

COURSE TITLE : METALLURGY AND MACHINE TOOLS
COURSE CODE : 3039
COURSE CATEGORY : B
PERIODS/WEEK : 6
PERIODS/SEMESTER : 108
CREDITS : 5

TIME SCHEDULE

MODULE	TOPICS	PERIODS
1	Material Science	26
2	Heat Treatment	26
	TEST I	2
3	Metal Cutting Lathe Drilling Machine	26
4	Reciprocating type Machine Tools – Shaper, Slotter Milling Machine	26
	TEST II	2
	Total	108

TIME SCHEDULE

OBJECTIVES

MODULE – I

Material science

1. Explain Structure of materials
 - 1.1. Explain Atomic structure
 - 1.1.1 Explain Bonding and properties
 - 1.2. Explain structure of solids
 - 1.2.1. Explain Metallic Crystal structure-bcc, fcc, hcp.
 - 1.2.2 Explain Changes in Crystal Structure w.r.t. temperature.
 - 1.2.3 Explain with sketch Crystal Defects, crystal imperfections
 - 1.3. Explain the crystal growth and grain formation
 - 1.4 Explain with sketch Deformations of metal- slip and twinning
 - 1.5 Explain Effects on rate of cooling
 - 1.6. Explain Effects of grain size on properties
 - 1.7 Explain Property changes by deformation- work hardening, solid solution hardening, strain hardening.

Manufacturing of metals and alloys

- 1.8. Classify the various metals- ferrous and non ferrous
- 1.9 Explain Types of Cast iron- White, malleable, grey and nodular cast iron
- 1.10 Explain Properties and application of the above cast irons
- 1.11 Explain with sketch manufacturing of Pig iron- Blast Furnace
- 1.12 Explain with sketch manufacturing of Cast iron - Cupola Furnace
- 1.13 List various types of steel-
- 1.14. Identify Chemical composition of low carbon, medium carbon, high carbon, stainless steel, magnetic steel

- 1.15. Explain the Influence of constituents of steel- carbon silicon, manganese, sulphur, phosphorus
- 1.16 Describe the effect of alloying element in steel- Nickel Chromium, Manganese, Silicon, Vanadium, Molybdenum, tungsten
- 1.17. Explain types of alloy steel- Tool steel, Stainless steel, etc
- 1.18 Explain with sketch Manufacturing of steel - Bessemer process, LD process, Open hearth & Electric furnace
- 1.19 Explain the BIS specification of steel
- 1.20 Briefly explain Non ferrous metals and alloys - Aluminum, Copper
- 1.20.1 State BIS specification of aluminum, copper
- 1.21. Explain with sketch manufacturing of non ferrous metals- Crucible furnace

MODULE -II

Heat Treatment Processes

2. Understand various Alloys and Phase diagram
 - 2.1 Classify different types alloys-Solid solutions, Inter metallic compounds, Mechanical mixture
 - 2.2. Explain about cooling of alloy- Eutectic, Eutectoid, Peritectic, Peritectoid
 - 2.3 Draw and explain Cooling Curve for Pure iron
 - 2.4 Draw the iron-carbon equilibrium diagram
 - 2.5 Identify the various phases of iron-carbon equilibrium diagram
 - 2.6 Explain the above equilibrium diagram
 - 2.7 Identify the constituents of steel from the iron-carbon equilibrium diagram
 - 2.8 Explain the effect of slow cooling for various composition
 - 2.9 Explain the TTT diagram/C curve/ Scurve
 - 2.10 Continuous cooling transformation diagram (CCT diagram)
 - 2.10 Identify the need for the heat treatment process
 - 2.11 List the various heat treatment process
 - 2.12 Explain the process – annealing, normalizing, hardening, tempering, mar tempering, austempering, case hardening (cyaniding, nitriding and carbonizing),
 - 2.13 Explain the residual stress due to heat treatment
 - 2.14. Explain the method to relieve residual stresses due to heat treatment.
 - 2.15. Explain Heat treatment of aluminium- age hardening

MODULE -III

3.1 Understand various aspects of metal cutting

- 3.1.1 Draw the geometry of orthogonal cutting.
- 3.1.2 Explain the action of cutting tool by orthogonal cutting and oblique cutting
- 3.1.3 Explain the chip formation with diagram
- 3.1.4 Name the various type of chips
- 3.5 Distinguish the effect of cutting speed, feed and depth of cut on cutting force
- 3.1.6 Explain about the tool signature/ nomenclature of the single point cutting tool
- 3.1.7 List the various cutting tool material-lathe, drilling, milling, shaper
- 3.1.8 State the properties of various cutting tool materials
- 3.1.9 List the factors affecting the life of cutting tools
- 3.1.10 List the qualitative measure of machinability of a material.
- 3.1.11 Give the nomenclature of taper shank Twist drill
- 3.1.12 Give the nomenclature of a plain milling cutters.

