMICS: Modeling and Simulation of Mechatronics Systems by Dean C. Karnoop, Donald L. Margolis, Ronald C. Rosenberg. John Wiley & Sons, INC
2. Bond Graph in Modeling, Simulation and Fault Identification by Amalendu Mukherjee, Ranjit Karmakar, Arun Kumar Samantaray. I.K.International Publishing House Pvt. Ltd.

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 526B ROBOTICS ENGINEERING							
M. Tech. Semester – II (Mechanical Engineering)							
L		P	Credits		Class Work	:	25 Marks
4		--	4		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

UNIT – I

FUNDAMENTALS : Introduction, What is a Robot, Classification of Robots, What is Robotics, History of Robotics, Advantages and disadvantages of Robots, Robot components, Robot degree of freedom, Robot joints, Robot coordinates, Robot reference frames, Programming modes, Robot characteristics, Robot workspaces, Robot languages, Robot applications, Other robots and applications, Social issues.

UNIT – II

ROBOT KINEMATICS: Introduction, Robots as mechanism, Matrix representation, Homogeneous transformation matrices, Representation of transformation, Inverse of transformation matrices, Forward and inverse kinematics of robots, Denavit – Hartenberg representation of forward kinematic, equation of robots, The inverse kinematic solution of robots, Inverse kinematic programming of robots, Degeneracy and dexterity.

DIFFERENTIAL MOTIONS AND VELOCITIES : Introduction, Differential relationship, Jacobian, Differential motions of a frame, Interpretation of the differential change, Differential changes between frames, Differential motions of a robot and its hand frame, Calculation of the Jacobian, Relating Jacobian and the differential operator, Inverse Jacobean.

UNIT – III

DYNAMIC ANALYSIS AND FORCES: Introduction, Lagrangian mechanics, Effective moments of inertial, Dynamic equations for multiple-degree of freedom robots, Static force analysis of robots, Transformation of forces and moments between co-ordinate frames.

TRAJECTORY PLANNING: Introduction, Path vs. trajectory, Joint-space vs. Cartesian-space description, Basics of trajectory planning, Joint trajectory planning, Cartesian space trajectories, Continuous trajectory recording.

UNIT – IV

ACTUATORS: Introduction, Characteristics of actuating systems, Comparison of actuating systems, Hydraulic devices, Pneumatic devices, Electric motors, Microprocessor control of electric motor, Magenetostrictive actuators, Shape-memory type metals, Speed reduction.

SENSORS: Introduction, Sensor characteristics, Position sensors, Velocity sensors, Acceleration sensors, Force and pressure sensors, Torque sensors, Micro-switches, Light and infrared sensors, Touch and tactile sensors, proximity sensors, Range-finders, Sniff sensors, Vision systems, Voice recognition devices, Voice synthesizers, REmotee centre compliance device.

Reference Books:

1. Introduction to Robotics – John J. Craig, Pub. Addison Wesley.
2. Industrial Robotics – Gordon M. Mair, Pub. PHI.
3. Industrial Robotics – Groover, Pub. MGH.

4. Robotics for Eneers – Yoram Koren, Pub – MGH.
5. Mechanical Design of Robots – Eugene I. Rivin, Pub – MGH.
6. A Robot Engineering Textbook – Mohsen Sahinpoor, Pub – Haper & Row, New York.
7. Introduction to Robotics (Analysis, Systems, Applications) – Saeed B. Niku, Pub – Pearson Education Asia.

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 528B RELIABILITY BASED DESIGN							
M. Tech. Semester – II (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**--**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT – I

RELIABILITY CONCEPTS AND STATISTICAL MODELS: Failure data analysis, Reliability function, Hazard rate, Failure rate, Relation among reliability, Hazard rate and– Failure rate, Mean time to failure, Mean time between failures, Normal, Long-normal, Weibull, Gamma, Exponential, uniform, Rayleigh, Chauchy, Beta and Poisson distribution.
DESIGN OF MECHANICAL COMPONENETS AND SYSTEMS: Deterministic design procedure, Probabilistic design procedure, Reliability based design of gear tains, Reliability analysis of cam-follower and four-bar mechanism.

UNIT – II

MODELING OF GEOMETRY, MATERIAL, STRENGTH AND LOADS: Modeling of geometry, Tolerance on finished metal products, Assembly of components, Modeling of material, strength, Statistics of elastic properties, Statistical model of material strength, Model for brittle, Plastic materials and fiber bundles, Constant and variable amplitudes, Fatigue strength, Modeling of dead, lie, wind and earthquake loads.

UNIT – III

STRENGTH BASED RELIABILITY AND INTERFERENCE THEORY: General and alternate expressions for reliability and probability of failure, Reliability when strength follows normal exponential, extreme value and type-iii extreme distributions, Reliability in terms of experimentally determine distributions of strength and load, Factor of safety corresponding to given reliability.

RELIABLITY BASED OPTIMUM DESIGN : Optimization problem, Reliability allocation problems, Structure and mechanical design problems, Optimum design by graphical optimization, Lagrange multiplier, Penalty function and dynamic programming methods.

UNIT – IV

MAINTABILITY AND AVAILABILITY : Concepts, Preventive and imperfect maintenance, Repair time distributions, Un repaired failures, Optimal replacement strategy, Spare parts requirements, Development of availability models, System with a single component.

FAILURE MODES, EVENT-TREE AND FAULT-TREE ANALYSIS: System safety analysis, Failure modes and effects analysis, Event-tree and fault-tree analysis, Minimum cut-sets.

