

# Detailed Syllabi

## MTech

IN

## MANUFACTURING TECHNOLOGY



2017-18

Department of Mechanical Engineering

JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY

A-B ROAD, RAGHOGARH, DT. GUNA-473226 MP, INDIA

**Master of Technology (M.Tech.)  
Branch – MEC**

**(Applicable from 2017 Batch Onwards)**

SEMESTER – I (M-1)

Course Code	Title	Core/Elective	L	T	P	Credits
14M11ME111	Analysis and Design of Machine Tools	Core	3	0	0	03
14M11ME112	Metal Machining	Core	3	0	0	03
14M11ME113	Casting and Welding	Core	3	0	0	03
14M11ME114	Unconventional Manufacturing Processes	Core	3	0	0	03
14M17ME172	Metal Machining Lab	Core	0	0	2	01
14M17ME173	Casting and Welding Lab	Core	0	0	1	01
14M14ME131-133	Elective – I	Elective	3	0	0	03
			<b>Sub Total</b>			<b>17</b>

SEMESTER – II (M-2)

Course Code	Title	Core/Elective	L	T	P	Credits
14M11ME211	Computer Integrated Manufacturing	Core	3	0	0	03
14M11ME212	Mechanics of Metal Forming	Core	3	0	0	03
14M11ME213	Additive Manufacturing Process	Core	3	0	0	03
14M11ME214	Mechatronics	Core	3	0	0	03
14M17ME271	Computer Integrated Manufacturing Lab	Core	0	0	2	01
14M17ME272	Metal Forming Lab	Core	0	0	2	01
14M14ME231-233	Elective – II	Elective	3	0	0	03
			<b>Sub Total</b>			<b>17</b>

SEMESTER – III (M-3)

Course Code	Title	Core/Elective	L	T	P	Credits
14M14ME331-334/15M14ME338	Elective – III	Elective	3	0	0	03
14M14ME335-337	Elective – IV	Elective	3	0	0	03
14M19ME391	Seminar I	Core	0	0	4	02
14M19ME392	Dissertation Part I*	Core	0	0	24	12
			<b>Sub Total</b>			<b>20</b>

\*The research work of Dissertation Part I is continued in the 4<sup>th</sup> semester.

SEMESTER – IV (M-4)

Course Code	Title	Core/Elective	L	T	P	Credits
14M14ME431/14M14CL452	Elective – V	Elective	3	0	0	03
	Elective – VI	Elective	3	0	0	03
14M19ME491	Seminar II	Core	0	0	4	02
14M19ME492	Dissertation Part II*	Core	0	0	28	14
			<b>Sub Total</b>			<b>22</b>

\*The research work in Dissertation Part I is continued in Dissertation Part II. The evaluation of dissertation Part II is done on the basis of the work done in both the semesters.

### LIST OF DEPARTMENT ELECTIVES

	<b>Code</b>	<b>Subject</b>
Elective – I	14M14ME131	Industrial Inspection and Quality Control
	17M14ME131	Welding Metallurgy
	14M14ME133	Tool and Die Design
Elective – II	17M14ME231	Design of Experiments
	14M14ME232	Experimental Mechanics and Non-Destructive Testing
	14M14ME233	Advanced Materials Technology
Elective – III	14M14ME331	Hydraulic and Pneumatic Control System
	14M14ME332	Micro-Fabrication
	14M14ME333	Robotics and Automation
	14M14ME334	Operations and Supply Chain Management
	15M14ME338	Modelling and Optimization Techniques in Engineering
Elective - IV	14M14ME335	Laser Beam Machining
	14M14ME336	Advanced Composite Materials
	14M14ME337	Computer Aided Design and Drafting
Elective – V	14M14ME431	Finite Element Analysis
	14M14CL452	Environmental Engineering
	14M14CI132	Artificial Intelligence in Manufacturing
Elective - VI	14M14ME432	Concurrent Engineering
	14M14MA432	Optimization and Statistical Methods
	14M14ME433	Advanced Metrology and Computer Aided Inspection

## **Year/Sem: Ist Year/Ist Sem**

### **14M11ME111 Analysis and Design of Machine Tools**

Introduction to machine tools, Design of Machine Tool: Design of Machine tool drives, Design of Kinematic Schemes of Machine Tools, Design of kinematic schemes used in modern machine tools drives, Design and Analysis of Machine Tool Structures, Static and dynamic testing of machine tools.