3.2 Understand various cutting fluids

- 3.2.1. List the requirement of cutting fluids
- 3.2.2 Explain the properties of cutting fluid

3.2.3 Explain method of application of lubrication-minimum quantity lubrication(mql),Dry machining

3.2.4 Understand the various types and selection of cutting fluids

3.2.5 Analysis the effect of coolants on cutting variables (speed, feed and depth of cut)

3.3 Recognize various parts of lathe and lathe work

3.3.1 List the type of lathes

3.3.2 Sketch the centre lathes

3.3.3 Explain the functions of each part

3.3.4 List the work holding devices

3.3.5 Explain the work holding devices

3.3.6 List the tool holding devices

3.3.7 Explain the tool holding devices

3.3.8 List the sequence of steps to be followed in performing the following operations on lathe with line sketches if turning, facing, forming, taper turning, screw cutting,drilling, boring and reaming.

3.3.9 Calculate the included angle for taper turning- compound rest, tail stock set over method

3.3.10 Calculate the gear train ratio for cutting specified screw threads

3.3.11 Select the correct feed, speed and depth of cut for different operators on different engineering materials

3.4 Appreciate the operations on Drilling machine

3.4.1 Classify the drilling machine

3.4.2 Identify the various parts and their functions

3.4.3 List the work holding devices for drilling

3.4.4 Explain the work holding devices for drilling

3.4.5 List different types of drill bits

3.4.6 Explain different types of drill bits with sketch

3.4.7 List different tool holding devices for drilling.

3.4.8. Explain tool holding devices for drilling

3.4.9 List different drilling machine operations

3.4.10 Explain different drilling machine operations

3.4.11. Select the feed, speed and depth of cut for a given operation.

MODULE- IV

4. Reciprocating type Machine Tools

4.1 Appreciate the operations on shaping, planing and slotting machines

4.1.1 State the working principles of the machines with line sketches

4.1.2 Identify their parts, and functions of each part

4.1.3 List the sequence of operations for a given job on these machines

4.1.4 Indicate the method of fixing tool and work on these machines

4.1.6 Select the feed, speed and depth of cut for a given operation

4.1.8 Explain the quick return motion arrangements such as crank and slotted lever method, with worth method and hydraulic method for a shaping machine.

4.1.9 Explain with sketch Automatic feed mechanism

4.1.10 Explain the quick return arrangements for a slotter.

4.1.12 Explain the method of table drive of a Planing machine.

4.1.15 Indicate the mode of specifying these machines for procurement

4.1.16 Compare the shaper, slotter and planer.

4.2 Appreciate the operations on milling machines

4.2.1 State the principles of working of milling machines with line sketches.

4.2.2 Identify the parts and their functions.

4.2.3 Classify the machines.

- 4.2.4 Explain the method of fixing the tool and the work for different operations.
- 4.2.5 Select the right type of milling cutter for a given operation
- 4.2.6 List the work holding devices for milling
- 4.2.7 Explain the work holding devices for milling
- 4.2.8 Explain the milling cutter holding devices
- 4.2.9 Explain the milling operations.
- 4.2.10 Explain the milling methods briefly.
- 4.2.11 Name the parts of an indexing head.
- 4.2.12. list different types of indexing methods
- 4.2.13 Explain the sequence of operations carried out by milling machines such as spur gear cutting,
- 4.2.14 Classify the milling cutters.
- 4.2.15 State the speed and feeds of tool for various metals.
- 4.2.16 Specify the machines for procurement.

