Scheme of M. Tech. I to IV Semester (Manufacturing Technology) w.e.f the session 2013-14.

1st SEMESTER

Name of subjects	Hrs./Week				Evaluation(Marks)				
	Lecture	Tutorial	Practical	Duration (Hrs)	Internal	Theory	Practical	Total	Time (Hrs.)
Automation and Computer-Integrated Manufacturing (MET-501)	3	1	0	4	25	75	_____	100	3
Robotics Engineering(MET-503)	3	1	0	4	25	75	_____	100	3
Machine Tool Design(MET-505)	3	1	0	4	25	75	_____	100	3
CIM Lab (MET-507)	_____	_____	4	4	25	____	50	75	-
Seminar (MET-509)	2	0	0	2	25	--------	-------	25	-
Total				18				400	-

2nd SEMESTER

Name of subjects	Hrs./week				Evaluation Marks				
	Lecture	Tutorial	Practical	Duration (Hrs.)	Internal	Theory	Practical	Total	Time (Hrs.)
Mechatronic Systems (MET-502)	3	1	0	4	25	75		100	3
Advanced Manufacturing Science(MET-504)	3	1	0	4	25	75		100	3
Advanced Tribology(MET-506)	3	1	0	4	25	75		100	3
Operation Research and Optimization Techniques(MET-508)	3	1	0	4	25	75		100	3
Product Design and Development(MET-510)	3	1	0	4	25	75		100	3
Optimization Techniques Lab	0	0	4	4	25		50	75	-

(MET-512)									
Mechatronic Lab(MET-514)	0	0	4	4	25		50	75	-
Total				28				650	-

3rd SEMESTER

Name of subjects	Hrs./Weeks				EVALUATION(Marks)				Time (Hrs.)
	Lecture	Tutorial	Practical	Duration (Hrs.)	Internal	Theory	Practical	Total	
Non-Conventional Machining(MET-601)	3	1	0	4	25	75		100	3
Production Planning and Control(MET-603)	3	1	0	4	25	75		100	3
Advance Material Science (MET-605)	3	1	0	4	25	75		100	3
Elective*	3	1	0	4	25	75		100	3
Dissertation Comprehensive (MET-607)			4	4	100			100	-

Name of subjects									
Advance Manufacturing Lab(MET-609)			4	4	25		50	75	-
Tribology Lab(MET-611)			4	4	25		50	75	-
Total				28				650	

Elective Subjects*

MET-621/Total Quality Management

MET-622/Finite Element Method

MET-623/Computer Aided Process planning

MET-624/Management Information System

MET-625/Computer Numeric Control

4thSEMESTER

Name of subjects	Hrs./Week			Hrs.	EVALUATION(MARKS)			
	lecture	Tutorial	practical		Internal	Theory	Practical	Total
MET-602/Thesis and Comprehensive Viva-voce	_____	_____	____	____	100	------	100	200

M. Tech. I & II Semester (Manufacturing Technology) w.e.f the session 2013-14

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-501			**Automation and Computer-Integrated Manufacturing**		
L	**T**	**P**		**Theory:**	**75**
3	**1**	**0**		**Sessional:**	**25**
				Time: 3 Hours	

Instruction: There will be eight questions in total; two from each unit, Students are required to attempt any five questions selecting at least one question from each unit. All questions will carry equal marks

Unit-I

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Level of Automation
Material Handling: Material Handling Systems, AG vehicles, conveyer system, Automated Storage/Retrieval Systems, Work holding system.

Unit-II

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, GT and Cellular Manufacturing, Part families, Part Classification and coding, Group technology machine cells, benefits of GT,
FMS, FMS components, application and benefits, FMS planning and implementation issues

Unit-III

Product design and CAD, CAD system hardware, CAM, CAD/CAM and Computer Integrated Manufacturing, Quality function deployment

Process Planning- Introduction, Computer-aided process planning, Material requirement planning, Capacity planning, shop floor control

Unit-IV

Numeric Control: Fundamentals of NC technology, Computer numeric control, DNC, Applications of Numeric control

NC part programming, engineering analysis of NC positioning system

Suggested books:

1. Automation, Production systems and CIM by MIKELL P. Grover, PHI.
2. Computer Integrated Manufacturing by Kant Vajpayee.

