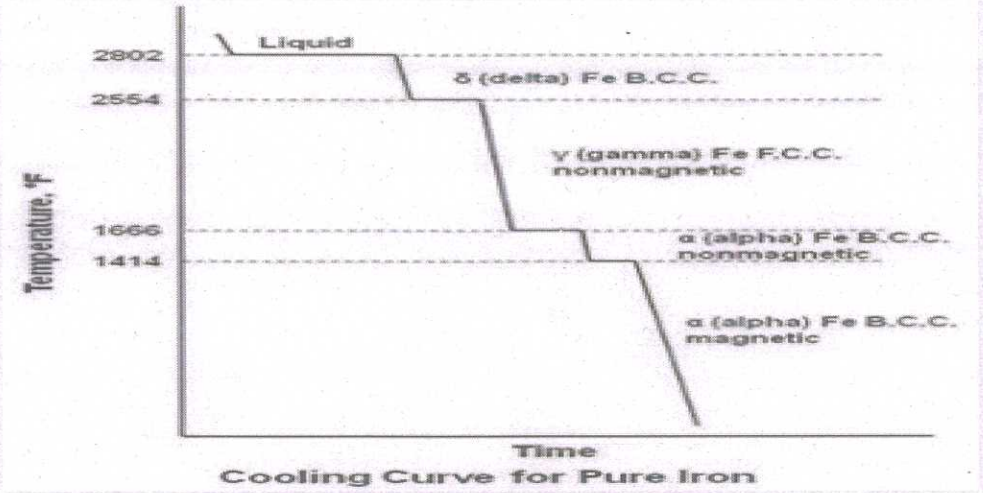
Revision : 15 Course code 4023

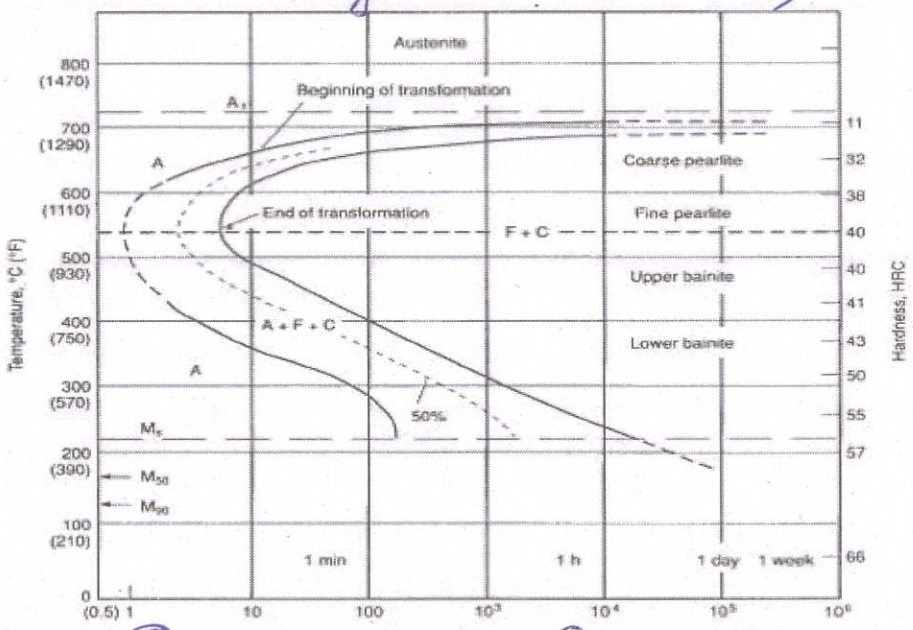
Course title : METTALLURGY AND MACHINE TOOLS

Qst No	Scoring Indicator	Split up Score	Sub Total	Total
1	PART A			
1)	 Cooling Curve for Pure Iron	2	2	
2	• Virtually unlimited choice of alloys and non metallics with associated properties • A variety of metal or non metal powders can be used. • Refractory materials are popularly processed by PM. • Can be very economical for mass production. • Long term reliability through close control of dimensions and physical properties. • Very good material utilization - loss of material very less. • Minimization or elimination of Machining. • Very good surface finish can be easily obtained	2×1	2	10
3	• Cool the tool and work piece • Reduce the friction • Protect work against rusting • Improve the surface finish • Prevent the formation of Built-up edges (BUEs) • Wash away the chips from the cutting zone	2×1 4×½	2	
4	Type; 1) ordinary or swiveling bed type 2) Size of the work table •3) Range of travels of the table in X-Y-Z directions 4) Arbour size (diameter) 5) Power of the main drive •6) Range of spindle speed •7) Range of table feeds in X-Y-Z directions 8) Floor space occupied.	2×1	2	
5	1)Machining Horizontal Surfaces,2)Machining Vertical Surfaces,3)Machining Angular Surfaces, 4)Machining a 'V' block	4×½	2	

