Swami Ramanand Tirth Marathwada University, Nanded

Proposed Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical Engineering)

w. e. f. Academic Year 2013-2014, for MPGI, SOE, Nanded. Center No. 727

Part – I

Sr. NO.	Name of Subject	Teaching hrs/week				Examination Scheme - Marks				
		L	T	P	Total Hrs	Theory	Class Test	Term Work	Pr/ Oral	Total
1	Advanced Optimization Techniques	03	-	-	03	100	20	25	-	145
2	Material Science	03	-	-	03	100	20	25	-	145
3	Research Methodology	03	-	-	03	100	20	25	-	145
4	Elective-I	03	-	-	03	100	20	25	-	145
5	Elective-II	03	-	-	03	100	20	25	-	145
6	Mechanical Lab-I	-	-	04	04	-	-	50	-	50
7	Seminar-I	-	-	02	02	-	-	25	-	25
8	Comprehensive Viva-I	-	-	-	-	-	-	50	50	100
Total		**15**	**-**	**6**	**21**	**500**	**100**	**250**	**50**	**900**

*Elective Subjects:

Elective	Group A Design	Group B CAD/CAM	Group C Thermal	Group D Industrial Engg.	Group E Production
4.Elective-I	Machine Stress Analysis	Computer Aided Design	Advanced Thermodynamics	Total Quality Management	Metal Forming Process
5.Elective-II	Kinematics: Dynamics & Synthesis	Product Life Cycle Management	Advanced Heat Transfer	Product Life Cycle Management	Non Conventional Machining Processes

***Note: Candidates are required to opt the elective subjects (Elective I, II, III & IV) from the same group as mentioned above.**

Swami Ramanand Tirth Marathwada University, Nanded

Proposed Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical Engineering)

w. e. f. Academic Year 2013-2014

Part – II

Sr. NO.	Name of Subject	Teaching hrs/week				Examination Scheme - Marks				
		L	T	P	Total Hrs	Theory	Class Test	Term Work	Pr/ Oral	Total
1	Advanced Machine Design	03	-	-	03	100	20	25	-	145
2	Finite Element Methods	03	-	-	03	100	20	25	-	145
3	Advanced Manufacturing Processes	03	-	-	03	100	20	25	-	145
4	Elective-III	03	-	-	03	100	20	25	-	145
5	Elective-IV	03	-	-	03	100	20	25	-	145
6	Mechanical Lab-II	-	-	04	04	-	-	50	-	50
7	Seminar-II	-	-	02	02	-	-	25	-	25
8	Comprehensive Viva-II		-	-	-	-	-	50	50	100
	Total	**15**	**-**	**06**	**21**	**500**	**100**	**250**	**50**	**900**

*Elective Subjects:

Elective	Group A Design	Group B CAD/CAM	Group C Thermal	Group D Industrial Engineering	Group E Production
4.Elective-III	Reliability & Maintenance Engg.	Reliability & Maintenance Engg.	Computational Fluid Dynamics	Reliability & Maintenance Engg.	Reliability & Maintenance Engg.
5.Elective-IV	Advanced Mechanical Vibrations	Computer Integrated Manufacturing	Refrigeration & Cryogenic Systems	Inventory Supply Chain Management	Computer Integrated Manufacturing

***Note: Candidates are required to opt the elective subjects (Elective I, II, III & IV) from the group as mentioned above.**

Swami Ramanand Tirth Marathwada University, Nanded

Proposed Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical Engineering)

w. e. f. Academic Year 2013-2014

Part – III

Sr. NO.	Name of Subject	Teaching Scheme hrs/week			Examination Scheme - Marks			
		L	CH	Total Hrs	Theory	Term Work	Viva - Voce	Total
1	Dissertation Phase - I	-	12	12	-	100	-	100
Total		**-**	**12**	**12**	**-**	**100**	**-**	**100**

Part – IV

Sr. NO.	Name of Subject	Teaching Scheme hrs/week			Examination Scheme - Marks			
		L	CH	Total Hrs	Theory	Term Work	Viva - Voce	Total
1	Dissertation Phase - II	-	20	20	-	150	150	300
Total		**-**	**20**	**20**	**-**	**150**	**150**	**300**
Grand Total (Part-I+II+III+IV)								**2200**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact Hours

Part-I

1. ADVANCED OPTIMIZATION TECHNIQUES

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Optimal problem formulation, engineering optimization problems, optimization algorithms. **Single Variable Optimization Algorithms:** Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient base, root finding using optimization techniques.	6
2	**Multivariable optimization algorithms:** Optimality criteria, unidirectional search, direct search method, gradient based methods, computer programs on above methods.	6
3	**Constrained Optimization Algorithms:** Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, computer programs on above methods.	6
4	**Special Optimization Algorithms:** Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.	6
5	**Optimization in operations research:** Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis.	6

Term Work:

Minimum four assignments based on the above syllabus including computer programs.

Reference Books:

1. Deb Kalyammoy, "Optimization in Engineering Design", PHI, New Delhi.
2. Rao S. S. "Engineering Optimization", John Wiley, New Delhi.
3. Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK.
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

Part-I

2. MATERIAL SCIENCE

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Materials and Classification: Solid materials-** Classification, Ceramics, composites and metal glasses, selection and application on tool steel, Magnetic alloys, Copper, aluminum and magnesium alloys, Bearing alloys, Super hard materials, Plastics, Alloying techniques- Thermal, Mechanical and chemical methods, Powder metallurgy techniques, Macro and micro analysis of materials, Macro analysis of ferrous and non ferrous materials, Dendritic structures, Segregation and bonding, Heterogeneity formed through treatment and mechanical working.	6
2	**Mechanical Properties:** Strengthening mechanism of materials, elements of dislocation theories, Strain hardening, Grain size control, Single crystal growth, Reinforcing fibers for polymers, Composite structure, determination of mechanical properties of materials, Dynamic tests, Fracture and toughness tests, Low temperature and high temperature tests, Creep characteristics, Hot hardness tests, Total intra-granular cracking and aggressive media, Ceramics and composites, Insulation, Strength and aging of plastics.	6
3	**Processing of Materials for** Casting and Joining: Plastic working of materials, Strain hardening, Recovery and recrystallisation, Formability, Forgibility and drawability of materials, Powder processing mach inability of materials, thermal treatment for better mach inability of metals, Universal mach inability index.	6
4	**Modern Materials and Alloys:** Super alloys-refractory materials, Ceramic and their applications, Low melting alloys, Advanced Composites-Particulate and dispersioned composites, Metal matrix and ceramic matrix composites, Carbon-Carbon composites, Ti and Ni based alloys for gas turbine applications, Margining and cryogenic steels-Newer materials and their treatment for automobile applications, materials for Naval and nuclear systems. Smart and Nano materials.	6
5	**Polymers and polymerization:** Structure and properties of thermoplastics and thermo sets, Engineering applications, Property modifications, Mechanical, thermal behavior of composites with polymer matrix, ceramics glasses.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. P. Finn and P. K. Trojan, "Engineering Materials and Applications", MIR Publications.
2. A. K. Bhargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice Hall of India.
3. Serope Kalpakjian, "Manufacturing processes for Engineering Materials", Wesley Publishing Co.
4. S. H. Avner, "An introduction to Physical Metallurgy", McGraw Hill.
5. P. Rama Rao, "Advance in Materials and Their Applications", Wiley Eastern.
6. Dieter G. E., "Mechanical Metallurgy", McGraw Hill.