### **14M11ME112 Metal Machining**

Mechanics of Metal Cutting, Thermal Aspects of Machining. Cutting fluids, Tool Wear, Tool Life. Machinability, Economics of Machining. Abrasive Processes, Vibrations in Cutting. Introduction to Modern Machining Processes.

### **14M11ME113 Casting and Welding**

**Castings** : Mechanism of Solidification, Design Principles of Gates, Runners and Risers. Design of Casting, Iron-Carbon Equilibrium Diagram, TTT Curves. **Welding**: Theory of fusion and pressure welding, flow and distribution of heat in welding, Weldability.

### **14M11ME114 Unconventional Manufacturing Processes**

Introduction to Unconventional Manufacturing Processes, Working principle AJM, AWJM, USM, EDM, EBM, LBM, PAM, IBM, ECM, ECG, CHM, etc. Hybrid Machining process. High Velocity Forming Process, Formability criteria.

### **14M17ME172 Metal Machining Lab**

S.No.	Name of Experiments
1.	Determine the shear plane angle and shear strain of a work piece on shaper
2.	To determine the roughness in a specimen
3.	Optimization of current to overcome the taper obtains during EDM drilling process

### **14M17ME173 Casting and Welding Lab**

S No	Name of Experiment
1	To design a wooden pattern for casting of cast iron
2	Making a wooden pattern designed in Experiment No. 1.

3	Preparing butt joint of two steel plates using manual Metal Arc Welding (MMAW)
4	Preparing lap joint of steel plates using Oxy Acetylene Gas welding.
5	To cut steel sheets of different thicknesses with the help of an oxy-acetylene gas cutting
6	To determine the hardness of Heat Affected Zone produced by welding and cut steels using oxy acetylene flame by Rockwell hardness tester.

### **14M14ME131 Industrial Inspection and Quality Control**

Concept of Quality, Quality Function, Quality Traits, Quality Characteristics, Inspection Inspection Planning, Measurement Errors, Objectives of Inspection, Floor / Patrol Inspection, Centralized Inspection, Process Inspection, Final Inspection, Difference between Inspection & Quality Control. Quality Assurance Importance, Quality Control and Management System, Analysis of Process Capability.

### **17M14ME131 Welding Metallurgy**

Introduction to welding and joining processes: Introduction to consolidation processes, Classification of welding processes, some common concerns, types of fusion welds and types of joints, physics of welding arc, Arc maintenance and arc characteristics, arc efficiency, welding power source. Heat flow - temperature distribution-cooling rates - influence of heat input, joint geometry, plate thickness, preheat, significance of thermal severity number. Fundamentals of physical metallurgy: Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, phase transformations in Fe-C system, TTT diagram, CCT diagram, carbon equivalent, Schaffer diagram, relevance of above in welding. Solidification of weld metal: Principle of solidification of weld metal, modes of solidification, effect of welding parameters on weld structure, grain refinement principle of weld metal, method of weld metal refinement, inoculation, arc pulsation, external excitation. Heat affected zone and weld metal: Transformations in HAZ of steel, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction. Metallurgical issue in weld joint: Mechanisms, causes and remedy of cold cracking, solidification cracking, nonmetallic inclusions, lamellar tearing, hydrogen damage, banding, segregation.

### **14M14ME133 Tool and Die Design**

Design of Cutting Tools, Chip breakers and their design. Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal, Design of Dies used for Casting and Moulding, Powder Metallurgy die design.

### **Year/Sem: Ist Year/ IInd Sem**

### **14M11ME211 Computer Integrated-manufacturing**

Automation strategies, levels of automation, Introduction to NC, CNC and DNC and Computer integrated manufacturing, CIM wheel, components of CIM. Part programming: Flexible Manufacturing System, Automated Material Handling and AS/RS, Robotics and Automated Inspection & Testing: introduction to robot programming, Manufacturing Support System

#### **14M11ME212 Mechanics of Metal Forming**

Analysis of Stress and Strain, General Equations of Elasticity, Plastic deformations, Theories of Plasticity. Modeling Techniques: slip line slab, Upper Bound and FEM. Mechanics & Analysis of Manufacturing Processes, Analysis of Die failure in Metal Forming. Strain, Strain rates and thermal effects in metal forming.