3.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-503   **Robotics Engineering**

L	T	P
3	1	0

Theory- 75
Sessional: 25
Time 3 hours

Instructions: There will be eight questions in total; two from each unit, Students are required to attempt any five questions selecting at least one question from each unit. All questions will carry equal marks.

Unit I

Robot Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, complete classification of Robots on the basis of configuration and control.

Specifications of Robot Systems, Robot end effectors and interface, field applications of Robots.

Unit 2

Various **Sensors** and their Classification, Use of Sensors and Sensor Based System in Robotics like displacement, proximity and range sensors, Machine Vision System.

Actuator and drive elements, hydraulic, pneumatic and electrical drives, criteria for selection of drives.

Unit-3

Forward kinematics of robots, D-H representation, Robotic Language and Control, Artificial Intelligence.
Introduction to inverse kinematics, Existence of solutions, Uniqueness solutions, solutions techniques.

Unit 4

Basic **control** mechanism, Types of Automatic control system, open and closed loop transfer function, linear control and force control schemes
Synthesis of crank and rocker mechanism, two position synthesis slider cranks mechanism. Methods of Function and path generation. Stages of Kinematic Synthesis.

Suggested books:

1. Robotics and control, Mittal and Nageath, Tata McGraw Hill.

2. Industrial Robotics, M.P. groover, Tata McGraw Hill

3. Robotics engineering klafter, PHI

4.   Theory of Mechanisms, Shiglay, TMH

MASTER OF TECHNOLOGY (MANUFACTURING SYSTEMS)

MET-505   **Machine Tool Design**

L	T	P	**Theory- 75**
3	**1**	**0**	**Sessional: 25**
			Time: 3Hours

Instructions: There will be eight questions in total; two from each unit, Students are required to attempt any five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I
Introduction, Machine body, Elements of Design, Section of Machine body, Guide ways, Materials for Machine Body and Guide ways, Stick slip Motion in guides, Slide ways Design, Spindles and spindles Bearings. Design features of spindles. Mountings of spindle.

UNIT-ll
Introduction, Basic Principles of Designs for Strength and rigidity, comparative Evolution of various Materials used in M/C Tool construction by weight, Optimum Design criterion, Dependence of Process Capability on the Rigidity of M/C Tool. Static Compliance of a Machine Tool, Design of Lathe Bed. Methods for Increasing Rigidity, Use of Reinforcing stiffeners in lathe Bed.

UNIT-III
Introduction, Motions in M/C Tools, Group vs Individual, Mechanical drive- design layout of mechanical stepped drivers. step less drive, Selecting the Maximum and minimum cutting speeds and feeds, Series of spindle speed - G.P, SL standard values of ø. Ray diagrams, Electrical drives, Hydraulic drives i.e. step less drives. Advantages and disadvantages of drives. Hydraulic circuits, Pneumatic drives, Kinematics calculation of speed gear Boxes.

Unit-IV
M /C Tool Controls: Basic elements of machine tool control, Principles of lever. Wheel and push button operation, Mechanical control, Electrical control, NC in M/C Tools, Fluidic Control, Adoptive control.
M/C Tool Vibrations:- Introduction, Effects of Vibrations on M/C tool, parameters on W/P. Tool life , Source of Vibration, Machine Tool Chatter.