PART B

II

1) ① CCT diagram (4 Marks)



② Description (2 Marks)

4

2

6

2) ① Austempering diagram (4 Marks)

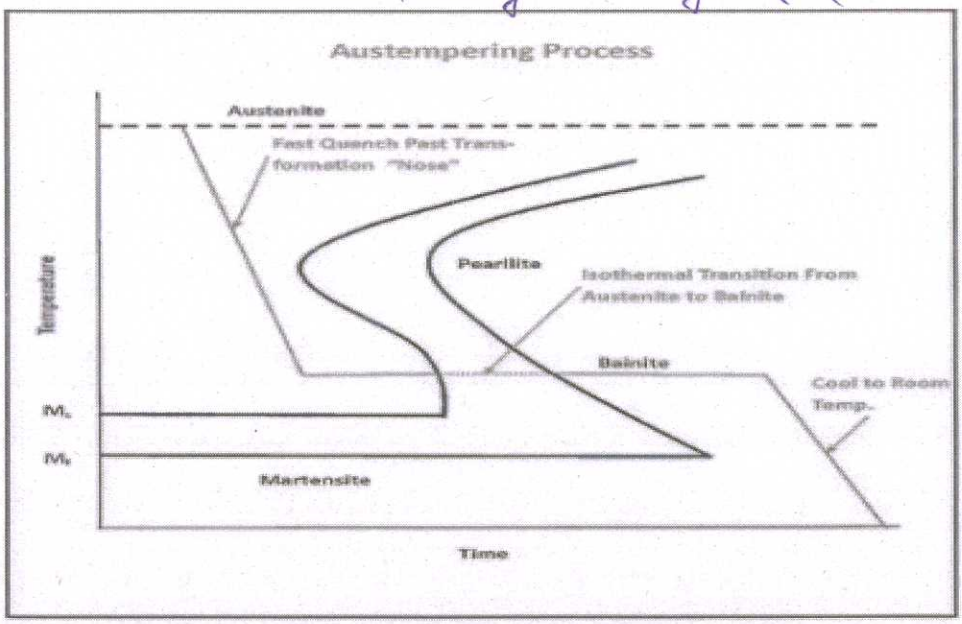


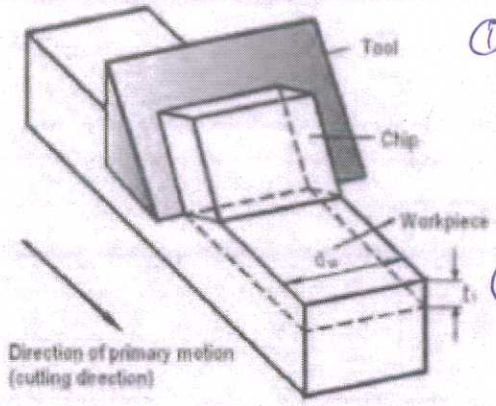
Fig 2 — Illustration of the isothermal cooling, Austempering process.

② Explanation (2 Marks)

4

2

6

3)	 Orthogonal Cutting ① Drawing (Sketch) - 3 Marks ② Parts Marking 3 Marks	3 3	6	
4)	1. Chucks 2. Face plate 3. Driving plate 4. Catch plate 5. Carriers 6. Mandrels 7. Centres 8. Rests Any 6 points	6×1	6	30
5)	Drilling machine (column type) • Maximum drill size (diameter) that can be used • Size and taper of the hole in the spindle • Range of spindle speeds • Range of feeds • Power of the main drive • Range of the axial travel of the spindle / bed • Floor space occupied by the machine Any 4 Specification [4×½ = 6]	4×½	6	
6)	1) Table size(working surface size),2)length of bed,3)width of bed,4)height under cross rail(vertical transverse)5) main drive motor power6)machining speed(forward stroke & return stroke speed) Any 4 Specification [4×½ = 6]	4×½	6	
7)	The slotting machine (slotter) is a reciprocating type of machine tool similar to a shaper or a planer machine. It may be considered as a vertical shaper. The main difference between a slotter and a shaper is the direction of the cutting action. The slotting machine operates in a manner similar to the shaper. However, the cutting tool moves vertically direction rather than in a horizontal direction. The workpiece is held stationary. The slotting machine has a vertical ram and a hand or power operated rotary table. Explanation 3 Marks Rough sketch 3 Marks	3 3	6	