#### **14M11ME213 ADDITIVE MANUFACTURING PROCESS**

Additive Manufacturing (AM), Medical AM and Rapid Tooling, Rapid manufacturing: Different applications of AM for directly making end-use parts – industrial applications, utilizing porous property. Mass Data validity checks for AM, Reverse Engineering (RE), Need for RE, Three phases in the generic RE process – scanning, point processing and geometric modeling.

#### **14M11ME214 Mechatronics**

Introduction to Mechatronics System, Elements of Data Acquisition System. Actuators, Sensors & Transducers: Fluid Power and Electrical Actuators-Piezoelectric Actuator; Sensors for position, motion, force and temperature-Flow sensors-Range sensors-Ultrasonic sensors-Fibre Optic Sensors-Magnetostrictive transducer-Selection of Sensors. Time Delays-Measures of System performance; Microprocessors, Micro-controllers and Programmable Logic Controllers-Components-PLC programming.

#### **14M17ME271 Computer Integrated Manufacturing Lab**

XL Turn Machine:

1. Write a manual part program for Linear and Circular Contour (G01, G02, and G03) operation for the component.

XL Mill Machine:

2. Write a manual part program for Contouring (G01, G02, and G03) operation (Linear & Circular Interpolation) for the component.

5-axis and 6-axis Robot:

3. Write a program for pick and place operation for 5-axis robot

#### **14M17ME272 Metal Forming Lab**

<b>Sr. No.</b>	<b>Name of Experiment</b>
1.	To study the UTM and perform the tensile test on given specimen
2.	To perform compression test on UTM.
3.	To study the effects of material properties (ductility, types, strength) on the springback and bending force.
4.	To compare formability of sheet metals using Erichsen Cupping test.

### **17M14ME231 Design of Experiments**

Basic Concepts: Fundamentals of experimental design, Selection of an appropriate design, Criteria for evaluation, Factors and levels, Review of statistical inference, Importance of optimized design, Functional design, Parametric design Single Factor Experiments: Introduction to one parameter at a time study, Analysis of variance (ANOVA), total sum of Squares, mean sum of the square, degree of freedom, calculation of p-value and f-value, physical significance of p-value and f-value, Randomized block design, Randomized incomplete block design. Factorial Design: Introduction to factorial design, types of factorial design, two way analysis of variance, Fixed, Random and Mixed models, Expected mean square rules. Response Surface Methodology (RSM) – Introduction to RSM, Central composite designs (CCD), Central Composite Rotary Design (CCRD), number of experiments required in RSM, Box-Behnken design, The method of steepest ascent, response surface designs, Statistical regression techniques, fitting of regression models. Robust Parameter Design: Steps in designing performance in to a product, Taguchi's definition of quality, Loss functions in quality, Orthogonal arrays, Types of Orthogonal arrays, selection of orthogonal array (OA), Orthogonal arrays vs. classical statistical experiments, Graphic evaluations of main effects, Selecting factors for Taguchi Experiments, Concept of S/N Ratios – its significance in robust design. Applications of RSM in Engineering, Case studies of S/N ratios in optimization, Identifying control and noise factors, Applications of Robust parameter design methodology.

### **14M14ME232 Experimental Mechanics and Non-Destructive Testing**

Experimental Mechanics, Interferometry, Holography, Moire fringe and their application in stress analysis, strain gauges and transducers, Modern NDE methods of flaw detection.

### **14M14ME233 Advanced Materials Technology**

Review of Mechanical Behavior of Materials, Griffith's theory of failure, Creep mechanisms, Diffusion coating, Electroplating and Electroforming Advanced Heat Treatment of Materials, Super alloys-Refractory materials-Ceramics and their applications.



## **Year/Sem: IInd Year/IIIrd Sem**

### **14M14ME331 Hydraulic and Pneumatic Control System**

Introduction to oil hydraulics and pneumatics, Hydraulic control, Electro hydraulic servomechanisms, Nonlinearities in control systems, Basic configurations of hydraulic power supplies, Development of single and multiple actuator circuits, Valves for logic functions; Time delay valve.

### **14M14ME332 Micro-fabrication**

Introduction, Micrometrology and Materials Characterization, Simulation of Microfabrication processes, Moulding and Stamping. Structures, Structures by Deposition, Tools for Microfabrication, Integrated Processing.

### **14M14ME333 Robotics and Automation**

Fundamentals of Automation: Strategies and economics, Manufacturing systems, Flexible Manufacturing Systems, Group Technology, Computer - Integrated Manufacturing systems, Programming languages, Work cell control Robot sensors, Robot applications.

