**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (MANUFACTURING SCIENCE & ENGINEERING)**

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| **SEMESTER- I** | **Subject** | **L** | **T** | **P/D** | **Total** | **Internal****Marks** | **External****Marks** | **Hrs. Per Week** | **Total Marks** |
| MTMSE-651 | Metal Casting and Joining Processes | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-653 | Reliability andMaintenanceEngineering | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-655 | Non-Traditional Machining Processes | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-657 | Operations Management | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-659 | Theory of Metal Forming | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-661 | Advance Manufacturing Lab | - | - | 2 | 2 | 40 | 60 | 2 | 100 |
| **Total** | **240** | **360** | **22** | **600** |

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| **SEMESTER-II** | **Subject** | **L** | **T** | **P/D** | **Total** | **Internal****marks** | **External****marks** | **Hrs. Per Week** | **Total Marks** |
| MTMSE-652 | Product Analysis and Cost Optimisation | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-654 | Theory of Metal Cutting | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-656 | Computer Integrated Manufacturing andAutomation | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-658 | Non Destructive Testing | 4 | - | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-660 | Metal Cutting and Tool Design Lab | - | - | 2 | 2 | 40 | 60 | 2 | 100 |
| MTMSE-662 | Seminar | - | - | 2 | 2 | 100 | - | 2 | 100 |
|  **Total**  | **300** | **300** | **20** | **600** |

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| **SEMESTER- III** | **Subject** | **L** | **T** | **P/D** | **Total** | **Internal****marks** | **External****marks** | **Hrs. Per Week** | **Total Marks** |
| - | Elective-I | 4 | 0 | - | 4 | 40 | 60 | 4 | 100 |
| - | Elective-II | 4 | 0 | - | 4 | 40 | 60 | 4 | 100 |
| MTMSE-663 | Synopsis of Dissertation | - | - | 2 | 12 | 100 | - | 12 | 100 |
|  |  |  |  |  | **Total** | **180** | **120** | **20** | **300** |

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| **LIST OF ELECTIVES- I&II (MANUFACTRING SCIENCE &ENGINEERING)** |
| 1. | MTMSE-665 | Finite Element Methods |
| 2 | MTMSE-667 | Industrial Robotics |
| 3 | MTMSE-669 | Surface Treatment & Finishing |
| 4. | MTMSE-671 | Composite Materials |
| 5. | MTMSE-673 | Industrial safety, Laws and Patent Acts |
| 6. | MTMSE-675 | Mechanical Working of Materials |
| 7. | MTMSE-677 | Intelligent Manufacturing systems |
| 8. | MTMSE-679 | Applied Probability and Statistics |
| 9. | MTMSE-681 | Industrial Design & Ergonomics |
| 10. | MTMSE-683 | Human Resource Management |

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| **SEMESTER-IV** |  | **L** | **T** | **P** | **Total** | **Internal Marks** | **External Marks** | **Hrs. Per Week** | **Max. Marks** |
| MTMSE-664 | Dissertation | - | - | - | - | 100 | 200 |  | 300 |
|  **Total** |  **300** |  | 300 |

**INSTRUCTIONS FOR PAPER SETTER**

1. The question paper is to be attempted in ***THREE Hours***.

2. Maximum Marks for the paper are ***60***

3. The syllabus for the course is divided into ***FOUR units***

4. The paper will have a total of ***NINE questions.***

5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

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| **Q. No. 2 & 3** | **from** | **Unit I** |
| **Q. No 4 & 5** | **from** | **Unit II** |
| **Q. No. 6 & 7** | **from** | **Unit III** |
| **Q. No 8 & 9** | **from** | **Unit IV** |

6. All questions will have equal ***weight of 12 marks*.**

7. The candidate will attempt a total of ***FIVE questions***, each of 12 marks. Q. No. 1 is compulsory.

*The candidate shall attempt remaining* ***four*** *questions by selecting* ***only one question from each******unit.***

8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b),------. A section may further have any number of subsections labeled as (i), (ii), (iii),----.