Part-I

3. Research Methodology

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Research Concept:** Concept, meaning, objectives, motivation, Types of research, approaches (descriptive research, conceptual, theoretical, applied and experimental research) **Formulation of Research Task:** Literature Review, importance & methods, sources, field study, laboratory, experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research, introduction to hypothesis testing.	6
2	**Mathematical Modeling and Simulation:** Concept of modeling, Classification of mathematical models, modeling with ordinary differential equations, differential equations, partial differential equations, graphs, Simulation concept, types (quantitative, experimental, computer, statistical process of formulation of model based on simulation. **Experimental Modeling:** Definition of experimental design, examples, single factor experiments, guidelines for designing experiments.	6
3	**General model of Process:** Input factors/variables, Output parameters/variables, controllable/uncontrollable variables, dependent/independent variables, compounding variables, extraneous variables and experimental validity. **Process optimization and designed experiments:** Methods for study of response surface, First order design. Determining optimum combinations of factors, determination of steepest ascent, and Taguchi approach to parameter design.	6
4	**Analysis of Results:** Parametric and non parametric, Descriptive and Inferential Data, types of data, Methods and techniques of data collection, sampling and sample design, Non parametric test, error analysis, analysis of variance, significance of variance, analysis of co-variance, multiple regression, Introduction to Analytical hierarchical process, Factor analysis, Cluster analysis, Fuzzy logic, testing linearity of model, testing adequacy of model	6
5	**Report Writing:** Types of report, layout of research report, interpretation of results, layout and format, style of writing, typing, references, pagination tables, figures, conclusions, appendices.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Research Methodology, C. R. Kothari, New Age International Publishers.
2. Research in Education, John W. Besr & James V. Kahn, Prentice Hall of India, New Delhi.
3. Theories of Engineering Experiments, Schank Fr. Tata McGraw Hi Publishing Ltd., New Delhi.
4. Experimental design by Coehran & Cocks, John Wielly & sons, New Delhi, 2005.
5. Design of Experiments, Douglas Montgomary, 1995.
6. Formulation of Hypothesis, Willkinson K, P L Bhandarkar, Himalaya Publishing House, Mumbai, 2005.

Part-I (Electives)

Group A: Design

A-1. MACHINE STRESS ANALYSIS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Theory of Elasticity:** Plane stresses and plain strain: Plane strain and stress and strain at a point, differential equations of equilibrium, boundary conditions, compatibility equations, and Airy's stress function. **Two-dimensional problems in rectangular coordinates:** Solutions by polynomials, end effects, Saint Venant's principle. Two-dimensional problems in polar coordinates: General equations in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates.	**6**
2	**Applications of Energy Methods:** First and second theorems, Castigliano's theorems, applications for analysis of loaded members to determine deflections and reactions at supports. **Theory of Torsion:** Torsion of prismatic bars of non-circular cross sections, Thin walled hallow and rectangular cross sections, Saint Venant's theory, Prandtle's membrane analogy, Kelvin's fluid flow analogy, wrapping of the cross sections.	**6**
3	**Experimental Stress Analysis:** Stress analysis by – mechanical, optical and electrical strain gauges, strain rosette, whole field methods, Moire fringe method, brittle coating for strain indication.	**6**
4	**Shear Center and Unsymmetrical Bending:** Shear center for beams of different cross sections, bending and deflections of beams subjected to unsymmetrical bending.	**6**
5	**Contact Stresses:** Hertz's contact stresses, expression for principle stresses, deflection of bodies in point contact, stress in bodies in point and line contacts.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Timoshenko and Young, "Theory of Elasticity",TMH Publications.
2. Seely and Smith, "Advanced Mechanics of Materials", John Wiely, New York
3. Den Hartog J. P., "Advanced Strength of Mateials", McGraw Hill Publications.
4. Nash W., "Strength of Materials", Schaum's outline series, McGraw Hill.

Part-I (Electives)

Group A: Design

A-2. KINEMATICS, DYNAMICS AND SYNTHESIS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage.	6
2	**Kinematic Synthesis:** Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain.	6
3	**Path Curvature Theory:** Fixed and moving centrode, Inflection points and inflection circle, Euler's –savary Equation, Bobiller's and Hartsman construction.	6
4	**Dynamic Force Analysis:** Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages.	6
5	**Spatial Mechanism:** Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Tao D. C., "Fundamentals of applied Kinematics", Addison Wesley, USA 1967
2. R. Hartenberg and Denavit, "Kinematics Synthesis of Linkages", McGraw Hill
3. A. K. Mallik and A. Ghosh, "Kinematic Analysis and Synthesis of Mechanisms", CRC Press
4. A. K. Mallik and A. Ghosh, "Theory of Mechanisms", East west Press
5. Hirschern J, "Kinematics and Dynamics of Plane Mechanisms", McGraw Hill, NY
6. Soni A. H., "Mechanism Synthesis & Analysis", McGraw Hill.