Suggested Books:
1. Principle of ˙Machine tools by G.C. Sen & A. Bhattacharya
2. Production Engg. by P C. Sharma
   Design of M/C Tool by S.K. Basu/ D.K. Pal

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-507   **CIM Lab**

L   T   P   **Practical- 50**
0   0   4   **Sessional: 25**

1. To study the hardware and software of cad system.

2. To study the different configuration of robots and their application.

3. To create the 2-D models in the sketch mode by using Pro-E software.

4. To study the different commands in the part mode

5. To create the 3-D model in part mode by using pro-E software.

6. To assemble the 3-D model in assemble mode by using Pro-E software.

7. To create the surface model in the part mode by using Pro-E software.

8. To convert the 3-D model in 2-D model by using Pro-E software.

9. To generate a NC program for machining a 3 D model generated by Pro E.

10. To study the different elements of FMS system take a case study of automotive component industry.

Note: - The students must perform at least eight experiments.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-509 **Seminar**

L T P
2 0 0   **Sessional: 25**

Students are required to deliver a seminar on some emerging areas of Mechanical Engineering.
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-answer session after the presentation.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-502   **Mechatronic Systems**

L   T   P   **Theory: - 75**

3   1   0   **Sessional:-25**

                                                                          Time: - 3 Hours

Instructions: - There will be eight questions in total, two from each unit. Students are required to attempt any five questions. All questions will carry equal marks.

Unit-1

Introduction to Mechatronics systems and components, Principles of basic electronics - Digital logic, number system logic gates, Sequence logic flip flop system, JK flip flop, D-flip flop.

Microprocessors and their applications Microcomputer computer structure/microcontrollers, Integrated circuits- signal conditioning processes, various types of amplifiers, low pass and high pass filters.

Unit-2

Sensors and Transducers, Performance Terminology, (Displacement, Position & Proximity Sensors),(Velocity & Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature & Light Sensors), Selection of Sensors.

Actuators, Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor.

Unit-3

Design and selection of Mechatronics systems namely sensors line encoders and revolvers, stepper and servomotors Ball screws, solenoids, line actuators and controllers with application to CNC system, robots, consumer electronics products .

Principles of Electronic system communication, Interfacing, A.D. and D.A.converters. Software and hardware principles and tools to build mechatronic systems., Basic system models mathematical models, mechanical and other system Building blocks.

Unit-4

Classification of machine tools – types, functions and processes - fundamentals of NC and CNC technologies, CNC systems - configuration of the CNC system interfacing monitoring diagnostics machine data.

CNC machine structure -types of loads on CNC machine, guide ways and types mechanical transmission elements - elements for rotary motion to linear motion, ball screw and types, roller screw and types, rack and pinion, various torque transmission elements requirements of feed drives and spindle drive.

REFERENCE BOOKS:

1. Mechatronics by W.Bolton, published by Addison Worley Longman Pvt. Ltd., India Brander,

 Delhi.

2. Automation Production System System and CIMS by Mikel P Groover, Prentice Hall of India Pvt. Ltd,

New Delhi.

3. HMT Limited, "Mechatronics", Tata Mcgraw-Hill Publishing Co Ltd, 2002

4. Radhakrishnan,P., "CNC Machine", New Central Book Agency, 2000.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)
MET-504   Advanced Manufacturing Science
L   T   P   **Theory: - 75**
3   1   0   **Sessional:-25**
                                                                                                          Time:3 Hours

Instructions: - There will be eight questions in total, two from each unit. Students are required to attempt any five questions. All questions will carry equal marks.

Unit 1
Tool geometry, Mechanics of orthogonal cutting, Shear angle relations in orthogonal cutting, Chip flow direction, chip control methods, Tool Life and tool life equations, Tool Wear and tool wear equations, Machinability, Machinability Index, Parameters affecting machinability.

Unit 2
Introduction, Mould & Cores, Melting of metals, Cooling and solidification of metals, Mechanism of Solidification, Rate of solidification, Gating Design, Permanent mould casting, Pressure die casting, Investment casting, Slush Casting, Shell mould casting, Centrifugal , Continuous casting process, Riser design and its placement, Defects in casting, Inspection of casting defects.