Reference Books:

1. Reliability Based Design by S.S. Rao, Published by McGraw Ill.
2. Mechanical Reliability by L.S. Srinath, Published by EWP.

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed

MET 520B			COMPUTATIONAL FLUID DYNAMICS				
M. Tech. Semester – II (Mechanical Engineering)							
L		P	Credits		Class Work	:	25 Marks
4		--	4		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

UNIT – I

INTRODUCTION TO CFD: Basic thoughts and philosophy, CFD as research tool, CFD as design tool, automobile and engine applications.

Conservation equations; Mass, momentum and energy equations; Conservative forms of the equations and general description, physical boundary conditions.

UNIT - II

NUMERICAL METHODS: Classification into various types of equations – parabolic, elliptic, hyperbolic and mixed type; Boundary and initial conditions; Overview of numerical methods.

DISCRETIZATION: Finite Difference Method - explicit, implicit, stability requirement, polynomial fitting, approximation of boundary conditions, applications to heat conduction and convection; Finite Element Method: Variational principle and weighted residual, Rayleigh-Ritz, Galerkin and Least square methods, 1-D and 2-D elements, applications to fluid flow and heat transfer problems; Finite Volume Method – finite volume discretization, approximation of surface and volume integrals, interpolation methods - central, upwind and hybrid formulations and comparison.

UNIT - III

METHODS OF SOLUTION: Solution of finite difference equations, iterative methods, matrix inversion methods, ADI technique, SIMPLE algorithm, operator splitting, fast Fourier transform, applications.

NUMERICAL GRID GENERATION: Grid generation techniques, transformation and mapping, structured and unstructured grid generation, Application of grid generation techniques.

UNIT - IV

INTRODUCTION AND APPLICATION OF ANSYS FLUENT: Geometric modeling-ANSYS Workbench/CFX, mesh generation, boundary and initial conditions, computational approach, analysis.

CASE STUDY: Design of gas carburetor using ANSYS software– use ANSYS Workbench for geometrical modeling and turbulence models (i.e., RNG k-ε model, Standard k-ε model) for comparative analysis.

Text Books:

1. Computational Fluid Dynamics – Anderson JD Jr, McGraw Hill.
2. Computational Fluid Flow and Heat Transfer – Muralidhar K and Sundararajan T., Narosa Publishing House, New Delhi
3. Computational Fluid Mechanics and Heat Transfer – Anderson DA, Tannehill JC and Pletcher RH, Taylor & Francis.

Reference Books :

1. Computational Methods for Fluid Dynamics Ferziger, J. H. and Peric, M.,, 3rd Ed., Springer.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method– Versteeg H and Malalasekra M, 2nd Ed., Prentice Hall.
3. The Finite Element Method in Heat Transfer and Fluid Dynamics – Reddy J N and Gartling DK, 3rd Ed., CRC Press

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 524B ALTERNATIVE FUELS							
M. Tech. Semester – II (Mechanical Engineering)							
L		P	Credits		Class Work	:	25 Marks
4		--	4		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

UNIT – I

BACKGROUND: Fossil fuels Vs alternative fuels, advantages and limitations, potential and problem associated with their utilization.

CHARACTERISTICS OF ALTERNATIVE FUELS: Liquid fuels (vegetable oils, biodiesel, Di-methyle ether, pyro oils, emulsified fuels), gaseous alternative fuels (hydrogen, compressed natural gas, liquefied petroleum gas, producer gas and biogas) and Solid fuels (Biomass, Coal, MSW and RDF…).

UNIT - II

LIQUID AND GASEOUS FUELS FOR SI ENGINE MODE: Mechanical conversion systems, Electronic conversion systems, evaluation Engine modifications, carburetor or induction system, vehicle modifications; engine performance – thermal (fuel economy) and emissions in single fuel mode, safety aspects, hybrid mode, Use of additives to improve the performance with alternative fuels.

UNIT - III

LIQUID AND GASEOUS FUELS FOR CI ENGINE MODE: Dedicated fuel operation: conversion to SI engine, dual fuel operation Fumigation; Engine performance – thermal and emissions in dual fuel mode, safety aspects.

Conversion of vegetable oils to biodiesel and effect on engine performance

UNIT - IV

SOLID BIOMASS AND FORESTRY BIOFUELS: Feedstock preparation, gasification technologies - thermochemical conversion route for generation of producer gas/ syngas, Biofuel availability, feedstock preparation, biochemical conversion route for biogas, Principle, potential and status of bioconversion technologies ; Processing of gaseous for engine use.

UTILIZATION IN GAS IC ENGINES: Engine modifications, specially designed induction system, gasifier-engine system operation, performance and emissions, safety aspects.

Text Books:

1. Alternative Fuels: Emissions, Economics, and Performance– Timothy T. Maxwell and Jesse C. Jones, SAE International.

Reference Books:

2. Renewable energy : Sources for fuels and electricity– Thomas B. Johansson, Henery Kelly, Amulya K.N. Reddy, Robert H. Williams and Laurie Burnham; Earthscan Publications Ltd. London.

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEI 520B RELIABILITY AND MAINTENANCE ENGINEERING

M. Tech. Semester – II (Mechanical Engineering)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT – I

RELIABILITY: Definition, failure data analysis, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate, Bathtub curve. Use of Weibull probability chart for assessing characteristics life, guarantee period etc.

