



INTRODUCTION TO MACHINING AND MACHINING FLUIDS

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INDUSTRY SUPPORT : Oil India Ltd., ONGC, TATA motors, ISRO, BARC, DRDL, NTPC, CMTI, CMERI, CGCRI, Grind Master, NRL
INTENDED AUDIENCE : BE/B.Tech, ME/M.Tech, PHD (Mechanical Engineering, Production Engineering). Faculty who teaches manufacturing.

COURSE OUTLINE :

Machining is one of the basic and very important courses for the mechanical undergraduate students. This process comes under the subtractive manufacturing processes where in material is removed. This course gives the basic understanding of the various machining processes and its physics. The mentioned syllabus is systematic order to understand gradually, importance of machining, machining region mechanism, tool signatures, tool life, multipoint machining processes, cutting fluid, cutting fluid emissions and its effect on human kind. This course also gives emphasis on cutting fluid emissions and its effect on operators, environment and water pollution. How to develop the eco-friendly cutting fluids as an alternative to commercial miner oils. Development of sustainable cutting fluids application techniques to improve the machining performance. This course is systemically arranged and taught in smooth as well as clear way so that students understand easily.

ABOUT INSTRUCTOR :

Prof. Mamilla Ravi Sankar is currently an Assistant Professor in the Department of Mechanical Engineering, IIT Guwahati. He did his B.Tech from Sri Venkateswara University, Tirupati, and M.Tech as well as PhD from IIT Kanpur. His research group is focus on Sustainable Manufacturing, Eco-friendly Cutting fluids, Coatings, Advanced Manufacturing, Tribology and Rheology. MRS Lab also involves in development of lab scale Innovations to Commercial Manufacturing Products. He has published over 30 research articles in internationally reputed journals, 2 Patents, 2 Edited Books and 6 Book chapters. He is recipient of prestigious awards such as Institution of Engineers India (IEI) Young Engineers Award-2015 in Production Engineering, Indian Society for Advancement in Materials and Process Engineering (ISAMPE)-2011 and finalist of Indian National Academy of Engineering (INAE) Young Engineer Award-2014. Apart from academic awards, he is also received Institute Blues (Outstanding Sports Personality) of IIT Kanpur for the year 2009.

COURSE PLAN :

Week 1:

- 1.1 Introduction and Importance of Machining: Introduction to manufacturing, Top-down and bottom-up approaches, Machining and Various Machining Processes.
- 1.2 Principles of Metal Cutting: Shear zone, Chip formation, chip thickness measurements, machining mechanics of ductile and brittle materials.

Week 2:

- 2.1 Cutting tool: Tool Geometry, Tool signature.
- 2.2 Cutting forces and Cutting velocities : Cutting forces, Merchant Circle, Empirical Models, Chip thickness ratio, Cutting velocities, Strain rates, Mathematical formulations.

Week 3:

- 3.1 Tribology, Surface roughness in Machining: Chip-tool tribology, tool-workpiece tribology, Sticking and sliding zone, types of lubrication, Surface roughness, Materials removal rate, Machinability.
- 3.2 Thermal Aspects of Machining: Cutting temperature, Measurement of temperature, heat generation, heat distribution, metallurgical and microstructural study.

Week 4:

- 4.1 Tool Wear and Tool life: Carter wear, flank wear, nose wear, other tool wears, tool life criteria.
- 4.2 Tool Materials and Coatings: Coating materials, PVD, CVD, RF, Laser coatings, Tool texturing.

Week 5:

- 5.1 Cutting Fluids: Classification, Functions, Types of lubrication, Cutting fluid additives, Emissions, Health Hazards, Rheology and Biodegradability.
- 5.2 Cutting fluid application: Standoff distance, angle of impingement, contact angle, area of cooling, Solid lubricants.
- 5.3 Eco-friendly cutting fluids: Development of eco-friendly cutting fluids, bio degradation of these fluids, COD, BOD, HRT, Advantages of sustainable cutting fluids over mineral oil based cutting fluids.

Week 6:

6.1 Multipoint Machining Processes: Milling, Drilling, Broaching, Tapping, Sawing, Gear Cutting.

Week 7:

7.1 Abrasive machining processes: Grinding wheel specification, classification, Thermal aspects, Lapping, Honing, Super finishing, Drag finishing, vibratory finishing, Applications.

7.2 Cutting fluids for abrasive machining processes: Cutting fluids in grinding, honing, super-finishing.

Week 8:

8.1 Machining of Advanced Materials: Machining of Biomaterials, Aero Space materials, Smart Materials.

8.2 Advances in Metal Cutting: Hard Machining, High Speed Machining, Diamond Turning, Double tool Machining, Machining with rotary tools, Thin wall machining, Laser Assisted Machining.

8.3 Cutting fluids machining advanced materials: Cutting fluids for machining advanced materials, high speed machining, hard machining.