**9. SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

**Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

**Emphasis is to be given on the basic concepts; analytical reasoning and understanding of the various topics in the subject** This question may have a number of parts and/or subparts. The shortquestions could be combination of following types:

i. Multiple Choice

ii. Yes/ No choice

iii. Fill in Blanks type

iv. Short numerical computations

v. Short Definitions

vi. Matching of Tables

The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

**1st Semester**

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester) (MANUFACTURING SCIENCE & ENGINEERING)**

**MTMSE–651 METAL CASTING AND JOINING PROCESSES**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**UNIT-I**

**Casting:** Patterns, pattern allowances, mould and core making, melting practice and furnaces, cooling and solidification, Elements of gating system, design of gating system, Theoretical consideration, Directional solidification, Design of risers, Modulus Caine’s and shape factor methods, application of chills.

**UNIT-II**

**Different moulding and casting processes**: Permanent mould casting, shell moulding, die casting, vacuum die casting, squeeze casting, centrifugal casting, investment casting-die casting continuous casting-low pressure casting, Casting defects and their remedies, Fettling and testing of casting.

**UNIT-III**

**Welding and Allied Processes:** Classification, structure and characteristics of welding arc, Arc blow, Methods of arc initiation and maintenance, arc stability, arc welding power sources, Duty cycle, Metal transfer, Selection of Welding process, Different welding processes: Shielded Metal Arc Welding (SMAW), Submerged Arc Welding (SAW), Gas Tungsten Arc Welding (GTAW/TIG), Gas Metal Arc Welding (GMAW), Welding Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding

**UNIT-IV**

**Welding Metallurgy:** Heat flow in welding, Metallurgical transformation in and around weldment, Implication of cooling rates, Heat affected zone (HAZ), Weldability of plain carbon steels, Stainless steels, Cast iron, Aluminium and its alloys.

**Design of weldments**, Joint design, Residual stresses and distortion, Testing of welded joints, Destructive Tests and Non-destructive tests (NDT)

**RECOMMENDED BOOKS:**

**Text Books:**

1. P. L. Jain, Principles of Foundry Technology, 5th edition, TMH Publications, 2009.

2. R. S. Parmar, Welding Processes and Technology, 3 rd Edition, Khanna Publishers, New Delhi, 2011.

**References:**

1. Richard Heine, Carl Loper, Philip Rosenthal, Principles of Metal Casting, TMH Publications, 2004.

2. A. Ghosh a nd A. K. Mallik, Manufacturing Science, East west press, New Delhi, 2006,

3. H.S.Bawa, Manufacturing Technology-I, TMH Publications, New Delhi, 2007.

4. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson Education, 2007

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

**(MANUFACTURING SCIENCE & ENGINEERING)**

**MTMSE–653 RELIABILITY AND MAINTENANCE ENGINEERING**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**UNIT-I**

**Reliability Engineering:** Reliability concepts and patterns of failure, Failure data, reliability function, failure rate and hazard rate, Numerical.

**Common distributions in failure mechanisms** – exponential, Welbull, gamma, Reliability expressions for constant, increasing and decreasing hazard rates. Data Analysis, Probability plots for various distributions- Normal, log normal, extreme value, model selection for components failure, failure analysis, Causes and types of failures.

**UNIT-II**

**Reliability prediction and analysis:** System reliability- series, parallel and mixed configuration, block diagram method, fault tree and success tree methods, event tree method, Numerical.

**Reliability design:** Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability

**UNIT-III**

**Maintenance Planning and Replacement**: Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement..

**Maintenance Systems**: Fixed time maintenance, Condition based maintenance, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terrotechnology

**UNIT-IV**

**Condition Monitoring:** Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, concept of S/N ratio, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis.