UNIT –II

SYSTEM RELIABILITY: Series, parallel and mixed configuration; Simple problems. Reliability improvement: Techniques, use of Pareto analysis-Design for reliability, redundancy unit and stand by redundancy, Optimization of reliability, Failure modes, Event Tree and Fault Tree analysis.

UNIT –III

Introduction: Maintenance Objectives and Functions; Maintenance Organization and Administration of Maintenance Systems. Need of planned maintenance. Maintenance policies; Breakdown, time based maintenance: Block replacement, age replacement and periodic replacement policy. Corrective and Preventive maintenance. Maintenance planning, Scheduled maintenance. Cost of maintenance versus Cost of equipment and production delays. Inspection: Inspection intervals, Inspection reports, card history system.

UNIT – IV

Predictive maintenance, Equipment wears records, standards. Equipment used in predictive maintenance. Computerized maintenance,, Total Productive Maintenance. Methods of condition monitoring, Non-destructive testing: Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis. Oil analysis, Radiographic testing.

Text Books:

1. Reliability Engineering by A.W. Von, PHI, ND.
2. Mechanical Reliability by L.S. Srinath, Published by EWP.
3. Maintenance Planning and Control by Enthory Kelly, EWP-NWP, ND.

References:

1. Smith, D.J. "Reliability Maintainability and Risk; Practical methods for engineers",Butterworth-Heinemann, New Delhi, 2001
2. Dhillon,B.S. "Maintainability, Maintenance and Reliability for Engineers", CRC Press 2006
3. Pha, H. " Handbook of Reliability engineering", Springer Publication, 2003.
4. Dhillon,B.S "Engineering maintenance; a modern approach", CRC Press, 2002
5. Mobley, R.K. "Maintenance Fundamentals", 2nd Edition, Butterworth-Heinemann, 2004
6. Brauer, R.L. "Safety and Health for Engineers", John Wiley Sons, 2006
7. Reliability Maintenance and Risk, Elsevier Science and Technology Books, 1997

Note

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed

MEP 502B NON TRADITIONAL MACHINING & ADVANCED MANUFACTURING

M. Tech. Semester – II (Mechanical Engineering)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT – I

INTRODUCTION TO NON TRADITIONAL MACHINING PROCESSES: Introduction, classification, characteristics, applications, limitations & need of non -traditional machining processes; general process parameters and machining; tooling for material removal process for non-traditional machining processes, automates, NC and CNC machines; graphical numerical control, design of pre & post processor; NC programming: APT programming, manual part programming, computer aided part programming, programming of CNC -turning & machining centre; interfacing with computers, machine tool controllers-programmable logic controllers (PLC), Supervisory Control and Data Acquisition (SCADA)

UNIT – II

NON TRADITIONAL MACHINING PROCESSES: Mechanical processes- Abrasive jet machining (AJM), ultrasonic machining (USM), water jet machining (WJM), abrasive water jet machining (AWJM); Electrochemical processes- Electrochemical Machining (ECM), Electro Chemical Grinding (ECG), Electro Jet Drilling (EJD); Electro-Thermal Processes, Electro-discharge machining (EDM), wire cut EDM, CNC EDM, Laser Jet Machining (LJM), Electron Beam Machining (EBM); Chemical Processes- Chemical Milling (CHM), Photochemical Milling (PCM), etc. & need of CNC control of non traditional machines and machining processes.

UNIT – III

TOOLING TECHNOLOGY IN NON TRADITIONAL MACHINING PROCESSES: Introduction to tooling technology for non conventional machines; role of tool room of non conventional machines and its manufacturing functions in industry; mould, tool and die making methodologies and process selection on non conventional machines; application, cost and basic concepts of jigs and fixtures used in non-traditional machining; gauges for inspection of non traditional machining, coordinate measuring machine (CMM), laser interferometer, optical profile projectors, 3D scanner etc.

UNIT – IV

ADVANCED MACHINING AND REVERSE ENGINEERING: development trends in advanced machining processes, applications and limitations of advanced machine tools, factors affecting the precision of non traditional machining processes and cost considerations, reverse engineering and its application in non traditional machining, introduction to 3D scanning facilities and surface reconstruction, types of 3D scanning and relevant considerations.

TEXT BOOKS

1. Metal Cutting Principles by M.C. Shaw; Oxford Clarendon Press
2. Fundamentals of Metal Cutting and Machine Tools by B.L. Juneja and G.S. Sekhon; New Age International
3. Principles of Manufacturing Materials & Processes by Campbell J. S.; Publisher – Mc Graw Hill.
4. Manufacturing Processes and Systems by Ostwald Phillip F., Munoz Jairo; John Wiley & Sons

5. Manufacturing technology by P.N.Rao; TMH Ltd. Fundamentals of Machining Processes: Conventional and Nonconventional Processes by Hassan El-Hofy, ISBN: 0849372887, Publisher: CRC, 2006.
6. A review of: Non traditional machining process by E.J. Weller SME, Dearborn, Michigan, DOI: 10.1080/10426919008953239.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEP 601B COMPUTER INTEGRATED MANUFACTURING SYSTEM							
M.Tech. Semester –III (Mechanical Engineering)							
L		P	Credits		Class Work	:	25 Marks
4		-	4		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

UNIT I

INTRODUCTION: Historical Developments in Manufacturing and Automation, Introduction to CAD, CAM & CIM, Components of CIM and CIM wheel.

