

# Proposal for M.Tech. in ME (Manufacturing)

## Course Curriculum

### Semester I (20 Credits)

1. Professional and Communication Skills**	1-0-2-2
2. Analytical Methods in Engineering (Compulsory)	3-0-0-4
3. Manufacturing Science (Compulsory)	3-0-0-4
4. Elective II**	3-0-0-4 / 2-0-2-4
5. Elective I	3-0-0-4 / 2-0-2-4
6. Manufacturing Processes Lab I (Compulsory)	0-0-2-2

\*\* May be offered in Semester I or Semester II

### Semester II (18/20 Credits)

1. Advanced Manufacturing Processes (Compulsory)	3-0-0-4
2. Elective III	3-0-0-4 / 2-0-2-4
3. Elective IV	3-0-0-4 / 2-0-2-4
4. Manufacturing Processes Lab II (Compulsory)	0-0-2-2
5. M.Tech Thesis	0-0-0-4

### Semester III (18 Credits)

1. M.Tech Thesis	0-0-0-16
2. Graduate Seminar I	0-0-0-2

### Semester IV (18 Credits)

1. M.Tech Thesis	0-0-0-16
2. Graduate Seminar II	0-0-0-2

## **List of Elective Courses**

### **Manufacturing**

1. Metal Forming
2. Precision Manufacturing

### **Manufacturing Management**

1. Manufacturing Planning & Control
2. Quality Control & Reliability
3. Production Planning & Control
4. Supply Chain Management
5. Materials Management
6. Six Sigma Technologies
7. Modeling & Simulation of Manufacturing System

### **Automation and Computer Aided Manufacturing**

1. Computer Aided Design
2. Computer Integrated manufacturing System
3. NC-CNC Machine Tools and Programming
4. Computer Aided Process Planning
5. Rapid Product Development Technology
6. Flexible manufacturing System
7. Material Handling Storage & Retrieval system
8. Design for Manufacturing & Assembly
9. Manufacturing Automation

### **Others**

1. Finite Element Methods
2. Industrial Robotics
3. Engineering Optimization
4. Manufacturing Metrology
5. Design of Experiments
6. Micro Electro Mechanical System
7. Computational Fluid Dynamics
8. Design & Analysis of Machine Tools
9. Mechatronics

## Course Contents

### ME 640 ANALYTICAL METHODS IN ENGINEERING

1. Solution methods for Ordinary Differential Equations (ODEs)
  - First and n-th order differential equations
2. Partial Differential Equations PDEs
  - Classification
  - Transformations to Canonical forms for Hyperbolic, Elliptic and Parabolic equations
3. Concepts in approximate solutions of differential equations
  - Space of Functions, Inner product spaces
  - Orthogonal projections
  - Norm
  - Projection of a Function onto an Orthogonal set
  - Gram-Schmidt Orthogonalization and Orthonormal set
4. Analytical series solutions of PDEs
  - Separation of Variables
  - Extension of Separation of Variables methodology by Method of Superposition
  - Rectangular coordinate system
  - Cylindrical coordinate system (Bessel function)
  - Spherical coordinate system (Legendre function)
  - Hyperbolic Equations
  - Elliptic Equations
  - Parabolic Equations
5. Introduction to integral transforms
  - Fourier and Laplace transforms and their applications.
6. Introduction to Numerical Methods
  - Ordinary differential equations and their numerical solutions
  - Euler Methods, Runge-Kutta, Multistep Methods and recent advances
  - Convergence and stability
  - Function Approximations and other methods: Chebyshev, Legendre and Bessel functions, Methods of Frobenius, Taylor
7. Applications:
  - Solution of linear and nonlinear ODE and PDE, System of ODEs and PDEs

#### **Text book:**

- J. B. Doshi, Differential equations for scientists and engineers, Narosa.

#### **Reference books:**

- Erwin Kreyszig, Advanced Engineering Mathematics.
- Jain, Iyenger & Jain, Numerical Methods for Scientific Engineering and Computation. New Age International Publishers.

## MANUFACTURING SCIENCE

Preamble of the course: This course aims to teach the physics and Mechanics of various conventional manufacturing processes.

**Casting:** Mechanism of Solidification, Runner and Riser Design and their placement

**Modeling and Mechanics of cutting process:** Review of cutting mechanism; Thin Zone model, Lee and Shaffer's relationship, Thick zone model: Okushima and Hitomi Analysis. Cutting force model; Oblique Cutting which includes Angle relationships, Forces and Temperature analysis (Finite Difference Method); Wear model; Evaluation of surface quality; Cutting processes for producing various shapes.

**Gear machining:** Hobbing

**Modeling of grinding process:** Grinding force model; Temperature analysis; Wheel life model.

**Introduction of finishing process:** Machining mechanism in finishing: Honing, Lapping, Super finishing, etc.

**Welding:** Principles of solid and liquid phase welding processes; modes of metal transfer in arc welding; heat flow characteristics; gas metal reaction, cooling of fusion weld.

### **Suggested Books/References:**

1. Boothroyd, G and Knight, W A., Fundamentals of Machining and Machine Tools, 3rd Third Edition, Saint Luce Pr, 2005.
2. Ghosh, and A.K. Mallik, Manufacturing Science, Affiliated East-West Press Ltd, New Delhi, 1985.
3. Amitabh Bhattacharya, Metal Cutting Theory & Practice
4. Sen & Bhattacharya, Metal Cutting Theory and Cutting Tool Design
5. E J A Armerago, R H Brown, Machining of Metals, Prentice Hall

## **ADVANCED MANUFACTURING PROCESSES**

Preamble of the course: This course aims to teach the physics, modeling, and mathematical inferences of various advanced manufacturing processes used in industries for making products. The students will get complete knowledge of the unconventional processes in terms of aspects stated above.

### **Unconventional Machining Processes:**

Electric Discharge Machining (EDM); Electron Beam Machining (EBM); Plasma Arc Machining (PAM); Laser Beam Machining (LBM); Ultrasonic Machining (USM); Abrasive Jet Machining (AJM); Water Jet Cutting (WJC), Abrasive Water Jet Machining (AWJM); Electro-Chemical Machining (ECM); Chemical Machining (CHM)

### **High Speed Machining:**

Introduction and concepts of HSM; Issues related to HSM; Comparison with conventional manufacturing processes.

### **Suggested Books/References:**

1. G.F. Benedict, Nontraditional Manufacturing Processes, Marcel Dekker, Inc. New York, 1987.
2. V.K. Jain, Advanced Machining Processes, Allied Publishers, New Delhi, 2002.
3. A. Ghosh, and A.K. Mallik, Manufacturing Science, Affiliated East-West Press Ltd, New Delhi, 1985.
4. P.C. Pandey, and H.S. Shan, Modern Machining Processes, Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1980.
5. J.A. McGeough, Advance Methods of Machining, Chapman and Hall, London, 1988.
6. E J A Armerago, R H Brown, Machining of Metals, Prentice Hall

## **MANUFACTURING PROCESSES LAB I**

Experiments on Manufacturing Science including Oblique machining, chatter, vibration, force measurement, etc.; welding; NC/CNC Machining

## **MANUFACTURING PROCESSES LAB II**

Analysis of NC Machining processes; Analysis of Forming- bending, punching processes; Metrology; Additive Manufacturing.