**Safety Aspects**: Importance of safety, Factors affecting safety, Safety aspects of site and plant, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety

**RECOMMENDED BOOKS:**

1. Industrial Engineering and Management Khanna O.P Dhanpat Rai & Sons 1994

2. A textbook of Reliability and Maintenance Engineering by Dr. Alakesh Manna, I K International.

3. Maintenance Planning and Control, Kelly A Buttersworth & Co. 1984

4. Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd

5. Reliability Engineering and Technology, Gupta, A.K Macmillan India Ltd. 1996

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

**(MANUFACTURING SCIENCE & ENGINEERING)**

**MTM SE-655 NON-TRADITIONAL MACHINING PROCESSES**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**Unit I**

**Introduction:** Need for non-traditional machining processes, Processes selection, classification – comparative study of different processes.

Mechanical Process: Ultrasonic machining, whirling jet machining. Fundamental principles, process parameters, characteristics, Tool design, Metal removal rate-analysis, important part design, Analysis of the Process.

**Unit II**

**Abrasive Jet Machining**: Principles - parameters of the process, applications-advantages and disadvantages.

**Thermal Metal Removal Process**: Electric discharge machining- basic principles & scheme, circuitry controls, metal removal rate, machining accuracy, optimisation, selection of tool material and tool design, Di-electric, Analysis, Applications.

**Unit III**

**Electro Chemical and Chemical Processes**: Electro chemical machining (ECM)- Classification ECM process, principle of ECM, Chemistry of the ECM, parameters of the processes-determination of the metal removal rate, dynamics of ECM process, Hydrodynamics of ECM process ,polarization, Tool Design-advantages and disadvantages, applications, Electro Chemical Grinding, Electro Chemical holding, Electrochemical deburring.

**Chemical Machining**: Introduction-fundamental principle, types of chemical machining, Maskants- Etchenes- Advantages and disadvantages, applications.

**Unit IV**

**Plasma Arc Machining**: Introduction-Plasma-Generation of Plasma and equipment, Mechanism of metals removal, PAN parameters, process characteristics, type of torches, applications.

**Electron Beam Machining (EBM)**: Introduction-Equipment for production of Electron beam, Theory of electron beam machining, Thermal & Non thermal types, characteristics, applications.

**Laser Beam Machining (LBM)**: Introduction-principle of generation of lasers, Equipment and Machining procedure, Types of Lasers, Process characteristics, advantages and limitations, applications

**RECOMMENDED BOOKS:**

1. New Technology Institution of Engineers - Bhattacharya - India

2. Production Technology - HMT - Tata Mc Graw Hill - ISBN-10; 0070964432

3. Modern Machining Process - P.C Pandy & H.S. Shan – Tata McGraw Hill - ISBN: 0070965536 – Publishing Date: Feb-80

4. Metals Hand Book - ASM - Vol-3.

5. High Velocity Forming of Metals - F.M Wilson - ASTME Pretice Hall. 1997

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE-657 OPERATIONS MANAGEMENT**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60 Time- 3Hrs.**

**Unit I**

**Operations Concepts**: Introduction to operations management, Operations function in organizations, Brief history of operations management, Functions of an Operations Manager, Scope of Operations management, Operations management in an E-business environment (Trends in business), Productivity, Factors affecting productivity, Computation of total factor productivity and partial factor productivity.

**Operations Decision Making :** Introduction, Characteristics of decisions, Framework for decision making, Decision types, Decision Tree Problems, Economic models-Break Even Analysis in operations, Statistical models.

**Unit II**

**System Design and Capacity:** Introduction, Manufacturing and service systems, Design the systems capacity, Capacity planning.

**Forecasting Demand:** Forecasting objectives and uses, Elements of a good forecast, Steps in forecasting process, Classification of forecasting methods – Qualitative (subjective) and Quantitative (objective) methods, Application and control of forecasts-Mean Absolute Deviation, BIAS, Tracking Signal.

**Unit III**

**Aggregate Planning and Master Scheduling:** Introduction, Objectives of aggregate planning, Pure and mixed strategies of aggregate planning, Aggregate planning for services; Master scheduling objectives, Master scheduling methods.

**Flow Shop Scheduling and Job Shop Scheduling**: Introduction, Johnson’s rule for sequencing **‘n’** jobs on 2 and 3 machines, CDS heuristic method.