Unit 3
Introduction, Metal transfer in arc welding, Heat flow characteristics, gas metal reaction, Cooling of fusion weld, Weld defects and inspection, Thermo chemical welding, Advanced welding processes, Ultrasonic Welding, Laser beam welding, Explosive welding.

Unit 4
True stress and true strain, True stress-strain curves, Yield criteria, Tresca maximum shear strain energy criteria, Von Mises criteria, Heat generation and heat transfer in metal forming processes, Analysis of processes of rolling, forging, extrusion, Defects in various metal forming processes.

Suggested Books:-
 1. Manufacturing Science, Amitabh Ghosh, A.K.Malik,EWP
2. Principles of Metal cutting by shaw, Oxford, IBH
3. Fundamentals of Metal Casting by Flin,Addison Wesley
4. Manufacturing Technology by P.N.Rao, TMH
5. Introduction to Principles of Metal Working by Rowe, Arnold
6. Production Technology, Fink Kreitk, HMT

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET- 506   **Advanced Tribology**

L T P
3 1 0   **Theory: 75**
                                                              Sessional: 25
                                                              Time:3 Hours

Introduction: There will be eight questions in total, two from each unit. Students are required to attempt any five questions. All questions will carry equal marks.

Unit l
Introduction to Tribological systems. Industrial interface & significance of tribology, various condition Monitoring Techniques for tribological systems, surface energy and flash temperature theory. Analysis of surface roughness and its measurement, Analysis of real area contacts and its measurement. Material properties influencing friction, Measurement of friction.

Unit ll
Wear: Industrial application of wear, Measurement of wear in dry atmosphere and different environments. Quantitative expression for adhesive and abrasive wear. Study of abrasion in grinding, lapping and Honing, wear resisting materials, Methods of Controlling Wear.

Unit lll

Lubrication: Mechanism of lubrication, Functions of lubricants, properties of lubricants, Boundary, squeeze film hydrodynamic and hydrostatic lubrications, Reynold's equation in two and three dimensional flow. Pressure equation and its distribution, load carrying capacity, frictional energy in oil film and coefficient of friction in journal bearing.

Unit lV

Bearings: Requirements of bearings, Design of bearing: clearance in journal bearing, pressure equation of journal bearing, Bearing materials, Minimum oil film thickness, summer field number, oil grooves and flow of oil in axial and circumferential grooves, cavitation and turbulence in oil bearings. Design of air bearing and other gas bearings, journal bearings with specialized applications.

Suggested Books:

1. Friction & wear by Robinwlcz by John Wiliey and sons.

2. Basic Lubrication theory by longman
3. Industrial Tribology, Tribology failure and their analysis by Dr. B.S. Prahbu

MASTER OF TECHNOLOGY (MANUFACTURING SYSTEM)
Operation Research and Optimization Techniques

MET-508
L T P
3 1 0

Theory: - 75
Sessional:-25
Time:3 Hours

Instructions: - There will be eight questions in total, two from each unit. Students are required to attempt any five questions. All questions will carry equal marks.

Unit 1
Development of OR, Characteristics of OR, OR in management, types of mathematical models, limitations of OR
Linear programming: Variable constraints and analysis of objective function, formulation graphical solution, standard and matrix forms of linear programming problems, Simplex method and its flow chart, Maximisation and minimisation problems

Unit 2

Two phase simplex method, Big-M method, Degeneracy.
Duality: Introduction, definition, general rule for converting any primar into its Dual, Dual simplex method and its flow chart.

Unit 3

Integer Programming: Importance and applications, Gomorg's all integer programming problem techniques, Branch and Bound Methods, Limitations and applications.
Quadratic Programming: Importance and Applications of quadratic programming, problem solving technique.