MANUFACTURING SYSTEM: Introduction of Manufacturing System and Its Objectives, Identifying Business Opportunities and Problems, Classification of Production Systems, Linking Manufacturing Strategies and System Analysis of Manufacturing Operations.

UNIT II

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING: Introduction, Part Families, Parts Classification and Coding; Group Technology Machine Cells and Benefits of G.T. Process Planning Function, CAPP, Computer Generated Time Standards

COMPUTER AIDED PLANNING AND CONTROL: Production Planning and Control, Cost Planning and Control, Inventory Management, Material Requirement Planning (MRP).

UNIT III

SHOP FLOOR CONTROL SYSTEM: Shop Floor Control, Factory Data Collection System, Supervisory Computer Control.

INTEGRATED MANUFACTURING SYSTEM: Definition, Application, Features, Types of Manufacturing Systems, Machine Tools, Materials Handling System, DNC System, Manufacturing Resource Planning, Manufacturing Cell, Flexible Manufacturing Systems and Concept, Transfer System, CAD/CAM system.

UNIT IV

PRODUCTION MONITORING SYSTEM: Types of Production Monitoring system, Direct Digital Control, Computers in Quality Controls, integration of CAQC with CAD/CAM

INTELLIGENCE SYSTEMS IN CIM: Intelligent Systems Rapid Prototyping, Artificial Intelligence and Expert Systems in CIM

TEXT BOOKS:

1. CAD/CAM, – Mikell P. Grover M. P. and Emory W.Zimmers, JR, PHI Pvt. Ltd., New Delhi.

2. CAD/CAM, Principle and Applications – P.N Rao, TMH, New Delhi.

REFERENCES BOOKS:

1. Computer Integrated Manufacturing - James A Rehg and Henry W Kraebble – Pearson Education Asia.Principles of Computer Integrated Manufacturing - S. Kant Vajpayee PHI, New Delhi.
2. Computer Integrated Manufacturing - James A Rehg and Henry W Kraebble – Pearson Education Asia..
3. Computer Integrated Manufacturing - 'From concepts to realization'. Roger Hanman, Addision Wesley.
4. System Approach to Computer Integrated Manufacturing- Singh, Nanua, John Wiley and Sons.
5. Automation, Production System and CIM – Grover M. P., PHI, New Delhi.
6. Computer Integrated Design and Manufacturing - David Bedworth, TMH, New Delhi.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 601B MECHATRONICS

M.Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT I

MECHATRONICS: Appreciate what Mechatronics is about. Comprehend the various forms and elements of control systems. Integrated design issues in Mechatronics. Mechatronics key elements. The Mechatronics design process. Advanced Approaches in Mechatronics.

SENSORS & TRANSDUCERS, SIGNAL CONDITIONING AND DATA PRESENTATION SYSTEM: Describe the performance of commonly used sensors. Evaluate sensors used in the measurements of: displacement, position and proximity; velocity & motion; force; fluid pressure; liquid flow; liquid level; temperature; light. Selection of sensors, inputting data by switches. Explain the requirements for signal conditioning. Explain how operational amplifiers can be used, the requirements for protection and filtering, the principle of the Wheatstone bridge and, in particular, how it is used with strain gauges, the principles and main methods of analogue-to-digital and digital-to-analogue converters, multiplexers and data acquisition using DAQ boards. Explain the principle of digital signal processing. Explain the principle of pulse-modulation. Explain the problem of loading. Describe the basic principles of use of commonly used data presentation elements: meters, analogue chart recorders, oscilloscopes, visual display units, printers. Explain the principles of magnetic recording on floppy and hard disk. Explain the principles of displays and in particular, the use of LED seven-segment and dot matrix displays and the use of driver circuits. Explain how data presentation can occur with the use of DAQ boards. Design measurement systems.

UNIT-II

PNEUMATIC & HYDRAULIC, MECHANICAL AND ELECTRICAL ACTUATION SYSTEMS: Interpret system drawings, and design simple systems, for sequential control systems involving valves and cylinders. Explain the principle of process control valves, their characteristics and sizing. Evaluate mechanical systems involving linkages, cams, gears, ratchet and pawl, belt and chain drives, and bearing. Evaluate the operational characteristics of electrical actuation systems: relays, solid-state switches (thyristors, bipolar transistors and MOSFETs, solenoid actuated systems, DC motors, AC motors and steppers motors).

ENGINEERING SYSTEM MODELS, DYNAMIC RESPONSE OF SYSTEMS: Devise models from basic building blocks for mechanical, electrical fluid and thermal systems. Devise models for rotational-translational, electro-mechanical and hydraulic-mechanical systems. Model dynamic systems by means of differential equations. Determine the response of first and second-order system to simple inputs.

UNIT-III

SYSTEM TRANSFER FUNCTIONS, FREQUENCY RESPONSE: Define the transfer function and determine the responses of systems to simple inputs by its means, using Laplace transforms. Identify the effect of pole location on transient response. Explain the use of MATLAB and SIMULINK to model systems. Analyse the frequency response of systems subject to sinusoidal inputs. Plot and interpret Bode plots.

CLOSED-LOOP CONTROLLERS: Predict the behaviour of systems with proportional, integral, derivative, proportional plus integral, proportional plus derivative and PID control. Explain how such

modes of control can be realised with operational amplifiers and digital controllers and controller settings determined. Explain what is meant by velocity feedback and adaptive control.