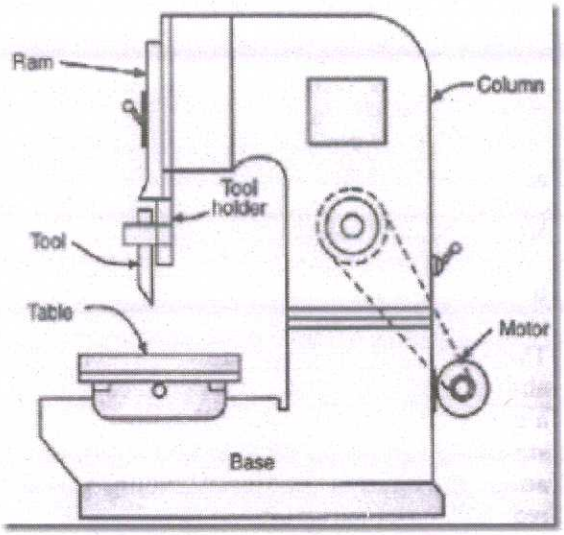


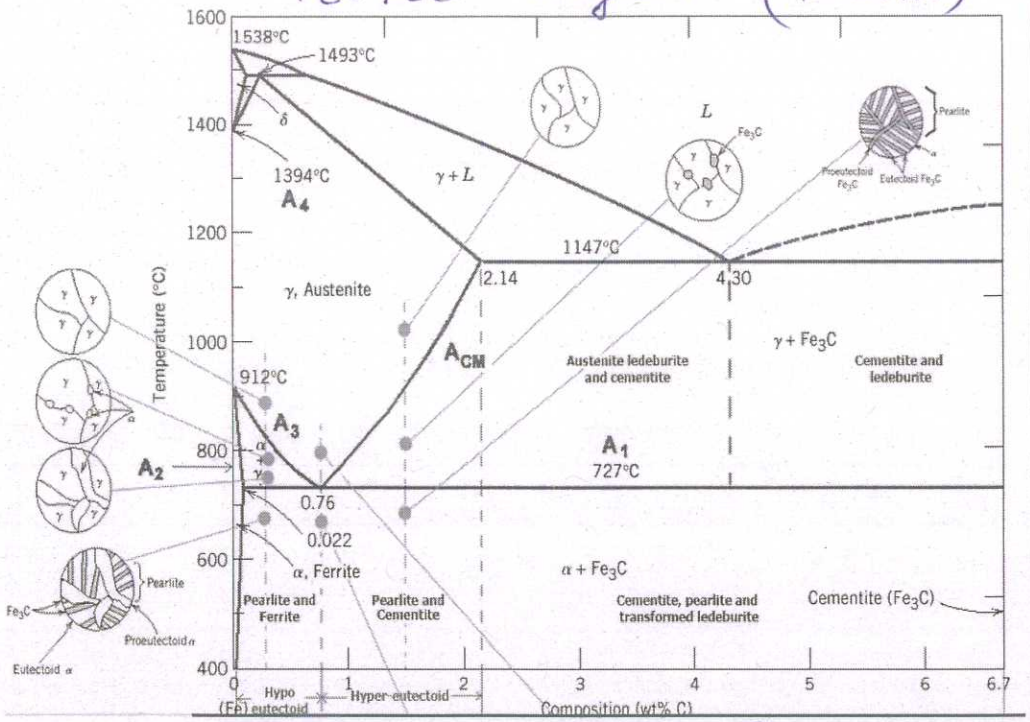
diagram (3 Marks)

3 | 3

III a)

PART C

Fe-FeC diagram (9 Marks)



9

15

b) phases Explanation like (3 × 2 = 6 Marks) 3 × 2

① α-ferrite ② γ - Austenite ③ δ ferrite

IV a)

Annealing

The steel is heated to a certain temperature and kept at this temperature, then slowly cooled to room temperature ,Furnace cooling ,Time consuming ,Stress relieving .annealed steels are more ductile than normalized steel

4×2 | 8

Normalizing

The steel is heated to a critical temperature above 30-50°C. After a while, the heat treatment process cooled in the air is called normalizing. Air cooling, harder than annealed steel, less ductile than annealed steel.

