

**Approval: 10<sup>th</sup> Senate Meeting**

**Course Number:** ME 635

**Course Name:** Manufacturing for Energy Systems

**Credits:** 3-0-0-3

**Intended for:** UG/M. Tech/MS

**Distribution:** Compulsory elective for M. Tech (Mechanical Engineering) specializing in Energy system, and Elective for others

**Semester:** Odd/Even

**Preamble:** This course aims to teach the manufacturing processes used to manufacture components of Energy systems and subsystems.

**Course Modules:**

**Module – 1: Casting and forging of super alloys**

Principles related to the practice of melting and casting of non-ferrous alloys. Typical problems encountered during melting and casting. Fettling and heat-treatment of castings; Casting defects: inclusions, hot-tearing, blow holes and pin holes, shrinkage, misrun, coldshut and coldlap, metal penetration and sand burn-on, scabs and rat tails, lustrous carbon defect, mismatch, sand drop and mold break.

Basic principles and development of additive manufacturing, generalized process chain, Vat photo polymerization, powder bed fusion, extrusion-based processes, material jetting, sheet lamination and directed energy deposition processes, direct write technologies, rapid tooling

(10L)

**Module – 2: Advanced machining**

Non-Traditional Machining: Abrasive Jet Machining, Ultrasonic Machining, Water Jet

Machining, Electrical Discharge Machining, Laser Beam Machining, Electron Beam Machining

CNC Machining: Milling center, turning center

(10L)

**Module – 3: Joining similar & non-similar materials**

Solid state welding- friction stir processing, and friction stir surfacing, process characteristics and applications, friction stir processing of particle reinforced composite materials, electron beam welding-weldability of aluminum and its alloys, Mg and its alloys and steels, flux cored arc welding, laser beam welding, cracks in welds, operations, advantages and limitations, applications, liquid penetration test, eddy current test, ultrasonic test, magnetic particle test, Xray radiography test.

Non-destructive Testing: Liquid penetrant test, Ultrasonic testing, Thermography, Radiography (10L)

**Module – 4: Case studies**

Manufacturing process of rotor, turbine blade, impeller, pipe, shaft, solar cell, solar panel and

fabrication of microelectronic devices (12L)

**Reference Books:**

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
2. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, Springer Publ. 2015.
3. Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.
4. Foundation of MEMS, Chang Liu, Pearson, 2012.
5. Advanced Machining Processes, V.K.Jain, Allied Publications.
6. Castings: The new metallurgy of cast metals (Second edition), John Campbell, Elsevier Publications, 2004.
7. Nondestructive Testing Handbook, American Society for Nondestructive Testing