UNIT-IV

DIGITAL LOGIC, MICROPROCESSORS: Use the binary, octal, hexadecimal and binary coded decimal number systems; explain how numbers can be signed and the twos complement methods of handling negative numbers. Explain the advantages of the Gray code. Describe parity methods of error detection. Recognize the symbols and Boolean representation of, write truth tables for and use in applications, the logic gates of AND, OR, NOT, NAND, NOR AND XOR. Use Boolean algebra to simplify Boolean expressions and present them in the form of sums of products or product of sums. Use Karnaugh maps to determine the Boolean expressions to represent truth tables. Explain how SR, JK and D flip-flops can be used in control systems. Describe the basic structure of a microcomputer, a microprocessor and a microcontroller. Explain how program can be developed using flow charts or pseudo-code.

INPUT/OUTPUT SYSTEMS, PROGRAMMABLE LOGIC CONTROLLERS, COMMUNICATION SYSTEMS, FAULT FINDING, DESIGN AND MECHATRONICS: Identify interface requirements and how they can be realised; in particular buffers, handshaking, polling and serial interfacing. Explain the function of peripheral interface adapters and program them for particular situations. Explain the function of asynchronous communications interface adapters. Describe the basic structure of PLCs. Program a PLC, recognising how the logic functions, latching and sequencing can be realised. Develop programs involving timers, internal relays, counters, shift registers, master relays, jumps and data handling. Describe centralised, hierarchical and distributed control systems, network configurations and methods of transmitting data, describing protocols used in the transmission of data. Describe the open systems Interconnection communication model. Describe commonly used communication interfaces: RS-232, Centronics, IEEE-488, personal computer buses, VXI bus, and I2C bus. Recognize the techniques used to identify faults in microprocessor-based systems, including both hardware and software. Explain the use of emulation and simulation. Compare and contrast possible solutions to design problems when considered from the traditional and the mechatronic point of view. Analyse case studies of Mechatronics solutions. Design Mechatronics solutions to problems.

Reference Books:

1. Mechatronics by W. Bolton, published by Pearson Education Asia
2. Mechatronics by David G. Alciatore and Michael B. Histand, Published by Tata McGraw-Hill Publishing company Limited
3. Mechatronics System Design by Devdas Shetty and Richard A. Kolk, Published by Vikas Publishing House
4. Introduction to Mechatronics by Appuu Kuttan K. K. Published by Oxford University Press.
5. Mechatronics: Integrated Technologies for Intelligent Machines by A. Smaili, F. Mrad published by Oxford University Press.

Note:

1. In the semester examination, the examiner will set two questions from each part (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 5 questions selecting at least one question from each part.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 603B MECHATRONICS & C.I.M.S. LAB
M.Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
-	3	1.5	**Class Work**	**:**	**20 Marks**
			Examination	**:**	**30 Marks**
			Total	**:**	**50 Marks**
			Duration of Examination	**:**	**3 Hours**

The students will be required to carry out 8 to 10 experiments covering the theory courses **MEM 601B** Mechatronics & **MEP 601B** Computer Integrated Manufacturing Systems.

MEM 605B DISSERTATION PHASE – I							
M.Tech. Semester –III (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**100 Marks**
-		**6**	**6**				

The primary objective of this course is to develop in student the capacity for analysis & judgment and the ability to carry out independent investigation in design / development through a dissertation work involving creativity, innovation and ingenuity. The work must start with comprehensive literature search and critical appreciation thereof so as to select research problem the student wishes to work on.

Each student will carry out independent dissertation under the supervision of some teacher(s) who will be called Supervisor(s). In no case more than two supervisors can be associated with one dissertation work.

The dissertation involving design/ fabrication/ testing/ computer simulation/ case studies etc. which commences in the III Semester will be completed in IV Semester. The evaluation of the dissertation phase –I besides approval of the dissertation topic of the students will be done by a committee constituted as under:

Chairperson of Department	: Chairperson
M Tech Coordinator / Sr Faculty	: Member Secretary
Respective dissertation supervisor	: Member

The student will be required to submit two copies of his/ her report to the department for record (one copy each for the department and participating teacher).

MEM 607B SEMINAR							
M.Tech. Semester –III (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**50 Marks**
-		**2**	**2**				

The objectives of the course remain:

- To learn how to carryout literature search
- To learn the art of technical report writing
- To learn the art of verbal communication with the help of modern presentation techniques

A student will select a topic in emerging areas of Engineering & Technology and will carry out the task under the supervision of a teacher assigned by the department.

He/ She will give a seminar talk on the same before a committee constituted by the chairperson the department. The committee should comprise of 2 or 3 faculty members from different specializations. The teacher(s) associated in the committee will each be assigned 2 hours teaching load per week.

However, supervision of seminar topic will be in addition to the regular teaching load.

MED 601B MECHANISM AND MANIPULATOR DESIGN
M. Tech. Semester –III (Mechanical Engineering)

L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT-I

MECHANISM DESIGN: Kinematics and Dynamics, Mechanisms and Machines, Plane and Space Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Mobility and range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion, Plane motion of a rigid body, Instantaneous Centre (IC) of Velocity, Velocity and Acceleration Diagrams, Velocity and Acceleration analysis, Coriolís component of acceleration

UNIT -II

MECHANISM SYNTHESIS: Dimensional synthesis of mechanism; motion, path and function generation, precision point approach, Chebyshev spacing, Three position synthesis, graphical approach for four link mechanisms, Advanced synthesis solutions, branch and order defects, Analytical methods, straight line mechanisms

UNIT -III

MANIPULATOR KINEMATICS: Classification, Actuation and transmission systems, Homogeneous Co-ordinate transformations, DH notations, Inverse and forward kinematics

UNIT -IV

MANIPULATORS DYNAMICS: Rigid body dynamics, Manipulator dynamics by Newtonian and Lagrangian approach.