Any 4 points to compare 4×2=8

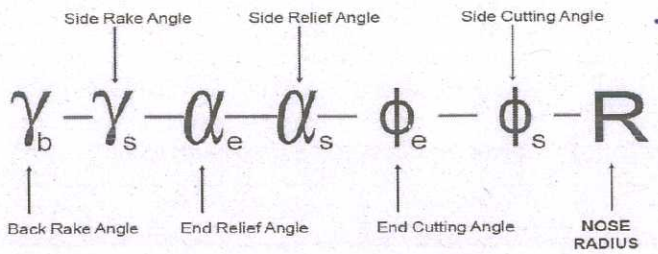
b)

Carburizing, form of surface hardening in which the carbon content of the surface of a steel object is increased. | 2

Nitriding, process for hardening the surface of steel objects by introducing nitrogen (N) into it, where it combines with iron and other alloying elements to form hard metallic nitrides. Nitriding is usually done by heating steel objects in gaseous ammonia (NH_3) at temperatures between 500 and 550 °C (950 and 1,050 °F) for periods of 5 to 100 hours, depending upon the desired depth of diffusion of the nitrogen | 2 | 7

Cyaniding is a case-hardening process that is fast and efficient; it is mainly used on low-carbon steels. The part is heated to 871-954 °C (1600-1750 °F) in a bath of sodium cyanide and then is quenched and rinsed, in water or oil, to remove any residual cyanide. | 3

V a)



7 elements 4
4 Marks 3

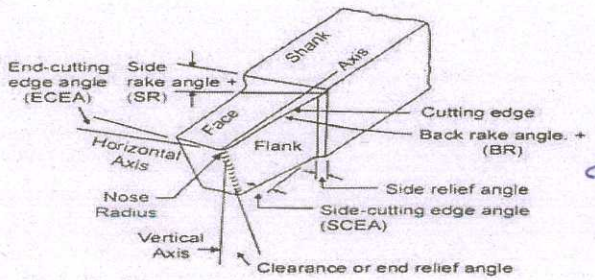


Fig. 14. (a) Tool Geometry of Single Point (Right hand) Cutting Tool.

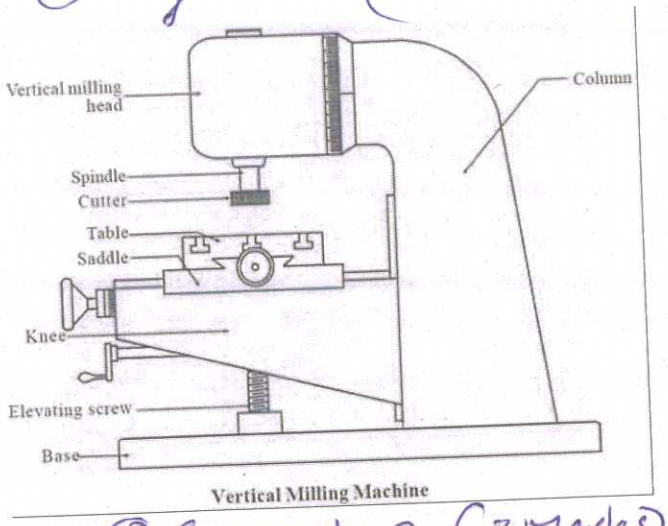
diagram (5 Marks) 5

b)	3 *Process Parameters:* 1. Cutting speed 2. Feed 3. Depth of cut 4. Tool Material 5. Workpiece material 6) Cutting Fluid etc 6×1	6×1	6
VI a)	Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or lathe, work piece, fixture, and cutting tool Facing on the lathe uses a facing tool to cut a flat surface perpendicular to the work piece's rotational axis. A facing tool is mounted into a tool holder that rests on the carriage of the lathe. The tool will then feed perpendicularly across the part's rotational axis as it spins in the jaws of the chuck. TAPER TURNING. When the diameter of a piece changes uniformly from one end to the other, the piece is said to be tapered. Taper turning as a machining operation is the gradual reduction in diameter from one part of a cylindrical work piece to another part. Tapers can be either external or internal. Lathe boring is a cutting operation that uses a single-point cutting tool or a boring head to produce conical or cylindrical surfaces by enlarging an existing opening in a work piece. For no tapered holes, the cutting tool moves parallel to the axis of rotation.	2 2 2 2	8
b)	1) High thermal conductivity for cooling 2) Good lubricating qualities 3) High flash point, should not entail a fire hazard 4) Must not produce a gummy or solid precipitate at ordinary working temperatures 5) Be stable against oxidation. 6) Must not promote corrosion or discoloration of the work material. 7) Must afford some corrosion protection to newly formed surfaces. 8) The components of the lubricant must not become rancid easily 9) No unpleasant odour must develop from continued use 10) Must not cause skin irritation or contamination 11) A viscosity that will permit free flow from the work and dripping from the chips. Any 7 points (7×1 = 7 Marks)	7×1	7