**Unit IV**

**Material and Capacity Requirements Planning:** An overview of MRP, MRP inputs, MRP processing, MRP outputs, Benefits and requirements of MRP; Capacity Requirement Planning - CRP process, CRP inputs and outputs.

**Operations Scheduling:** Introduction, Objectives of scheduling, Activities in operations scheduling, Graphical tools used in scheduling, Types of scheduling and loading, Types of scheduling problems and solution methods, Single machine scheduling using priority decision rules.

**RECOMMENDED BOOKS:**

1. Operations Management – Roberta Russell and Bernard Taylor, Pearson publishers, 2011.

2. Operations Management – William Stevenson, Tata McGraw Hill, latest edition

3. Production and Operations Management – Kanishka Bedi, Oxford University Press, 2007.

4. Operations Management – Norman Gaither and Greg Frazier, Thomson South-Western, latest edition.

5. Operations Management – Joseph Monks, McGraw Hill, latest edition.

6. Operations Management – Buffa and Sareen, Wiley Eastern Ltd.

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE-659 THEORY OF METAL FORMING**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**Unit I**

**Introduction to Forming Process:** Introduction to metal forming, Effect of temperature on forming process-hot working, cold working. Effect of Metallurgical structure, Effect of speed of deformation work on Plastic deformation, Friction in forming operation.

**Forging**: Classification, various stages during forging, Forging equipment, brief description, deformation in compression, forging defects. Residual stresses in forging.

**Unit II**

**Rolling of Metals** Classification of rolling mills, analysis of the process. Prediction of roll pressure for flat strip rolling in the leading and lagging zones, roll separating forces, torque on the roll, affect of front and back tensions, affect of support rolls, various factors which affect rolling force.

**Unit III**

**Extrusion:** Classification, Extrusion equipment, variables in extrusion, Deformation in extrusion, Extrusion defects, Work done in extrusion.

**Drawing:** Principles of Rod and wire drawing, variables in wire drawing, Residual stresses in rod, wire and tube drawing, Defects in Rod and wire drawing.

**Unit IV**

**Sheet Metal Forming:** Introduction, Forming methods, shearing and Blanking, Bending, stretch forming.

**Deep Drawing**: Theory and deep drawing of circular blanks, analysis of the process, prediction of radial stress and punch load, ironing, wrinkling, blank holding and various parameters/variables affecting the deep drawing process.

**RECOMMENDED BOOKS:**

1. Mechanical MetalIurgy - Dieter G.E. - Mc Graw Hill Publications.

2. Principles of Metal Working - R.Rowe - Amold London – 1965.

3. Metals Handbook – ASM - Volume II -.ASM

4. Fundamentals of working of Metals - Sach G. - Pergamon Press

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE-661 : ADVANCED MANUFACTURING LAB**

 **Time- 2Hrs.**

**List of Experiments –**

1. Exercises on grinding and surface measurement

2. Measurements in Universal Measuring Microscope, Profile Projector, and with various advanced instruments,

3. Flatness measurement using autocollimator,

4. Metallographic studies using Metallurgical Microscope,

5. Programming and measurements with CNC Coordinate Measuring Machine, surface texture analysis,

6. Experiments on non destructive evaluation using ultrasonic testers,

7. Exercises on virtual instrumentation.

8. Preparation of standard specimen and testing on UTM.

**Note: Total Eight experiments must be performed. At least six experiments should be**

**performed from the above list. Remaining two experiments may either be performed**

**from the above list or outside the list.**

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE-652 : PRODUCT ANALYSIS AND COST OPTIMISATION**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**Unit I**

New product strategy, market definition - idea generation - design process - forecasting sales potential - product engineering, manufacturing planning - selection of economical process - standardization - implification – specialization - break even analysis.

**Unit II**

Value engineering – Evaluation of function, determining function - classifying function - evaluation of costs - evaluation of worth - determining worth - evaluation of value – value engineering

**Unit III**

Job plan information phase - Speculation phase - analysis phase - development phase - presentation phase - implementation phase - follow up phase - fast diagramming – cost models - life cycle costs.