Books:

1. Robot Design Handbook G.B. Andeen McGraw Hill
2. Introduction to Robotics, Mechanics and Control J.J. Craig Addison Wesley
3. Robotic Manipulators: Mathematics, Programming and Control R.P. Paul MIT Press
4. Robot Dynamics and Control M. Spong and M.Vidyasagar JohnWiley, NY
5. Dextrous Robot Hands S.T. Venkataraman Springer-Verlag
6. Theory of Mechanism and Machine Amitabh Ghosh, Asok Kumar Malik Affiliated East-West Press Private Limited

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MED 621B TRIBOLOGY M. Tech. Semester –III (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**25 Marks**
4		**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

UNIT-I

INTRODUCTION: Tribology, Historical background; Properties and testing of lubricants, Viscosity, Viscometry, Effect of temperature and pressure on viscosity

SURFACE ROUGHNESS, FRICTION AND WEAR : Surface topography, surface characterization, apparent & real area of contract, laws of friction, friction theories with criticism, frictional heating, classification of wear, mechanism of wear, laws of wear: Qualitative & quantitative, wear resistance materials.

UNIT-II

HYDRODYNAMIC BEARINGS: The generalized Reynold′s equation, fundamentals of lubrication and lubrication regims, mechanism of pressure development, Plane slider bearing, Step bearing, Idealized journal bearing: infinitely long & short journal bearing; Petroff equation, oil film thickness: approx. relation, film shape, accurate expression; finite journal bearings, boundary conditions: Sommerfeld condition, Half Sommerfeld condition, Reynold′s condition; load carrying capacity and attitude angle, oil flow, friction in journal bearings; Cavitation, oil whirl in journal bearings and methods of cure; bearing materials

UNIT-III

HYDROSTATIC BEARINGS: System of hydrostatic lubrication, restrictors, circular step bearings, Rectangular thrust bearings, opposed pad bearings; multirecess journal bearings, hydrostatic lift, hybrid bearings.

GAS LUBRICATED BEARINGS: Governing equations, limiting solutions, infinitely long plane slider & journal bearings, externally pressurized gas bearings.

UNIT-IV

ELASTOHYDRODYNAMIC LUBRICATION & ROLLING ELEMENT BEARINGS : Theoretical consideration, Grubin type solution, film-thickness equation, different regimes in EHL contacts, Geometry and kinematics of ball bearings, stress & deformations, load capacity, prediction of fatigue life of ball bearings and lubrication of ball bearings.

Reference books:

1. Basic Lubrication Theory by Alastair Cameron, Published by El;lis Horwood Ltd., New Work.
2. Introduction to Tribology of bearings by B.C. Majumdar, a.h. wheeler & Co. Pvt. Ltd., Delhi.
3. Applied Tribology: Bearing Design & Lubrication, M.M. Khonsari & E.R. Booser, John Wiley & Sons INC.
4. Engineering Tribology by G.W. Stachowiak & A.W. Batchlor, Butterworth- Heinenann.
5. Rolling Element Bearings by T.A. HARRIS

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEI 601B ADVANCE OPERATION RESEARCH

M. Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
4	-	4	**Class Work**	**:**	**25 Marks**
			Examination	**:**	**75 Marks**
			Total	**:**	**100 Marks**
			Duration of Examination	**:**	**3 Hours**

UNIT-I

ADVANCED TOPICS IN LP: Duality, Dual simplex method, Revised simplex method, The decomposition method, Sensitivity analysis, Parametric LP, Variants in Transportation problem, Least time Transportation problem, Post optimality analysis in Transportation, Trans-shipment problem, Dual of TP, Variants in Assignment Problem, Sensitivity Analysis in Assignment Problems, The travelling salesman Problems(Shortest Cyclic Route Models)

UNIT-II

GAMES THEORY AND GOAL PROGRAMMING: Introduction, Theory of games, Application of Goal Programming

REPLACEMENT: Introduction, Replacement of items that deteriorate , Replacement of items that fail suddenly, Group replacement, Mortality and staffing problems, Renewal Theory, Application of Replacement Policy in Real life Problem

UNIT-III

QUEUING MODELS - Multichannel queuing systems, limited queue length

NETWORK ANALYSIS- Financial Planning through network, Network crashing, Allocation of resources in a Project, Applications of Network Techniques

Simulation- Monte Carlo method, Markov Chains

UNIT-IV

NON LINEAR PROGRAMMING: Introduction, Integer Programming, Non linear Programming Problem, Quadratic Programming, Separable Programming, Dynamic Programming

Text Books

1. Operations Research -C.K. Mustafi- New Age International Publishers
2. Operations Research – Prem Kumar Gupta and D.S. Hira- S. Chand

Reference Books:

1. Introduction to Operations Research- Hiller/ Liberman- Tata Mcgraw Hill
2. Operations Research- Taha- PHI
3. Operations Research- Gupta and Khanna (PHI)

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEI 627B TECHNOLOGY & MANUFACTURING STRATEGIES
M. Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I

COMPETITIVE STRATEGY PLANNING: Levels of Strategy, Strategy process, Customer Matrix - Perceived use value, Producer matrix – Core Competences, Scenarios planning- PEST analysis, PORTER-Five force model, Value Chain Concept, Generic strategy concept.