Part-I (Electives)

Group B: CAD/CAM

B-I. COMPUTER AIDED DESIGN

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Product design process:** Importance of design, design process, technological innovation and the design process, Team behavior and tools; Embodiment design: Product architecture, configuration of design, parametric design, Industrial design, Human factors design, Design for X (DFX) **CAD:** Introduction, Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Solid modeling methods	**6**
2	**An overview of modeling software:** like UG/NX, Solid Works, Autodesk Inventor, Professional, AutoCAD, PRO/E, CATIA: Capabilities, Modules, Coordinate systems, Sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities **Geometric transformations:** 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections	**6**
3	**CAD/CAM Data exchange and data storage**: Introduction, graphics and computing standards, data exchange standards like IGES, STEP, Model storage - Data structures - Data base considerations – Object oriented representations - Organizing data for CIM applications - Design information system **Mathematical representations of solids:** Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration	**6**
4	**Mathematical representations of curves and surfaces:** Curve representation, Parametric representation of analytic and synthetic curves; Surface models, Surface representations, Parametric representation of analytic and synthetic surfaces	**6**
5	**Assembly modeling:** Representation, mating conditions, representation schemes, generation of assembling sequences AI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Introduction to Advanced visualization topics in CAD like Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Software Documentation, tutorials, manuals of any three of following software's
1. UG/NX
2. Solid Works
3. CATIA
4. Autodesk Inventor Professional
5. AutoCAD
6. Open CASCADE
7. ANSYS Design modeler
8. Pro/E

Reference Books:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Dieter George, Engineering Design – A materials and processing approach, McGraw Hill Publishers,2000
4. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY,
1989
6. P.Radhakrishnan, S.Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd.,
New Delhi.
7. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
8. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi,
Second Edition, 2000.

Part-I (Electives)

Group B: CAD/CAM

B-2. PRODUCT LIFECYCLE MANAGEMENT

Teaching Scheme:

Lectures: 03 hrs / week

Class Test: 20 Marks (1 hr)

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Term Work: 25 Marks

Units	Contents	Hrs
1	**INTRODUCTION**: Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement,. Threads of PLM- computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics -singularity, cohesion, traceability, reflectiveness.	5
2	**PRODUCT LIFE CYCLE ENVIRONMENT** Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Developing a PLM strategy, Strategy identification and selection, PLM System Architecture (2tier/3tier/4tier etc),	5
3	**INTRODUCTION TO PDM** Benefits and Terminology, CIM Data, PDM functions, definition and architectures of PDM systems, Engineering data, engineering workflow and PDM acquisition and implementation, Resolving Data Issues, product data interchange, present market constraints, collaborative product development, Internet and developments in client server computing, portal integration	5
4	**COMPONENTS OF PDM** Components of a typical PDM setup - hardware and document management – creation and viewing of documents - creating parts-version - control of parts and documents, configuration management for product structure, change management and associated activities	5
5	**FUNDAMENTAL CONCEPTS OF DATABASE MANAGEMENT** Introduction to DBMS, Entity-Relationship model, Relational model, SQL concepts, Object-Based databases and XML, DBMS architectures, Distributed databases, introduction to search with sample search algorithms,	5
6	**COMPONENTS OF PLM** Different phases of product lifecycle and corresponding technologies, Product development processes and methodologies, Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration), Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use.	5

Term Work:

Minimum four assignments based on the above syllabus.

TEXT/REFERENCE BOOKS

1. Grieves, Michael, **Product Lifecycle Management**, McGraw-Hill, 2006. ISBN 0071452303
2. AnttiSaaksvuori, AnselmiImmonen, **Product Life Cycle Management** - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John, **Product Lifecycle Management: Paradigm for 21st Century Product Realization**, Springer-Verlag, 2004. ISBN 1852338105
4. Kari Ulrich and Steven D. Eppinger, **Product Design & Development,** McGraw Hill International 1999.
5. Burden Rodger, **PDM: Product Data Management**, Resource Pub, 2003. ISBN 0970035225
6. Silberschatz, Korth and Sudarshan, **Database System Concepts**, McGraw Hill, 2002

OTHER REFERENCES

Relevant recent technical articles, research papers, key note addresses, etc.

Part-I (Electives)

Group C: Thermal

C-I. ADVANCED THERMODYNAMICS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Equation of State**: State postulate for simple system and equation of state, Ideal gas equation, Deviation from ideal gas, Equation of state for real gases, generalized Compressibility chart, Laws of corresponding states. **Properties of Pure Substances:** Phase change process of pure substances, PVT surface, P-v & P- T diagrams, Use of steam tables and charts in common use.	**6**
2	**Laws of thermodynamics:** 2nd law Analysis for Engg. Systems, Entropy flow & entropy generation, Increase of entropy principle, entropy change of pure sub, T –ds relations, entropy generation, thermo electricity, Onsager equation. Exergy analysis of thermal systems, decrease of Exergy principle and Exergy destruction.	**6**
3	**Thermodynamic Property Relations:** Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, Δh, Δu, Δs of real gases.	**6**
4	**Chemical Thermodynamics:** Chemical reaction – Fuels and combustion, Enthalpy of formation and enthalpy of combustion, First law analysis of reacting systems, adiabatic flame temperature Chemical and phase equilibrium – Criterion for chemical equilibrium, equilibrium constant for ideal gas mixtures, some remarks about Kp of ideal-gas mixtures, fugacity and activity, Simultaneous relations, Variation of Kp with Temperature, Phase equilibrium, Gibb's phase rule, Third law of thermodynamics, Nerst heat theorem and heat death of universe.	**6**
5	**Gas Mixtures:** Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule. **Statistical Thermodynamics-** Fundamentals, equilibrium distribution, Significance of Lagrangian multipliers, partition function for Canonical Ensemble, partition function for an ideal monatomic gas, equpartition of energy, Bose Einstein statistics, Femi-Dirac statistics.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Cengel, "Thermodynamics:, TMH
2. Nag P.K., "Basic & Applied Thermodynamics", TMH, New Delhi.
3. Kalyan Annamalai, Ishwar K. Puri, "Advanced Thermodynamics Engineering", CCRC PRESS
4. Holman, "Thermodynamics", 4th edition, McGraw Hill
5. Rao, Y.V.C., "Postulational and Statistical thermodynamics", Allied Pub. Inc.
6. Jones and Hawkings, "engineering Thermodynamics", john Wiley & Sons, Inc. USA
7. Faires V.M. and Simmag, "Thermodynamics", McMillan Pub. Co. Inc. USA
8. Stephen Turns, "Thermodynamics- Concepts and Applications", Cambridge University Press.