VII a)	**Reaming** The size of hole made by drilling may not be accurate and the internal surface will not be smooth. Reaming is an accurate way of sizing and finishing a hole which has been previously drilled by a multi point cutting tool known as reamer. **Boring** is the operation enlarging the diameter of the previously made hole. It is done for the following reasons. 1. To enlarge a hole by means of an adjustable cutting This is done when a suitable sized drill is not available or the hole diameter is so large that is cannot be ordinarily drilled. 2. To finish a hole accurately and bring it to the required size. 3. To machine the internal surface of the hole already produced in casting. 4. To correct out of roundness of the hole. 5. To correct the location of the hole as the boring tool follows independent path with respect to the ho **Counter boring** is the operation of enlarging the end of the hole cylindrically. The enlarged hole forms a square shoulder with the original hole. This is necessary in some cases to accommodate the heads of bolts, studs and pins. The tool used for counter boring is known as counter bore. **Countersinking** Countersinking is the operation of making a cone shaped enlargement at the end of the hole. The included angle of the conical surface may be in the range of 60° to 90°. It is used to provide recess for a flat headed screw or a counter sunk rivet fitted into the hole. The tool used for counter sinking is known as a countersink	2 2 2 2	8
b)	1. Drill vise 2. 'T' – bolts and clamps 3. Step block 4. V – block 5. Angle plate 6. Drill jigs 6x1½	7x1	7
VIII a)	• Face **Milling**, machining flat surfaces which are at right angle to the axis of the cutter. • Plain **or Snab Milling**, machining flat surfaces which are parallel to the axis of the cutter. • Angular **Milling**, machining flat surfaces which are at an inclination to the axis of the cutter. • **Form Milling**, machining surfaces having an irregular outline	2 2 2 2	8

b)

① diagram (4 Marks)



Vertical Milling Machine

② Explanation (3 Marks)

4

3

7

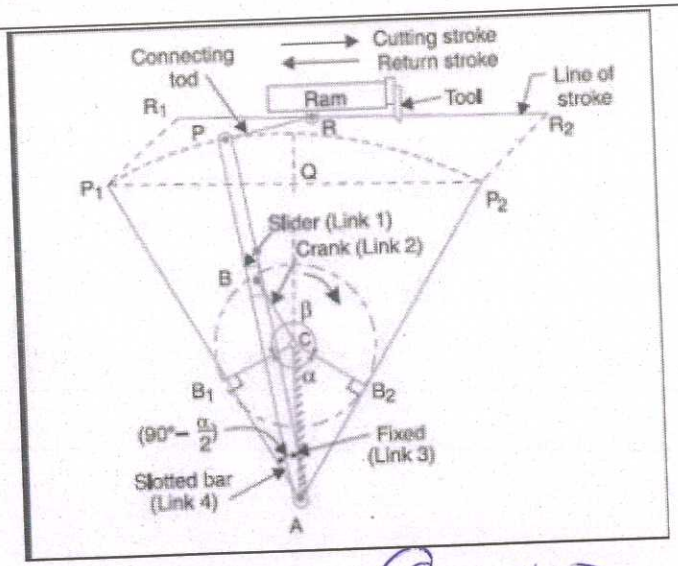
IX) a)

1. Machining horizontal surface
2. Vertical surfaces
3. Angular surfaces
4. Irregular surfaces
5. Cutting slots, grooves and keyways
6. Machining splines or cutting gears.

6 x 1

6

b)



① diagram (6 Marks)

② Explanation (3 marks)

6

3

9

X

a)

	Shaper	Planer	Slotter
1.	Can use light cuts and finer feed.	It can use heavier cuts and coarse feed.	It can use light cuts and improved feed.
2.	Use for shaping greatly smaller jobs.	Inevitable for much bigger jobs. Jobs as big like 6 metre wide and twice as long can be machined.	It use for make slots in smaller jobs.
3.	Work is held at a stop and the tool on ram is moved back with forth across the work.	Tool is fixed and the work piece on the table movements back and forth under the tool.	The job is held at a stop anc the tool on the ram is moved up and down across the work.
4.	Driven use quick- return link mechanism.	Drive on planer table is too by gears or by hydraulic means.	The rams are also crank-driven or hydraulically driven.
5.	Uses single cutting tool at a time.	Some tools can cut at the same time.	Shaper uses single cutting tool at a time.
6.	It is fewer rigid and fewer robust.	Enhanced rigidity that gives more precision on machined surfaces.	It is fewer rigid and fewer robust.
7.	It is a light machine.	It is a heavyweight machine.	It is light machine.

Any 6 Comparison

6 x 1½ 9

b)

1) Maximum length of ram stroke

2) Diameter of work table

3)Type of drive

4) Maximum table travel

5) Power input

6) Floor space required

4 x 1½ 6