

Indian Institute of Technology Kanpur
Proposal for a new course

1. Course No: ME362
2. Course Title: Manufacturing Processes
3. Per Week Lectures: (L), Tutorial: (T), Laboratory: NA(P),
Additional Hours [0-2]: (A), NA
4. Credits (3*L+2*T+P+A): (3-0-0-9)
5. Pre-requisite: TA211, TA212.
6. Duration of Course: Full Semester
7. Proposing Department: Mechanical Engineering
8. Proposing instructors(s): Dr. A. Kumar, Dr. M. Law, Dr. S. Mukhopadhyay, Dr. V. Kumar, Dr. S. Mishra, Dr. N. Sinha
9. Other Departments/IDPs which may be interested in the proposed course: MSE, AE
10. Other faculty members interested in teaching the proposed course: Faculty members from MSE, AE

11. Course Description:

A) Objectives:

The main objective of this course is to acquaint students with various manufacturing processes such as casting, joining, bulk deformation, additive manufacturing, machining and metrology. In addition to their classification, this course includes design aspects, physics-based analysis and defects associated with these processes besides measurement techniques used in manufacturing.

B) Contents (preferably in the form of 5 to 10 broad titles):

Total Number of Lectures: 40

1. Introduction to manufacturing and properties of materials (1 lectures)
2. Introduction to manufacturing machines (2 lectures)
Machines related to primary and secondary manufacturing processes and their operation.
3. Casting (6-7 lectures)
Overview of casting and solidification of alloys and its mechanism; Estimation of solidification time, analysis of cooling curve; Runner and gating system design; Riser design; Defects and their causes; Industrial casting processes; Crystal growth.
4. Joining (3-4 lectures)
Overview of joining process; Fusion welding mechanism; Heat flow and material transfer mechanism; Analysis of cooling curve; Microstructure formation; Welding defects and inspection; Industrial joining processes.
5. Bulk Deformation (6-7 lectures)
Overview of bulk deformation process; Brief review of plastic deformation and yield criteria; Mechanistic analysis of Forging, Rolling, Drawing and Forming processes

including defects.

6. Additive Manufacturing (3-4 lectures)
Overview of additive manufacturing process; Mechanistic analysis of polymers, metals and ceramics based additive manufacturing processes.
7. Conventional machining processes (6-7 lectures)
Orthogonal cutting mechanics; thermal aspects of machining; tool wear and life analysis; oblique cutting; turning with a nose radius; milling; drilling; grinding.
8. Non-traditional machining processes (4-5 lectures)
Mechanical, thermal, electrochemical and chemical processes such as abrasive jet machining, ultrasonic machining, electric discharge machining, electrochemical machining, and laser beam machining.
9. Metrology (2 lectures)
Measurements and measurement equipment; measurement standards; limits, fits and tolerances; testing and calibration.

B) Short summary for including in the Courses of Study Booklet

Introduction to manufacturing processes and properties of materials; Machines and their operations: Working of manual and CNC machines and their operations; Casting and solidification of alloys: Mechanism; Analysis of cooling curve; Runner and gating system design; Riser design; Joining processes: Fusion welding mechanism; Heat flow and material transfer mechanism; Microstructure formation; Welding defects and inspection; Bulk deformation processes: Brief review of plastic deformation and yield criteria; Mechanistic analysis of Forging, Rolling, Drawing and Forming processes including defects; Additive manufacturing processes: Mechanistic analysis of polymers, metals and ceramics based additive manufacturing processes; Conventional machining processes: Orthogonal cutting mechanics; tool wear and life analysis; oblique cutting; milling; drilling; grinding; Non-traditional machining processes: AJM, USM, EDM, ECM, and LBM; Metrology: Measurements and measurement equipment; measurement standards; limits, fits and tolerances; testing and calibration.

C) Recommended books:

- Ghosh, A., Mallik, A.K., Manufacturing Science (2nd edition), EastWest Press.
- Groover, M.P., Fundamentals of Modern Manufacturing (2nd edition), John Wiley.
- Kalpakjian, S., Schmid, S.C., Manufacturing Engineering and Technology, Pearson Education.
- Loper, C.R., Rosenthal, P.C., Heine, R.W., Principles of Metal Casting, McGraw Hill.
- Little, R., Welding and Welding Technology, McGraw Hill.
- Dieter, G.E., Mechanical Metallurgy, McGraw Hill.
- Gibson, I., Rosen, D.W., Stucker, B., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
- Boothroyd, G., Knight, W.A., Fundamentals of Machining and Machine Tools, Taylor & Francis.
- Galyer, J.F.W., Shotbolt, C.R., Metrology for Engineers, ELBS.