Lesson plan
Subject: Theory of Metal Cutting
Subject Code: BPE04003
B. Tech. 4th Semester, Production Engineering
Faculty: Dr. Sudhansu Ranjan Das

Course objectives: After successful completion of this course, students will able:

1. To study the basics of metal machining and mechanics of metal machining
2. To study the different cutting tool materials and types & geometry of cutting tools
3. To predict tool life and tool failure
4. To select suitable cutting fluid for respective materials
5. To introduce students to the theory of metal cutting, cutting tools and optimization of metal cutting parameters

Lecture No.	Module	Content	Remark
1.	1	Metal cutting, classification of metal cutting operations and methods of cutting	
2.	1	Tool geometry of Single point cutting tool	
3.	1	Tool nomenclature and designation of cutting tool in ASA system	
4.	1	Designation of cutting tool in orthogonal rake system (ORS)	
5.	1	Interconversion of angles between ASA and ORS system	
6.	1	Geometry of twist drill bit and slab milling cutter	
7.	1	Tool materials and its characteristics development of cutting tool materials.	
8.	2	Mechanism of chip formation in machining. Discussion on various reasons of chip formation	
9.	2	Different types of chip formation in machining under shear plan	
10.	2	Chip thickness ratio (r) and chip reduction coefficient (k), mathematical derivation related to r and k	
11.	2	Chip formation mechanism in drilling and milling operations	
12.	3	Mechanics of metal cutting, various machining forces in turning (for a system in turning)	
13.	3	Force relationship in turning, Merchant's force circle diagram and its assumptions	
14.	3	Mathematical derivation of velocity relationship	
15.	3	Stress and strain on shear plane in turning operation	
16.	3	Energy consideration in metal cutting	
17.	3	Theory of Lee and Shaffer, Merchant's shear angle relationship (Principle of minimum energy applied to machining)	
18.	3	Force system in drilling and slab milling operations	
19.	3	Tool force dynamometer and its desirable characteristic	
20.	3	Types of tool force measurement dynamometer in machining (Mechanical, Optical, Electrical strain gauge and pneumatic)	
21.	3	Principle of measurement of force dynamometer in drilling	
22.	3	Kronenberg's shear angle relation	

23.	4	Thermal aspects of metal cutting (Temperature and heat generation)	
24.	4	Thermodynamics of chip formation (Shear plane and tool face temperature)	
25.	4	Dimensional analysis for determination of chip-tool interface temperature	
26.	4	Experimental technique of temperature measurement in metal cutting by thermocouple	
27.	4	Metal cutting fluids, Theory of cutting fluid	
28.	4	Functions and characteristics of cutting fluids	
29.	4	Action and advantages of cutting fluid application as lubricant	
30.	4	Types of cutting fluids	
31.	4	Various cooling-lubrication techniques for application of cutting fluid	
32.	5	Tool war, types of tool wear, effects of tool wear	
33.	5	Mechanisms of tool wear	
34.	5	Tool life, it's specifications. Taylor's tool life equation	
35.	5	Factors affecting tool life and surface finish	
36.	5	Machinability, evaluation of machinability	
37.	5	Factors affecting machinability	
38.	5	Vibration and chatter in machining	
39.	5	Economics of metal machining (Gilbert's machining economic model)	
40.	1-5	Revision of subject syllabus, Discussion of problems & Solutions	

Text Book(s):

1. Metal cutting Theory & Practice- A. Bhattacharya, C.B. Publisher
2. Production Technology- P.C Sharma.
3. A course in workshop technology" Vol-II (Machine Tool)-B.S. Raghuwanshi. Dhanpat Rai & Co.
4. Textbook of Production Engineering- AK Jain and KC Chitale, PHI

Reference Book(s):

1. Fundamentals of Metals machining & machine Tools- Boothroyd International Edition.
2. Theory of Metal cutting- M.C. Shaw

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

- The students have learned the basics of metal machining
- Theoretical derivation of equations for temperature, strain, force
- Summarize the theory of metal cutting and compute cutting forces involved from Merchant's circle.
- Select appropriate machining processes and conditions for different metals.
- Be able to plan and diagnose machining process related issues including becoming familiar with phenomena unique to high speed machining