Part-I (Electives)
Group C: Thermal

C-2. ADVANCED HEAT TRANSFER

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	Brief introduction to different modes of heat transfer and the basic laws of heat conduction. Convection and radiation. Heat transfer applications. One dimensional steady state heat conduction. Extended surfaces. Design and analysis of fins. Fins of constant and variable cross section. Two dimensional steady state heat conduction in semi-infinite and finite flat plates. Graphical method and relaxation method for solving 2D heat conduction problems. Conduction shape factor.	**6**
2	Transient heat conduction. Lumped heat capacity systems. Response of thermocouple. Use of Heisler charts for solving one dimensional unsteady state heat transfer problems in infinite plates, cylinders and spheres. Periodic heat flow.	**6**
3	Convective heat transfer. Concept of velocity and thermal boundary layers. Laminar and Turbulent flow. Differential convection equations. Non dimensional convection equations. Analogy between momentum and heat transfer for laminar and turbulent flow. External forced convection, Parallel flow over a flat plate, Flow over cylinders, spheres and tube bank. Mixed boundary layer considerations. Internal forced convection. Thermal analysis and convection correlations for laminar and turbulent flow in circular and non circular tubes, Constant heat flux and constant wall temperature conditions. Heat transfer enhancement. Free convection, Empirical correlations for external free convection flows for various geometrics and orientations, free convection within parallel plate channels. Empirical correlations for enclosures combined free and forced convection.	**6**
4	Boiling heat transfer. The pool boiling curve. Modes of pool boiling and correlations. Transition boiling and system influences. Forced convection boiling in tubes. Two phase flow in horizontal tubes. Limiting heat fluxes in flow boiling. Condensation heat transfer phenomenon. Condensation number, laminar film condensation on a vertical plate, Correlations for condensation inside and outside a vertical tube, on inclined plates, on outer surface of horizontal tube, on horizontal tube blank, turbulent film condensation, Drop wise condensation. Design considerations of Heat pipe.	**6**
5	Principles of thermal radiation. Greenhouse effect. Atmospheric and Solar radiation. Radiation exchange between black and non black surfaces. Direct method (Matrix method) and Network method for solving radiation heat transfer problems. Radiation shields. Radiation exchange with emitting and absorbing gases. Radiation effect on temperature measurement. Multimode heat transfer.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Yunus Cengel, "Heat Transfer; A Practical Approach", 3 (2007), Tata McGraw-Hill
2. Holman J. P., "Heat Transfer", Tata McGraw Hill
3. Hottel H. G. & Sarofim A. F., "Radiative Heat Transfer", McGraw Hill
4. Michael Modest, "Radiative Heat Transfer", McGraw Hill
5. Sukhatme S. P., "Heat transfer", University Press
6. Sarit K. Das, "Engineering Heat & Mass Transfer", Dhanpat Rai.

Part-I(Electives)

Group D: Industrial Engineering

D-I. TOTAL QUALITY MANAGEMENT

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**EVOLUTION OF QUALITY:** Quality control-Quality Assurance-total quality management-Core concepts-Quality Gurus and their contribution- Quality costs-Quality measurement.	6
2	**TOOLS OF QUALITY:** Review of SQC -Quality control Vs Process control-Control charts-Applications-Problems-Old and New seven tools of quality-Applications.	6
3	**TECHNIQUES OF QUALITY:** Quality Function Deployment (QFD) -Failure mode effect Analysis (FMEA)- Just in time-KANBAN-KAIZEN-5S Principles-Zero defects-POKA-YOKE-Quality circles.	6
4	**ISO 9000/QS 9000:** Philosophy-Elements-Requirements-Benefits-Procedures-Doccumentation-Certification -Auditing-Implementation- Cost of Certification.	6
5	**CASE STUDIES:** Case studies in Quality Management (The students may be asked to select case studies and present).	6

Term Work:

Minimum four assignments based on the above syllabus.

References:

1. MOHAMED ZAIRI - " Total Quality Management for Engineers "-Woodhead Publications, 1991.
2. John Bank, "Essence of TQM ", Prentice Hall of India, 1990
3. TAGUCHI .G., L. SYED et al', " Quality Engineering production systems " - McGraw Hill, 1980.
4. JURAN, - "Quality Control Handbook ", McGraw Hill, 1995.
5. ZAIDI,-SPC - "Concepts, Methodologies & Tools ", Prentice Hall of India, 1990
6. FEIGENBAUM - "Total Quality Control ", McGraw Hill, 1995.
7. VINCENT K. OMACHONU and JOEL E.ROSS - " Principles of Total Quality ", Kogan press, 1994.
8. PERRY L. JOHNSON - "ISO 9000 ", McGraw Hill, 1993.

Part-I (Electives)

Group D: Industrial Engineering

D-2. PRODUCT LIFECYCLE MANAGEMENT

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**INTRODUCTION**: Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement,. Threads of PLM- computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics -singularity, cohesion, traceability, reflectiveness.	5
2	**PRODUCT LIFE CYCLE ENVIRONMENT** Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Developing a PLM strategy, Strategy identification and selection, PLM System Architecture (2tier/3tier/4tier etc),	5
3	**INTRODUCTION TO PDM** Benefits and Terminology, CIM Data, PDM functions, definition and architectures of PDM systems, Engineering data, engineering workflow and PDM acquisition and implementation, Resolving Data Issues, product data interchange, present market constraints, collaborative product development, Internet and developments in client server computing, portal integration	5
4	**UCOMPONENTS OF PDM** Components of a typical PDM setup - hardware and document management – creation and viewing of documents - creating parts-version - control of parts and documents, configuration management for product structure, change management and associated activities	5
5	**FUNDAMENTAL CONCEPTS OF DATABASE MANAGEMENT** Introduction to DBMS, Entity-Relationship model, Relational model, SQL concepts, Object-Based databases and XML, DBMS architectures, Distributed databases, introduction to search with sample search algorithms,	5
6	**COMPONENTS OF PLM** Different phases of product lifecycle and corresponding technologies, Product development processes and methodologies, Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration), Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use.	5

Term Work:

Minimum four assignments based on the above syllabus.

TEXT/REFERENCE BOOKS

1. Grieves, Michael, **Product Lifecycle Management**, McGraw-Hill, 2006. ISBN 0071452303
2. AnttiSaaksvuori, AnselmiImmonen, **Product Life Cycle Management** - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John, **Product Lifecycle Management: Paradigm for 21st Century Product Realization**, Springer-Verlag, 2004. ISBN 1852338105
4. Kari Ulrich and Steven D. Eppinger, **Product Design & Development,** McGraw Hill International 1999.
5. Burden Rodger, **PDM: Product Data Management**, Resource Pub, 2003. ISBN 0970035225
6. Silberschatz, Korth and Sudarshan, **Database System Concepts**, McGraw Hill, 2002

OTHER REFERENCES

Relevant recent technical articles, research papers, key note addresses, etc.