NEW MANUFACTURING PHILOSOPHY: Strategic importance of various Manufacturing systems based on Volume & Variety, Three flows of manufacturing systems, Synchronous Manufacturing, Brief concept of JIT, TQM, Simultaneous Engineering & Reverse Engineering, Lean Manufacturing.

UNIT-II

MANUFACTURING COMPETITIVENESS: Competitiveness through Manufacturing Advantage-Quality, Speed, Dependability, Flexibility and Cost advantages; Internal & External performance, Manufacturing focus & Segmentation, Manufacturing Strategy Competitiveness & activities.

MANUFACTURING STRUCTURE & STRATEGY: Manufacturing structure, Focused factory, Group technology & its impact on manufacturing Strategy; Experience curve; Objective and characteristics of Manufacturing strategy, Order winning & qualifying objectives, process of formulating & implementing manufacturing strategy.

UNIT – III

STRATEGIC TECHNOLOGY MANAGEMENT: Understanding technology, Business strategy, Technology strategy & Technology Management, Technology Management philosophy; Brief idea of technology forecasting; Technology Portfolio, Competitive position analysis, Strategic planning & management of technology.

TECHNOLOGY DEVELOPMENT: Product development cycle & its problems; Managing technology for new product, Managing product development capability, Technological innoration - Context & opportunities, Project & its evaluation, Policy imperatives & strategic issues; Technology fusion- its principles, New R&D collaboration.

UNIT – IV

INTERNATIONAL TECHNOLOGY & OPERATIONS STRATEGY: Global strategy, Porter's model of International Strategy, Technology Innovation and Strategy process, Technology accumulation, Global manufacturing, International procurement, Manufacturing strategy, Process development, Organization issues.

ORGANIZATIONAL SUPPORT SYSTEMS: Organization structure, environment & technology, Organization flexibility, Role of Manager in organization design, Five parts of the organization and

various configuration - Mintzberg theory; Strategic issues of Organization Culture - Creative Miller's Theory, Learning Organization- SENGE's Theory.

Text Books:

1. Management of Technology & Innovation - P.N. Rastogi, Sage Publiation, New Delhi
2. Manufacturing Advantage - Nigel Slack, Viva Books, New Delhi.
3. The Essence of Competitive Strategy - Faulkner & Bowman, PHI, New Delhi

Ref. Books:

1. The Essence of International Business - Taggart & McDermott, PHI, New Delhi
2. Manufacturing Strategy – T.Hill Macimillan
3. Operations Management - Schroeder, McGraw Hill, ISE
4. Manufacturing - The Formidable competitive Weapon - W. Skinner, Jotin Wiley

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 621B HYDRAULIC & PNEUMATIC SYSTEMS

M. Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
4	-	4	**Class Work**	**:**	**25 Marks**
			Examination	**:**	**75 Marks**
			Total	**:**	**100 Marks**
			Duration of Examination	**:**	**3 Hours**

UNIT-I

THE SOURCE OF HYDRAULIC POWER: Introduction, Pumping Theory, Pump Classification, Gear Pumps, Vane Pumps (Balanced & Unbalanced), Piston Pumps: Axial Piston Pump (Bent-Axis Design), In Line Piston Pumps (Swash Plate Design), Radial Piston Pumps, Pump Performance, Pump Noise, Pump Selection

HYDRAULIC ACTUATORS AND MOTORS: Introduction, Linear Hydraulic Actuators (Hydraulic Cylinders): Single Acting, Double acting (Single rod end, Double rod end, Tandem), Cushing Devices, Sealing Devices: O-ring, Compression packing, Piston Cup packing, Piston Rings, Wiper Rings, Mechanics of Hydraulic Cylinder Loadings: Limited Rotation Hydraulic Actuators: Rotary Actuators: Gear Motors, Vane Motors, Piston Motors, Hydraulic Motor Performance.

UNIT-II

VALVE & OTHER CONTROL COMPONENTS IN HYDRAULIC SYSTEM: Introduction: Direction Control Valve: 2/ 2 way, 3/ 2 way, 4/ 2 way, 5/ 2 way, 4/ 3 way, Pressure Control Valve: Pressure Relief Valve, Pressure Reducing Valve, Sequence Valve, Flow Control Valve: Check Valve, Pilot Controlled Check Valve, 2-Way Flow Control Valve, Hydraulic Fuses: Valve Actuation

ELECTRIC CONTROLS: Basic Electrical Devices: Push button, Limit switch, Pressure switch, Temperature switch, Timer, Relay & solenoid

FLUID CONDITIONERS: Air Filter, Air Pressure Regulator, Air Lubricator, Pneumatic Indicator, Pneumatic Silencer, Aftercoler, Chiller Air Dryer.

UNIT-III

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS: General Types of fluids, ANSI symbols of hydraulic components, The Reservoir System, Filters & Strainers, Power Pack, Control of Single & Double Acting Hydraulic Cylinder, Regenerative Circuit, Double Pump Hydraulic System, Pressure Intensifier Circuit, Hydraulic Cylinder Sequencing Circuits, Automatic Cylinder Reciprocating System, Locked Cylinder Using Pilot Check Valves, Cylinder Synchronizing Circuits, Meter-in flow Control, Meter-out flow Control, Time- Motion Diagram, Circuit Design for a particular Application like Lifting Platforms, Clamping Fixtures, Tool slides working under varying load, Uniform & jerk less feed motion, To lift unevenly loaded plate, To hold the cylinder at a particular position, Accumulator Circuit, Practice to design a circuit on a Software.