Unit 4

Queuing Models: Introduction, applications, characteristics, single and multiple serving stations problems with poisson, design of optimum serving stations, waiting and ideal time costs.
Optimization States: Transient and steady states for optimization, M/M/1, M/M/C, M/EK/1 and determinism models.

Suggested Books:-
 1. Gupta P.K, Hira and D.S., operation research, sultan chand and sons, New Delhi. 1994.

2. Kanti Swarup, Gupta P.K. & Man Mohan, Operation Research, sultan chand and sons, New Delhi. 1990.
3. Mittal K.V., Optimization Methods in Operation Research and system Analysis, New Age International (P) ltd., New Delhi, 1992.
4. Rao S.S., Optimization Theory and applications, wlley Eastern ltd. New Delhi, 1991.
5. Sharma, S.D., Optimization Research, Kedar Nath and Ram Nath.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET-510   **Product Design and Development**

L	**T**	**P**		**Theory: 75**
3	**1**	**0**		**Sessionals: 25**
				Time: 03 Hours

INSTRUCTIONS: There will be eight questions in total, two from each unit. Students are required to attempt any five questions selecting at least one from each unit. All questions will carry equal marks.

Unit-I

Introduction, Relation between product design and product cost, Product and its classification, Considerations in new product design, a generic Product development process, Role of Product Design and Development.

Company Policy regarding product development, Product Characteristics, Factors responsible for Product Design and Development, Standardization, Computer Aided Design (CAD).

Unit -II

A typical product cycle, Product planning process, Identifying customer needs, product specifications, concept of generation, concept of selection, concept of testing, product architectures.

Industrial product design: What is Industrial product design , Assessing the needs for industrial product design, Impact of industrial product design, Industrial product design process,

Unit-III

Design for manufacturing, Prototyping, Principle of prototyping, prototyping technology, planning for prototypes.

Ergonomics, objectives of Ergonomics, Scope and fields of application of Ergonomics, Design of man-machine systems, Anthropometry Ergonomics and its importance.

Unit-IV

Product Development Economics, Element of economic analysis, cost analysis, cost reduction and value analysis techniques.

Suggested Books:

1. Ulrich, Karl T, "Product design and development", Tata Mcgraw Hills, New Delhi.

2. Chatle and Gupta, "Product design", Tata Mcgraw Hills, New Delhi.

3. Dr. S. K. Sharma and Savita Sharma, "Industrial Engineering & organization Management", S.K. Kataria & Sons, New Delhi.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)
MET-512 Optimization Techniques Lab

L T P   **Practical : 50**
0 0 4   **Sessional :25**
                                                                      Total : 75 Marks

List of Experiments

1. Program to test the goodness of fit for Qualitative data (Chi-square test)

2. Program to make an analysis on variance of data one way ANOVA

3. Program for computation of trend value using moving-Average method.

4. Program for computation of trend value using semi-Average method

5. Program for fitting linear equation by using least square method.

6. Program for fitting exponential curve.

7. Program to implement Lagrange's interpolation formula.

8. Program to Newton backward and forward interpolation formula using switch statement.

9. Program to test the difference between mean of two independent sample using T test

Note: The students must perform eight experiments.

MASTER OF TECHNOLOGY (MANUFACTURING TECHNOLOGY)

MET- 514   **Mechatronic Lab**

L T P   **Practical : 50**
0 0 4   **Sessional :25**
                                                           Total : 75 Marks

List of Experiments

1. Design and testing of the circuits such as
    i) Pressure control valves ii)Flow control valves iii)Directional control valves
2.   Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic hydraulics circuits using software.
4. Simulation of basic pneumatic and electric circuits using software.
5. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
6. Temperature measurement using thermocouple, thermistor and RTD Measurement of speed with
    the application of sensor.
7. Measurement of Linear Displacement with the application of sensor.
8. Measurement of Angular Displacement with the application of sensor.
9. Measurement of Temperature with the application of sensor.
10. Measurement of force and pressure with the application of sensor.

Note: The students must perform eight experiments.