Part-I (Electives)

Group E: Production

E-I. METAL FORMING PROCESSES

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes, Formability and theory of sheet metal working, Friction and lubrication in metal working operation, Theories of friction and lubrication, Assessment of friction at interface.	6
2	**Process Analysis:** Various methods of analyzing the metal working processes (slip-line field theory, Upper bound solution, stab methods).	6
3	**Mechanics of Forming Processes:** Rolling-Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings, Forging-Forces in strip forging and disc forging, Drawing-determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing, Bending-determination of work load and spring back, Extrusion-Determination of work load from stress analysis and energy consideration, Power loss, Hydrostatic extrusion, Punching & Blanking-Mode of metal deformation and failure, 2D deformation model and fracture analysis, determination of work force.	6
4	**Hydrostatic Extrusion:** Comparison with conventional extrusion, Pressure required extruding, variables affecting the process.	6
5	**High Speed Forming:** Classification, Comparison of low and high speed forming, operation problems in high speed forming operation, Introduction to high forming process such as explosive forming, Electrical and Mechanical high speed forming techniques.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Rowe Arnold, "An Introduction to the Principles of Metal Working"
2. Avitzur, "Metal Forming Analysis", McGraw Hill
3. "Mathematical Simulation and Computer analysis of Thin Strip Rolling Mill Polukhin", MIR Publications
4. Johnson & Mellore Van Nostrand, "Plasticity for Mechanical Engineers".
5. "High Velocity Working of Metals", ASTME EEE
6. Ghosh & Mallik, "Manufacturing Science", Affiliated East-West.
7. S. Kumar, "Technology of Metal Forming Processes", Prentice Hall of India.

Part-I (Electives)
Group E: Production

E-2. NON CONVENTIONAL MACHINING PROCESSES

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Introduction: Limitations of conventional manufacturing processes need of unconventional manufacturing processes & its classification and its future possibilities. • Introduction to unconventional machining processes, their needs and classification. • Brief introduction to the type of energy source employed in AJM, USM, WJM, EDM, ECM, ECG, LBM< PAM, EBM.	**6**
2	**Machining Energy Based Processes** Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.	**6**
3	**Electrical Energy Based Processes** Electric Discharge Machining (EDM)- working principles-equipments-Process Parameters-MRR-electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.	**6**
4	**Thermal Energy Based Processes** Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles-Equipment- Types-Beam control techniques – Applications.	**6**
5	**Electrochemical and Chemical Metal Removal Process:** Introduction, Study of ECM machine, Elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, Chemistry of the process ECM process characteristics – Material removal rate, Accuracy, Surface finish. **ECM Tooling:** ECM tooling technique, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburing, Advantages, Limitations. **Chemical Machining (CHM):** Introduction, Elements of process Chemical blanking process:-Preparation of work piece. Preparation of masters, masking with photo resists, etching for blanking, applications of chemical blanking, chemical milling (Contour machining) :-Process steps – masking, Etching, process characteristics of CHM :-material removal rate accuracy, surface finish, Hydrogen embritlement, Advantage & application of CHM.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Recommended Books:

1. Pandey P. C. and Shan H. S. "Modern Machining Processes", Tata McGraw-Hill, New Delhi
2. Ghosh A. and Mallik A. K., "Manufacturing Science", East-West Press Pvt. Ltd. New Delhi.
3. Jain V. K., "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi.

Reference Books:

1. Mc. Geough, "Advanced Methods of Machining", Chapman and Hall, London
2. Paul De Garmo, J. T. Black, and Ronald A. Kohser, "Material and Processes in Manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Benedict. G. F, Nontraditional Manufacturing Processes, Marcel Dekker Inc., New York (1987).

6. MECHANICAL LAB - I

Teaching Scheme: **Examination Scheme:**

Practical: 04 hrs / week **Term Work:** 50 Marks

Minimum five experiments based on the above syllabus of Part-I which may include computer programs.

7. SEMINAR - I

Teaching Scheme: **Examination Scheme:**

Tutorials: 02 hrs / week **Term Work:** 25 Marks

It shall be based on the literature survey on any topic, which may lead to Dissertation in that area. It will be submitted as a report. The candidate will have to deliver a seminar presentation before the faculty members.

8. COMPREHENSIVE VIVA-I

Examination Scheme: **Oral:** 50 Marks

Comprehensive Viva-I is based on oral assessment of all the subjects of Part-I conducted by internal examiners and external examiner(s) appointed by University.

Part-II

1. ADVANCED MACHINE DESIGN

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Fundamentals of Design Considerations:** Principal planes and principal stresses, tri-axial State of stresses, Mohr's circle for tri-axial state of stresses and strains, volumetric strains, Principal stresses computed from principal strains, Principal strains due to perpendicular stresses & shear stresses.	**6**
2	**Mechanical Springs:** Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of rectangular or square bars helical springs under axial loading, cone or flat disc spring theory.	**6**
3	**Cams:** Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps.	**6**
4	**Fracture and Creep:** Fracture Mechanics approach to design. Causes and interpretation of failures, Creep behavior; rupture theory; creep in high temperature low cycle fatigue; designing against creep.	**6**
5	**Computer Aided Machine Design:** Philosophy of Computer Aided Machine Design, Interactive design software, Basic advantages of analysis Software, Design of machine components (springs, gears, temporary fasteners, permanent fasteners, belts and ropes) through interactive programming.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. L. S. Srinath, "Advanced Solid Mechanics", Tata McGraw-Hill
2. V Ramamurti, "Computer Aided Mechanical Design and Analysis", (Third Edition), Tata McGraw-Hill
3. Wahl A. M., "Mechanical Springs"
4. Rothbart John, "Cams", Wily & sons
5. Sidebottom Borosi, "Advanced Mechanics of materials", John Wily & sons Pub
6. Smith Seely, "Advanced Mechanics of materials", John Wily & sons Pub
7. Timoshenko, "Strength of Materials"
8. Kocanda, "Fatigue Failure of Metals", Sijthoff & Noordhoff International Publication
9. Behan & Crawford, "Mechanics of Engineering Materials", John Wily & sons Pub
10. Spotts M. F., "Mechanical Design Analysis", PHI Publications, New Delhi
11. R. C. Juvinall, "Fundamentals of Machine Component Design"

Part-II

2. FINITE ELEMENT METHOD

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches	**6**
2	Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and path test, Higher order elements.	**6**
3	Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, plate bending problems with isotropic and anisotropic materials, structural stability, other applications e.g., Heat conduction and fluid flow problems. Idealisation of stiffness of beam elements in beam-slab problems.	**6**
4	Applications of the method method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems.	**6**
5	FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. O. C. Zienkiewicz and R. L. Taylor, "The Finite Element Method", McGraw Hill
2. J. N. Reddy, "An Introduction to Finite Element Method", McGraw Hill
3. K. J. Bathe, "Finite Element Procedure in Engineering Analysis", McGraw Hill
4. C. S. Krishnamurthy, "Finite Element Analysis", Tata McGraw Hill
5. R. D. Cook, D. S. Malcus and M. E. Plesha, "Concepts and Application of Finite Element Analysis", John Wiley
6. T. R. Chandragupta and A. D. Belegundu, "Introduction to Finite Element Engineering", Prentice Hall India
7. O. C. Zenkiewicy & Morgan, "Finite Element and Approximation"
8. Introduction to Finite Element Method in Engineering by S.S.Rao, Butterworth Heinmann Publication
9. Finite Element Method with applications in Engineering – Desai- Pearson Education

