BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

ME G532: MACHINE TOOL ENGINEERING: FIRST SEMESTER 2023-2024

Mid Semester Examination: Closed Book

Max Marks: 25 **Duration: 90 min.** **Date: 14 October, 2023**

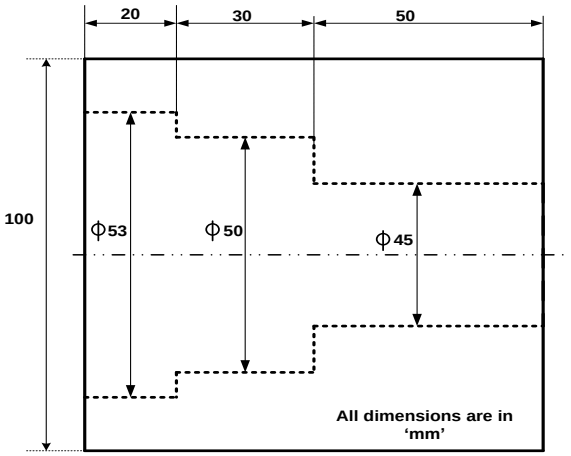
Note: 1) Partial marks will not be awarded if justification is incorrect or multiple answers are written.

2) Assume data wherever necessary with proper justification

Q1.

An operator wants to manufacture 10 products with maximum precision and higher productivity of shape as shown in figure, on a conventional drilling machine tool using HSS cutting tools. The raw material is available in the form of cuboid 100 mm^3 Mild Steel.

Working Parameters	Drilling	Boring
Cutting Tool	Two flute drill bits of diameter 8, 15, 27, 36, 42 mm	Boring bar
Feed (mm/tooth)	0.1	0.5
Max. Depth of cut (mm)	8	1
Cutting Speed (m/min)	40	-
Point angle	120^0	-
Helix angle	30^0	-
Length of approach (mm)	2	2
Length of over-travel (mm)	3	3
Side Cutting Edge Angle	-	45^0
Rpm available	275, 435, 685, 1082	435



i) Determine the minimum machining time in minutes to manufacture all products. **[6]**

ii) Determine the total productivity loss (if occurs), to produce one component. **[2]**

Q2.

An XYZ company want to manufacture a product of size 100 × 100 × 50 mm^3 as shown in figure from a raw material (Cast Iron) of size 100 × 100 × 55 mm^3 with **maximum productivity** on a conventional machine tool. Using HSS cutting tool. The details of available machine tools and cutting tools in the company are following:

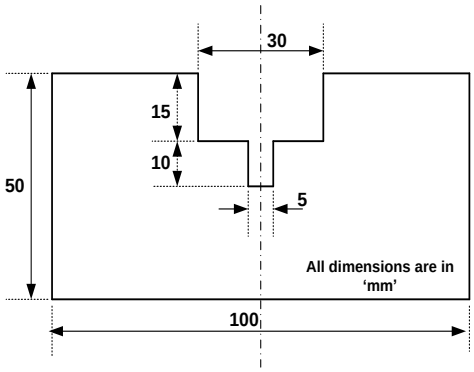
Machine Tool: Shaper and Vertical Milling

Cutting Tool: Right hand single point cutting tool, Plain milling cutter of diameter 100 mm with 20 teeth, Plain milling cutter of diameter 5 mm with 5 teeth, Face milling cutter of diameter 30 mm with 15 teeth, End milling cutter of diameter 5 mm with 2 teeth and a drill bit of diameter 5 mm.

i) Which machine tool (s) you would recommend to manufacture the product? Justify **[1]**

ii) Determine the **minimum machining time** to manufacture the component. **[5]**

Working parameters	Shaper	Milling Machine
Feed	0.1 mm/stroke	0.15 mm/tooth
Cutting stroke to return stroke velocity ratio	0.84	-
Max. Depth of cut (mm)	5	5
Cutting Speed (m/min)	25	30
Stroke length (mm)	25 – 150	-
Clearance at each end (mm)	15	-
Length of approach (mm)	2	2
Length of over-travel (mm)	3	3
Side Cutting Edge Angle	45^0	45^0



Q3.

You are intended to design a twelve speed center lathe to be used for machining mild steel rods of diameter ranging from 70.735 mm – 3183 mm. Assume the optimum cutting speed is 300 m/min during turning of mild steel rod using a cemented carbide tool. If the speeds are laid out in A.P, then

i) Determine the percentage productivity loss to machine the cylindrical component of diameter 250 mm. **[2]**

ii) Show the above productivity loss region in the SAW diagram. **[2]**

iii) Derive an expression to prove that productivity loss = $\frac{a\pi d}{1000}$, where d is the diameter of work piece and a is the common difference between successive speeds. **[1]**

Q4.

i) An operator wants to manufacture washers from a hollow pipe. Will the cutting speed remain constant during the recommended operation? Justify. **[1]**

ii) Derive an expression to prove that the ratio (ϕ) between two corresponding speed steps lies between 1 and 4 in stepped drives for a maximum productivity loss of 75% with a suitable diagram showing the productivity loss. **[2]**

iii) You are intended to design a machine tool for machining the large mild steel jobs of diameter ranging from 500 mm to 1500 mm at optimum cutting speed of 150 m/min. Recommend and justify a machine tool in terms of size (large/small) for machining above mention jobs. Justify your recommendation analytically. **[1+2]**

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