**Unit IV**

Cost accounting - Cost estimation, Cost calculations for machined components, welding, casting and forging components - calculation of selling price - activity based cost analysis.

**REFERENCES BOOKS :**

1. Samual Eilon, “Elements of Production Planning and Control”,Universal Book Co,1984

2. Miles L.D, “Techniques of Value Engineering and Analysis”, McGrawHill, 1972.

3. Narang, C.B.S and Kumar V, “Production and Costing”, Khanna publishers ,1983.

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE-654 : THEORY OF METAL CUTTING**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**Unit I**

**Mechanics of Metal Cutting:** Mechanism of chip formation, Orthogonal & Oblique cutting, Types of chips, Built-up edge, Determination of shear plane angle, Forces on the chips, forces in orthogonal cutting, Merchant circle diagram and analysis, Theory of Lee & Shaffer, Co-efficient of friction, Power & Energy Relationship, Velocity Relationship, Shear-Strain, Factors affecting forces and power, Problems.

**Geometry of Cutting Tools:** Single point and Multi point cutting tools, Tools nomenclature, Tool point reference systems, Tool angle specifications –ISO and ASA systems, Conversion from one system to another. Recommended tool angles, Effect of cutting parameters on tool geometry.

**Unit II**

**Tool Materials and Their Properties:** Characteristics of Tool Materials, Types of tool materials – Carbon tool steels, High speed steels, Cast alloys, Cemented carbides, Ceramics, Diamonds, SIALON, CBN, UCON, Recommended Cutting Speeds for the above Tools, Water, Oil hardening of Tools and their applications.

**Measurement of Cutting Forces:** Reasons for Measuring cutting forces, Classification of cutting force dynamometers – Mechanical, Hydraulic, Pneumatic, Optical, Inductance, Piezoelectric, and Strain gage type Dynamometers, Dynamometers for lathe, Drilling, and Milling, Calibration of Dynamometers.

**Unit III**

**Tool Wear, Tool Life:** Mechanisms of tool wear, Sudden & gradual wear, crater wear, Flank wear, Tool failure criteria, tool life equations, Effect of process parameters on tool life, Tool life tests, conventional & Accelerated tool wear measurement, Machinability index.

**Thermal Aspects in Metal Cutting:** Heat sources in metal cutting, Temperature in chip formation, Temperature Distribution, Experimental Determination of Tool Temperatures.

**Unit IV**

**Cutting Fluids:** Basic actions of cutting fluids, properties of cutting fluids, Selection of cutting fluids, application of cutting fluids, Filtration of fluids, Recommended cutting fluids.

**Economics of Machining:** Introduction, Elements of total production cost, Optimum cutting speed and tool life for Minimum cost, Optimum cutting speed and Tool life for Maximum Production, Problems.

**REFERENCES BOOKS :**

1. Metal Cutting Principles - M.C. Shaw - Oxford Publication – 1985.

2. Fundamentals of Metal Cutting & Machine Tools – by B.L.Juneja & G.S – Sekhar - Wiley Eastern.

3. Metal Cutting - V.C.Venkatesh & S.Chandrasekhanan – Pantice Hall – 1991.

4. Metal Cutting - Dr. B.J.Ranganath -Vikas Publications

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd SEMESTER)**

**(MANUFACTURING SCIENCE & ENGINEERING)**

**MTIP-656 : COMPUTER INTEGRATED MANUFACTURING AND AUTOMATION**

**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**UNIT-I**

**Production Development Through CIM:** Computers in Industrial manufacturing, Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping.

**Computer Process Monitoring:** Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control.

**UNIT-II**

**Computer Aided Quality Control:** The computer in Q.C, automated inspection principles and methods, Contact inspection methods, non-contact inspection methods, machine vision system, optical inspection method, sensors, coordinate, measuring machine, Computer-Aided testing, Integration of CAQL with CAD/CAM.

**Computer Integrated Manufacturing:** Fundamentals of CAD/CAM, Computerized Manufacturing planning systems, shop floor control & automatic identification techniques. Computer Network for manufacturing and the future automated factor.