Part-II

3. ADVANCED MANUFACTURING PROCESSES

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Metal cutting:** 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 dynamometer, Drill, Milling and grinding dynamometer, Heat distribution in machining-effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.	**6**
2	**Tool Materials, Tool Life and Tool Wear & Wear Mechanisms:** Essential requirements of tool materials, Developments in tool materials. ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests, Concepts of machinability and machinability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force v/s Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Machinability data systems.	**6**
3	**Sheet Metal Forming & Special Forming Processes:** Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold iso-static pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.	**6**
4	**Unconventional and special Welding Processes and Automation:** Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots, Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding.	**6**
5	**Special Casting Processes & Recent Advances in Casting:** Shell molding, precision investment casting, CO_2 molding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mould casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. M. C. Shaw, "Metal Cutting Principles", Oxford Clarendon Press
2. Bhattacharya, "Metal Cutting Theory and Practice", New Central Book Agency
3. B. L. Juneja and G. S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International
4. G. Kuppuswamy, "Principles of Metal Cutting", Univerties Press
5. D. G. Boothroy and W. A. Knight Marcel Dekker, "Fundamentals of Machining and Machine Tools", NY
6. H. Loper and Rosenthal, "Fundamentals of Metal Casting", Tata McGraw Hill
7. T Altan, Soo-Ik-Oh and H.L. Gegel, "Metal forming-Fundamentals and Applications", American Society of Metals, Metal Park, 1983.

Part-II (Electives)

Group A: Design

A-III. RELIABILITY AND MAINTENANCE ENGINEERING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazard rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	6
2	**Reliability prediction and analysis:** Reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism.	6
3	**Reliability design:** Design for reliability, design process, assessment methodology, reliability allocation reliability improvement, selection of components to improve system reliability.	6
4	**Maintenance in context:** maintenance and profitability, terro-techonology, application of terro-technology. **Principles:** the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model.	6
5	**Establishing a maintenance plan-preliminary consideration:** items, classification of items, maintenance procedure, guidelines for machine procedures to items. **Maintenance planning and control:** Basic requirements, Management information, labour costs, computer based Management information system, work planning and work control, basic rules for success.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control", Hiromitsu
5. Kumampto, "System reliability", PHI Pub.
6. B Bhadury and S. K. Basu, "Technology; Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A. K. Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

Part-II (Electives)
Group A: Design

A-IV. ADVANCED MECHANICAL VIBRATIONS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations.	**6**
2	**Two-degree of Freedom Systems:** Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems. Undamped vibration absorbers, Forced damped vibrations, Vibration isolation.	**6**
3	**Multi-degree Freedom systems:** Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Model analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh,s, Dunkerely, Stodolas and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems.	**6**
4	**Continuous systems:** Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/bars.	**6**
5	**Transient Vibrations:** Response to an impulsive, step and pulse input, Shock spectrum. **Non-linear Vibrations:** Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. J S. Rao and K. Gupta, "Theory and practice of Mechanical Vibrations", New Age International
2. G. K. Groover, "Mechanical Vibrations", Nem Chand & Brothers.
3. V. Ramamurti, "Mechanical Vibration", Practice, Narosa Publications
4. V. P. Singh, "Mechanical Vibrations", Dhanapat Rai & sons
5. R. V. Dukkipati & J. Srinivas, "Textbook of Mechanical Vibrations", Prentice Hall of India

Part-II (Electives)

Group B: CAD/CAM

B-III. RELIABILITY AND MAINTENANCE ENGINEERING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazrd rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	6
2	**Reliability prediction and analysis:** Reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism.	6
3	**Reliability design:** Design for reliability, design process, assessment methodology, reliability allocation reliability improvement, selection of components to improve system reliability.	6
4	**Maintenance in context:** maintenance and profitability, terro-techonology, application of terro-technology. **Principles:** the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model.	6
5	**Establishing a maintenance plan-preliminary consideration:** items, classification of items, maintenance procedure, guidelines for machine procedures to items. **Maintenance planning and control:** Basic requirements, Management information, labour costs, computer based Management information system, work planning and work control, basic rules for success.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control", Hiromitsu
5. Kumampto, "System reliability", PHI Pub.
6. B Bhadury and S. K. Basu, "Technology; Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A. K. Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

Part-II (Electives)

Group B: CAD/CAM

B-IV. COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** The meaning and origin of CIM- the changing manufacturing and management scene – External communication – islands of automation and software-dedicated and open systems-manufacturing automation protocol – related activities of a company marketing engineering – production planning – plant operations – physical distribution – business and financial management**.**	**6**
2	**Group Technology and Computer Aided Process Planning:** History of group technology role of G.T. in CAD/CAM integration – part families – classification and coding – DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. – benefits of G.T. – cellular manufacturing. Process planning – role of process planning in CAD/CAM integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP process planning systems.	**6**
3	**Shop Floor Control and Introduction of FMS:** Shop floor control-phase –factory data collection system –automatic identification methods- Bar code technology-automated data collection system. **FMS-**components of FMS – type –FMS workstation –material handling and storage systems-FMS layout –computer control systems-application and benefits.	**6**
4	**CIM Implementation and Data Communication:** CIM and company strategy – system modeling tools –IDEF models – activity cycle diagram CIM open system architecture (CIMOSA) – manufacturing enterprise wheel-CIM architecture- Product data management CIM implementation software. Communication fundamentals- local area networks –topology –LAN implementations – network management and installations.	**6**
5	**Open System and Database For CIM:** Open systems-open system inter connection manufacturing automations protocol and technical office protocol (MAP /TOP). Development of databases –database terminology- architecture of database systems-data modeling and data associations –relational data bases – database operators – advantages of data base and relational database.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Yorem Koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. M. P. Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
4. David D. Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
5. Roger Hanman "Computer Integrated Manufacturing", Addison- Wesley, 1997.
6. M. P. Groover and Emory Zimmers Jr., "CAD/CAM", PHI Pvt., Ltd., New Delhi, 1998.
7. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
8. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Ed. New Age International (P).