UNIT-IV

PNEUMATIC CIRCUIT DESIGN AND ANALYSIS: Introduction, , Air Control Valves, Pneumatic Actuators, Pneumatic Circuit Design Considerations, Basic Pneumatic Circuit: Operation of Single & Double Acting Cylinder, Air Pilot Control of Double Acting Cylinder,, Cylinder Cycle Timing System, Two-Step Speed control System, Two Handed Safety Control System, Control of Air Motor, Deceleration Air Cushion of Cylinder, Practice to design a circuit on a Software.

ELECTRICAL CIRCUIT DESIGN AND ANALYSIS FOR FLUID POWER CIRCUITS: Introduction, Circuit Diagram, Electro-hydraulic Servo System, Programmable Logic Controller, Electrical Components, Control of a Cylinder Using a Single Limit Switch, Reciprocation of a Cylinder Using

Pressure or Limit Switches, Dual-Cylinder Sequence Circuits, Electro-Pneumatic System for Sorting Different-Sized Boxes, An Electro-Hydraulic System for Counting, Timing and Reciprocation of Hydraulic Cylinder, Practice to design a circuit on a Software.

Reference Books:

1. Anthony Esposito, "Fluid power with Applications", Prentice Hall,/ Pearson .
2. James A. Sullivan, "Fluid Powe-Theory and Applicationr", Prentice Hall,.
3. Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999.
4. Bolton, W. "Pneumatic and Hydraulic systems", Butterworth – Heinneman, 1997
5. A text Book from FESTO DIDACTIC, "Hydraulics Course for Vocational Training'

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MET 623B I.C. ENGINES PROCESS MODELING
M. Tech. Semester –III (Mechanical Engineering)

L	P	Credits			
4	-	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I

INTRODUCTION: Overview and historical perspective on development of internal combustion engines. **IC engine cycles**: Properties of working fluid, air-standard cycle, fuel-air cycle, real cycle, availability analysis of engine processes.

UNIT - II

ENGINE PROCESSES MODELING : Inlet and exhaust processes in four stroke cycle, volumetric efficiency, flow through valves, essential features of combustion process in S.I. and C.I. engines; Autoignition, Knock models, Modeling Spray, Flame Propagation, Heat Release, Laminar burning speed, free gas jet theory., packet models.

MODELING POLLUTANT FORMATION: Modeling pollutant formation in SI and CI engines– Models for NOx, CO and soot formation, unburned hydrocarbon combustion.

UNIT - III

ENGINE CYCLE SIMULATION: Simulation of ideal and actual Otto cycles at full throttle, part throttle and super charged conditions and their comparative evaluation; Introduction to Computer Routines: Estimation of the composition and properties of unburned and burned mixtures.

SIMULATION OF COMBUSTION PROCESSES: Progressive and spray combustion processes with reference to homogeneous and heterogeneous charge engines.

UNIT - IV

ENGINE SIMULATION TOOLS: Introduction to FIRE and BOOST software

INTRODUCTION TO ANSYS FLUENT FOR ENGINE PROCESSES SIMULATION: Geometric modeling-ANSYS Workbench/ CFX, mesh generation, boundary and initial conditions, computational approach, analysis.

Text Books:

1. Internal Combustion Engine Fundamentals – Heywood, JB, McGraw Hill.
2. Modeling Engine Spray and Combustion Processes – Stiesch G, Springer-Verlag.
3. Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation – Warnatz J, Mass U, and Dirbble RW, 4th Ed., Springer-Verlag

Reference Books:

1. Modeling Diesel Combustion – Lakshminarayanan PA and Aghav YV, Springer-Verlag
1. Fluid Dynamics and Transport of Droplets and Sprays – Sirignano WA, Cambridge University Press.

NOTE:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit (1 & 2 from unit I, 3 & 4 from unit II, 5 &6 from unit III and 7 & 8 from unit IV). The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

MEM 602B DISSERTATION							
M.Tech. Semester –IV (Mechanical Engineering)							
L		**P**	**Credits**		**Class Work**	**:**	**50 Marks**
-		**20**	**20**		**Examination**	**:**	**100 Marks**
					Total	**:**	**150 Marks**
					Duration of Examination	**:**	**3 Hours**

The dissertation started in III Semester will be completed in IV Semester and will be evaluated in the following manner.

Internal Assessment

Internal Assessment (class work evaluation) will be effected as per ordinance through interim report, presentation and discussion thereon by the following committee of three persons:

Chairperson of Department	: Chairperson
M Tech Coordinator/ Sr Faculty	: Member Secretary
Respective dissertation supervisor	: Member

External Assessment

Final dissertation will be assessed by a panel of examiners consisting of the following:

Chairperson of Department	: Chairperson
Respective Supervisor(s)	: Member(s)
External expert	: To be appointed by the University

Note: The External Expert must be from the respective area of specialization. The chairperson & M Tech Coordinator with mutual consultation will divide the submitted dissertations into groups depending upon the area of specialization and will recommend the list of experts for each group separately to the V C for selecting the examiners with the note that an external expert should be assigned a maximum of FIVE dissertations for evaluation.

The student will be required to submit THREE copies of his/ her report to the M Tech Coordinator for record and processing.