**UNIT-III**

**Detroit Type of Automation:** Flow lines, Transfer Mechanisms, work pattern transfer, Different methods, & Problems.

**Analysis of Automated Flow Lines:** Analysis of transfer lines without storage with storage buffer single stage, Double stage, Multistage with problems, Automated assembly systems, Design for automated assembly, parts feeding devices, analysis of Multi station assembly machine, Analysis of Single stage assembly machine.

**UNIT-IV**

**Automated Material Handling Storage:** Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems ,work in process storage, interfacing handling & storage with manufacturing.

**RECOMMENDED BOOKS :**

1. **CAD/CAM** - Zimmers & Grover – PHI.

2. **CAD/CAM/CIM** - P.Radhakrishna - New Age International - 2nd edition.

3. **Automation, Production systems & Computer Aided Manufacturing** - M.P. Grover - Prentice Hall - 1984.

4. **CAD/CAM** - Zeid – Mc-Graw Hill - 2005.

5. **CAD/CAM** - P.N.Rao - TMH.- 2 nd edition, 2004.

6. **Robotics for Engineering** - Koren.Y - Mc-Graw Hill - 1985.

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| **MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)**

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| **(MANUFACTURING SCIENCE & ENGINEERING)** |  |  |

**MTMSE : 658 NON DESTRUCTIVE TESTING** |  |
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**L T P/D Hrs. Internal Marks 40**

**4 0 - 4 External Marks 60**

 **Time- 3Hrs.**

**UNIT-I**

**Introduction to ND Testing:** Selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation.

**Magnetic Particle Inspection:** Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations.

**UNIT-II**

**Eddy Current Inspection:** Principles, operation variables, procedure, inspection coils, and detectable discounts by the method.

**Microwave Inspection:** Microwave holography, applications and limitations.

**UNIT-III**

**Ultrasonic Inspection:** Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods- Pulse echo, A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks.

**UNIT-IV**

**Radiography Inspection:** Principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment, inspection methods applications.

**Optical Holography:** Basics of Holography, recording and reconstruction – Acoustical Holography: systems and techniques applications. Indian standards for NDT.

**RECOMMENDED BOOKS :**

1. **Non Destructive Testing** - Mc Gonnagle JJ – Garden and reach New York.

2. **Non Destructive Evolution and Quality Control -** volume 17 of metals hand book 9 edition Asia internal 1989 .

3.**The Testing Instruction of Engineering Materials** - Davis H.E Troxel G.E wiskovil C.T.McGraw hill.

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Semester)**

**(MANUFACTURING SCIENCE & ENGINEERING)**

**MTMSE–660 Metal Cutting and Tool Design Lab**

  **Time- 2Hrs.**

**List of Experiments:**

1. Measurement of shear plane angle

2. Measurement of cutting forces in orthogonal cutting

3. Measurement of cutting forces in oblique cutting

4. Study of surface conditions during grinding process

5. Calculation of tool life during machining process

6. Measurement of tool chip interface temperature

7. Fabrication of single point cutting tool as per given tool signature

8. Study of tool wear on different cutting tools.

9. Design of stamping dies.

**Note: Total Nine experiments must be performed. At least Seven experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Semester)**

**(MANUFACTURING SCIENCE & ENGINEERING)**

**MTMSE–662 SEMINAR**

**L T P/D Hrs. Internal Marks 100**

**4 0 - 4 External Marks -**

 **Time- 3Hrs.**

Students are required to deliver a seminar on some emerging areas of Manufacturing Science & Engineering or related field.

The student will deliver a power point presentation for about 30 minutes in the seminar on any of the above topics. This will be followed by question answering session for about 10 minutes. The questions/queries on the topic will be asked by the teacher and class students. The students will also prepare a detailed report in MS word and after proper binding (spiral form) will submit it to the teacher concerned. The report is to be submitted at least one week prior to the presentation. The awards will be given according to the student’s presentation, report submitted, topic of presentation and the discussion or question answering after the presentation.