Part-II (Electives)

Group C: Thermal

C-III. COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Conservation Laws of Fluid Motion and Boundary Conditions:** Governing equations of fluid flow and heat transfer, Equations of state, Navier-Stokes equations for a Newtonian fluid.	6
2	**Classification of physical behavior:** Classification of fluid flow equations, Auxiliary conditions for viscous fluid flow equations. **Turbulence and its Modeling:** Transition from laminar to turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models.	6
3	**The Finite Volume Method for Diffusion Problems:** Introduction, one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems, discredited equations for diffusion problems.	6
4	**The Finite Volume Method for Convection-Diffusion Problems:** Steady one-dimensional convection and diffusion, The central differencing scheme, Properties of discretisation schemes-Conservativeness, Boundedness, Transportiveness, Assessment of the central differencing scheme for convection-diffusion problems, The upwind differencing scheme.	6
5	**One-dimensional unsteady heat conduction,** Discretisation of transient convection-diffusion equation, Solution procedures for unsteady flow calculations, Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Anderson, J. D. Jr., "Computational Fluid Dynamics".-McGraw Hill Inc., 1995
2. Hoffman, K. A. and Chaing, S. T., "Computational Fluid Dynamics", Engineering Education System, Kanasa, USA, 1993
3. Chung D. Anderson, "Computational Fluid Dynamics; the Basics with Applications", McGraw-Hill, New York, 1995.
4. Vivek V. Ranade, "Computational Flow Modeling for Chemical Reactor Engineering", Academic Press, San Diego, 2002.

Part-II (Electives)

Group C: Thermal

C-IV.REFRIGERATION AND CRYOGENIC SYSTEMS

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Vapour Compression refrigeration: system:-** Simple systems, Multi-evaporator system; Multi expansion system; Cascade systems; Study of p-h; T-s; h-s and T-h charts for various refrigerants, Concept of Heat pump. **Refrigerant:** Designation, selection, desirable properties, refrigerant blends, secondary refrigerants, refrigerant recycling, reclaim and charging, alternative **refrigerants, Refrigerant lubricant mixture behavior, ODP, GWP concepts.**	**6**
2	**Vapour absorption refrigeration:** Standard cycle and actual cycle, thermodynamic analysis, Li-Br-water, NH-3water systems, Three fluid absorption systems, half effect, single effect, single-double effect, double effect, and triple effect system. **Non-conventional refrigeration system (Principle and thermodynamic analysis only):** Thermoelectric refrigeration, thermo-acoustic refrigeration, adsorption refrigeration, steam jet refrigeration, vortex tube refrigeration, and magnetic refrigeration.	**6**
3	**Compressor rating and selection:** Hermetic, reciprocating, screw, Scroll and centrifugal Compressors based on applications. **Evaporators:** types, thermal design, effect of lubricants accumulation, draining of Lubricants, selection and capacity control. **Condenser:** types, thermal design, purging, selection and capacity control.	**6**
4	**Introduction to Cryogenics:** Importance of cryogenics, Development history of cryogenics, Application areas of cryogenics, Material properties at Cryogenics Temperatures, super conductivity applications, Cryogenics in space Industries. Cryogenics in Aviation and Aerospace Industry, Cryobiology.	**6**
5	**Liquefaction systems:** Carnot Liquefaction system, F.O.M. and Yield of Liquefaction system, Inversion Curve – Joule Thomson Effect. Linde system, Linde-Hampson System, Precooled Linde Hampson System, Claudes system, Dual pressure System, Kapitza system, Heylandt system, Philips machine.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. R. J. Dossat, "Principles of refrigeration", Pearson Education Asia
2. C. P. Arora, "Refrigeration and Air Conditioning", McGraw-Hill
3. W. F. Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill
4. P. C. Koelet, "Industrial Refrigeration: Principles, design and applications", Mcmillan
5. ASHRAE Handbook (i) Fundamentals (ii) Refrigeration
6. ISHRAE handbooks
7. Mamata Mukhopadhyay, Fundamentals of Cryogenic Engineering", PHI Learnig Private limited.
8. R. Baron, "Cryogenic Systems", Oxford University Press.
9. A Bose and P. Sengupta, "Cryogenics applications and progress", McGraw-Hill

Part-II (Electives)

Group D: Industrial Engineering

D-III. RELIABILITY AND MAINTENANCE ENGINEERING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazard rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	6
2	**Reliability prediction and analysis:** Reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism.	6
3	**Reliability design:** Design for reliability, design process, assessment methodology, reliability allocation reliability improvement, selection of components to improve system reliability.	6
4	**Maintenance in context:** maintenance and profitability, terro-techonology, application of terro-technology. **Principles:** the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model.	6
5	**Establishing a maintenance plan-preliminary consideration:** items, classification of items, maintenance procedure, guidelines for machine procedures to items. **Maintenance planning and control:** Basic requirements, Management information, labour costs, computer based Management information system, work planning and work control, basic rules for success.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control", Hiromitsu
5. Kumampto, "System reliability", PHI Pub.
6. B Bhadury and S. K. Basu, "Technology; Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A. K. Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

Part-II (Electives)

Group D: Industrial Engineering

D-IV. INVENTORY AND SUPPLY CHAIN MANAGEMENT

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction to Supply Chain Management (SCM):** Concept of Logistics Management, Concept of supply management and SCM, Core competency, Value chain, Elements of supply chain efficiency, Flow in supply chains, Key issues in supply chain management, Decision phases in supply chain, Supply chain integration, Process view of a supply chain, Competitive Strategy and supply chain strategies, Uncertainties in supply chain, Supply chain drivers.	**4**
2	**Sourcing and Procurement:** Outsourcing benefit, Importance of suppliers, evaluating a potential supplier, Supply contracts, Competitive bidding and Negotiation, E-procurement **Purchasing:** Objectives, Relations with other departments, Centralised and Decentralised purchasing, Purchasing procedure, Types of orders, Tender buying, Purchasing department records, Computer based Systems/EDI. **Stores Management:** Functions, Storage methods, Receiving, Inspection, Issues, and Inventory Valuation.	**4**
3	**Introduction to Inventory Management:** Selective Control Techniques, MUSIC-3D systems, Various costs. **Independent Demand Systems:** Deterministic Models, Quantity Discounts - all units, incremental price; Sensitivity, Make-or-buy decisions. **Multi-item Joint Replenishment:** Economic Production Quantity for multiple items. **Inventory System Constraints:** Exchange Curve (Optimal Policy Curve), Working Capital restrictions, Storage Space restrictions.	**12**
4	**Independent Demand Systems (Probabilistic Models):** **Single order Quantities:** Payoff Matrix, Expected Value Criterion, Lost sales case, Mathematical formulation of discrete and continuous cases. **Dynamic Order Quantities:** Q- system, P- system, Mathematical modeling under known stock out costs and service levels, **Managing inventory in supply chain**: Bullwhip effect, Information and supply chain trade-offs	**10**

Term Work:

Minimum four assignments based on the above syllabus.