CONTENT OUTLINE METALLURGY

MODULE I

Material science

Structure of materials-Atomic structure -Bonding and properties, structure of solids-Metlalic Crystal structure-bcc,fcc,hcp.,Changes in Crystal Structure w.r.t. temperature.,Crystal Defects, crystal imperfections-crystal growth and grain formation,Deformations of metal,rate of cooling,grain size on properties,Property changes by deformation- work hardening, solid solution hardening, strain hardening (Strain ageing).

Manufacturing of metals and alloys

ferrous and non ferrous

Cast iron- White, malleable, grey and nodular cast iron,Properties and application ,Manufacting of Pig iron- Blast Furnace,Manufacturing of Cast iron - Cupola Furnace,Types of steel-Chemical composition ,Influence of the constituents of steel,Effect of alloying element in steel,Types of alloy steel, Manufacturing of steel - Bessemer process, LD process, Open health & Electric furnace, BIS specification of steel, Non ferrous metals and alloys - Aluminum, Copper , BIS specification of aluminum, copper , Crucible furnace.

MODULE II

Heat Treatment Processes

Alloys and Phase diagram, types alloys-Solid solutions,Inter metallic compounds, Mechanical mixture,cooling of alloy- Eutectic, Eutectoid, Peritectic,Peritectoid, Cooling Curve for Pure iron,iron-carbon equilibrium diagram,constituents of steel from the iron-carbon equilibrium diagram, effect of slow cooling for various composition, TTT diagram/C curve/ S curve. Continuous cooling transformation diagram (CCT diagram),heat treatment process, annealing, normalizing, hardening, tempering, mar tempering, austempering, case hardening (cyaniding, nitriding and carbonizing),residual stress due to heat treatment, age hardening

MACHINE TOOLS

MODULE III

Metal cutting

Orthogonal cutting and oblique cutting, chip formation ,type of chips, cutting speed , feed and depth of cut , tool signature/ nomenclature of the single point cutting tool, 1.2.8 State the properties of various cutting tool materials, tool life problems, machinability, nomenclature of taper shank Twist drill, plain milling cutters. cutting tool material-lathe ,drilling, milling, shaper.

Cutting fluids

Lubricants, coolants - requirement ,properties, method of application, selection.

Lathe and lathe work

Type of lathe – Centre lathe, Tool room lathe, Bench lathe and Speed lathe. Lathe construction – lathe parts, function of each part. Lathe accessories – work holding and tool holding devices.

Metal cutting –speeds, feeds and depths of cut for different operation for different materials.

Operations – cylindrical turning , time calculation and measurements, taper turning methods, thread standards and forms, thread calculation , gear changing for screw cutting, drilling, boring, and reaming.

Lathe specification

Drilling machine- classification ,work holding devices , types of drill bits, tool holding devices drilling machine operations,Select the feed, speed and depth of cut for a given operation, specification

MODULE – IV

Shaping Machines

General use of a shaper – parts and their functions – shaper tool holding devices. Quick return motion,arrangements and adjustments of stroke. crank and slotted lever method With worth method,Hydraulic method, Automatic feed mechanism, Speed, feed and depth of cut for various materials. Shaper specifications.

Slotting Machines

General use of a slotter. Slotter parts and their functions. Tools and work holding devices. Speed feed and depth of cut for various materials. Quick return arrangements.. specifications.

Planing machines

General use of a planer, planner parts and their functions, Tool and work holding devices. Table drive and feeds. specifications.

Milling machines

General use of milling machines, Parts of milling machines and their functions, Types of milling machines (a) plain (b) universal. Cutter holding devices (a) arbours (b) collets (c) adopters, Setting of work –(a) work holding devices (b) alignment (c) speed feed and depth of cut on various materials,Milling operations - plain milling, key and key ways, gang milling , T – slot milling , Milling methods (a) conventional milling (b) climb milling. Constructions on indexing head (name of the parts only).types of indexing, spur gear cutting , Types of milling cutters Milling machine specifications

TEXT BOOK

1. Work shop technology Vol- I,II - S.K Hajra Choudhary,S.K.Bose, A.K. Hajra Choudhary, Nirjhar roy
2. . Engineering materials and metallurgy- R. Srinivasan

REFERENCE

1. Manufacturing processes – serope kalpakjain, steven.r.schmid
2. W/S Technology - B.S. Reghuwanshi
3. Production technology - Er.R.K. Jain
4. Enginnering materials- b.k. Agarwal
5. Production Technology - P.C. Sharma Pub: S. Chand and Co.