### **14M14ME334 Operations and Supply Chain Management**

Forecasting, Facility layout and location. Capacity and aggregate planning, Outsourcing and transportation, Distribution and logistics in supply chains, Information technology in supply chain.

### **14M14ME335 Laser Beam Machining**

Lasers for Machining: Properties, Generation of laser beam, Basics of Laser Machining: Laser processing of materials and process capabilities, Laser processing of materials and process capabilities, Laser Micromachining.

### **14M14ME336 Advanced Composite Materials**

Fibers and matrices, various composites, Stress-strain distribution at fibre ends, Thermal stresses and curing stresses, Failure modes of fiber composites, Manufacturing techniques of composites, Current and potential applications of composites.

### **14M14ME337 Computer Aided Design and Drafting**

Computer aided design, Computer representation drawing and diagrams, Representation of Curves, Techniques for visual realism: hidden line removal, surface removal Entity manipulation and data storage: manipulation of model, object transform, mirror transformation, Data Structure and Interactive Modeling, Object oriented representation.

### **15M14ME338 Modelling and Optimization Techniques in Engineering**

Introduction : need for modelling and optimization of manufacturing processes, constrained optimization methods, Design of experiments, statistical regression techniques, fitting of

regression models, grey relational analysis (gra), Meta-heuristics: genetic algorithms, simulated annealing, tabu search, particle swarm optimization, ant colony optimization and bee algorithms.

### **Seminar I 14M19ME391**

The Seminar-I is an independent course, not related to Dissertation Part-I. The student is expected to give clear and concise oral presentations in the three evaluations.

### **14M19ME392 Dissertation Part I**

The objective of Dissertation Part-I is to promote a systematic understanding of the knowledge, critical awareness of current problems, originality in the application of knowledge and the quality of work.

### **Year/Sem: IInd Year/IVth Sem**

#### **14M14ME431 Finite Element Analysis**

Introduction: Basic concepts – steps involved in finite element analysis, Finite element analysis of fluid mechanics and heat transfer problems, Bending of beams, Eigen value and time dependent problems, Finite element error analysis – Automatic mesh generation.

#### **14M14CL452 Environmental Engineering**

The Multidisciplinary nature of environmental studies, Environmental standards & Quality, Sustainable building, Policy and law: Environmental Laws & Regulations (Different Acts – Environmental Protection Act, Air and Water Acts, Wildlife and Forest Acts), National Environmental Policy, Case studies, Explore the surrounding flora & fauna.

#### **14M14CI132 Artificial Intelligence in Manufacturing**

Introduction: Artificial Intelligence, Knowledge Sources: Knowledge Sources, Expert System Languages: Expert System Languages - ES Building Tools or Shells; Typical examples of Shells. Expert System software for manufacturing applications in CAD, CAPP, MRP, Adaptive control. Linking expert systems to other software, Case studies of typical applications in tool selection.

#### **14M14ME432 Concurrent Engineering**

Fundamentals of concurrent engineering, Introduction to various integrating mechanisms, Forming of concurrent engineering team, Quality By Design, Design For Manufacturability: Virtual manufacturing, Value engineering analysis and techniques, Rapid Prototyping, Design for serviceability, Design for maintainability and economics.

#### **14M14MA432 Optimization and Statistical Methods**

Functional and externals, functional spaces, Euler equation, Natural boundary and transition conditions, Lagrange's equations of motion, Statistical models : random variables, probability

distributions, data analysis, estimation of point and confidence interval, regression models, analysis of variance, experimental design.

#### **14M14ME433 Advanced Metrology and Computer Aided Inspection**

Experimental Test Plan, Surface Roughness Measurement, Data acquisition and filtering, Form Evaluation, Coordinate Measuring Machines: construction, thermal and environmental effects, CMM Software, Latest Developments: Machine Vision, Laser Interferometry, Nanometrology.

#### **14M19ME491 Seminar II**

Seminar-II is a course requirement wherein under the guidance of a faculty member, a student is expected to do in-depth study in a specialized area by performing literature survey.

#### **14M19ME492 Dissertation Part II**

Each student should present analytical and/or experimental works in consultation with his/her supervisor towards the fulfillment of Master's degree. The evaluation will be done based on the work done in both the semesters. In the end-semester evaluation of 4<sup>th</sup> semester, the student will present his/her research work and defend his/her dissertation. Dissertation has to be submitted to the University for Partial Fulfillment of M. Tech. program according to university rules.