References

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
3. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.
4. Tersine, R.J., Principles of Inventory and Materials Management, 4th Edition, Prentice-Hall Inc., New Jersey, 1994.
5. Christopher, M., Logistics and Supply Chain Management, Pitman Publishing, Company, London, 1993.
5. Narasimhan, S.L., McLeavey, D.W. and Billington, P.J., Production Planning and Inventory Control, 2nd Edition, Prentice-Hall India, New Delhi, 1995.
6. Starr, M.K. and Miller, D.W., Inventory Control: Theory and Practice, Prentice-Hall India, New Delhi, 1986.
7. Raghuram, G. and Rangaraj, N., Logistics and Supply Chain Management: Cases and Concepts, Macmillan India Limited, New Delhi, 2000.

Part-II (Electives)
Group E: Production

E-III. RELIABILITY AND MAINTENANCE ENGINEERING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazard rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	6
2	**Reliability prediction and analysis:** Reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism.	6
3	**Reliability design:** Design for reliability, design process, assessment methodology, reliability allocation reliability improvement, selection of components to improve system reliability.	6
4	**Maintenance in context:** maintenance and profitability, tero-techonology, application of terro-technology. **Principles:** the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model.	6
5	**Establishing a maintenance plan-preliminary consideration:** items, classification of items, maintenance procedure, guidelines for machine procedures to items. **Maintenance planning and control:** Basic requirements, Management information, labour costs, computer based Management information system, work planning and work control, basic rules for success.	6

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control", Hiromitsu
5. Kumampto, "System reliability", PHI Pub.
6. B Bhadury and S. K. Basu, "Technology; Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A. K. Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

Part-II (Electives)

Group E: Production

E-IV. COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme:

Lectures: 03 hrs / week

Examination Scheme:

Theory Paper: 100 Marks (3 hrs)

Class Test: 20 Marks (1 hr)

Term Work: 25 Marks

Units	Contents	Hrs
1	**Introduction:** The meaning and origin of CIM- the changing manufacturing and management scene – External communication – islands of automation and software-dedicated and open systems-manufacturing automation protocol – related activities of a company marketing engineering – production planning – plant operations – physical distribution – business and financial management**.**	**6**
2	**Group Technology and Computer Aided Process Planning:** History of group technology role of G.T. in CAD/CAM integration – part families – classification and coding – DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. – benefits of G.T. – cellular manufacturing. Process planning – role of process planning in CAD/CAM integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP process planning systems.	**6**
3	**Shop Floor Control and Introduction of FMS:** Shop floor control-phase –factory data collection system –automatic identification methods- Bar code technology-automated data collection system. **FMS-**components of FMS – type –FMS workstation –material handling and storage systems-FMS layout –computer control systems-application and benefits.	**6**
4	**CIM Implementation and Data Communication:** CIM and company strategy – system modeling tools –IDEF models – activity cycle diagram CIM open system architecture (CIMOSA) – manufacturing enterprise wheel-CIM architecture- Product data management CIM implementation software. Communication fundamentals- local area networks –topology –LAN implementations – network management and installations.	**6**
5	**Open System and Database For CIM:** Open systems-open system inter connection manufacturing automations protocol and technical office protocol (MAP /TOP). Development of databases –database terminology- architecture of database systems-data modeling and data associations –relational data bases – database operators – advantages of data base and relational database.	**6**

Term Work:

Minimum four assignments based on the above syllabus.

Reference Books:

1. Yorem Koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. M. P. Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
4. David D. Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
5. Roger Hanman "Computer Integrated Manufacturing", Addison- Wesley, 1997.
6. M. P. Groover and Emory Zimmers Jr., "CAD/CAM", PHI Pvt., Ltd., New Delhi, 1998.
7. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
8. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Ed. New Age International (P).

6. MECHANICAL LAB - II

Teaching Scheme: **Examination Scheme:**

Practical: 04 hrs / week **Term Work: 5**0 Marks

Minimum five experiments based on the above syllabus of Part-II which may include computer programs.

7. SEMINAR - II

Teaching Scheme: **Examination Scheme:**

Tutorials: 02 hrs / week **Term Work:** 25 Marks

It shall be based on the literature survey on any topic, which may lead to Dissertation in that area. It will be submitted as a report. The candidate will have to deliver a seminar presentation before the faculty members.

8. COMPREHENSIVE VIVA-II

Examination Scheme: **Oral: 5**0 Marks

Comprehensive Viva-II is based on oral assessment of all the subjects of Part-II conducted by internal examiners and external examiner(s) appointed by University.

Part-III

DISSERTATION – Phase I

Teaching Scheme: **Examination Scheme:**

Contact Hours: 12 hrs / week **Term Work: 100** Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The report must include comprehensive literature work on the topic selected for dissertation.

Term work:

The *Dissertation- Phase I* will be in the form of seminar report on the dissertation work being carried out by the candidate and will be assessed by examiners appointed by the department, one of whom will be the guide and other (s) will be expert examiner (s) from the department.

PART -IV

DISSERTATION- Phase II

Teaching Scheme:

Contact Hours: 20 hrs / week

Examination Scheme:

Term Work: 150 Marks

Viva – voce: 150 Marks

The *Dissertation – Phase II* will be in continuation of *Dissertation phase – I* and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in the required number of copies.

The dissertation work may consist of an extensive work, study or analysis of field/industrial problems with appropriate solutions or remedies. It may be any of the following :

1. Fabrication of model, machine, prototype on the basis of innovative ideas.
2. Modeling and/or simulation of a system and improvements in the system.
3. Design of experiments, experimental setups, fabrication of test equipment/rigs, experimentation and Statistical analysis, comparison with the existing data.
4. Renovation of machines, testing equipments.
5. Extensive analysis of some problems solved with the help of suitable software.
6. Design, modeling, analysis and so on as deemed fit.

The bona-fide work carried out for Dissertation Phase – II should be potentially rich in terms of academics.

Dissertation Report

The project report shall be hard bound. It is a report on the work done by the student. It should have Literature review, problem definition and formulation, adopted methodology, experimentation plan if any, Results, conclusions, discussion and its relevance to the further work.

Term work:

The Dissertation will be assessed by internal examiners appointed by the Institute, one of whom will be the guide and others will be concerned faculty members from the Department.

Viva-voce:

It shall consist of a defense presented by the examinee on his work in the presence of examiners appointed by the university, one of whom will be the guide and other will be an external examiner.