REG.NO.:

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST -II
FALL SEMESTER 2024-2025

SLOT: D2+TD2

Programme Name & Branch : B-Tech, Mechanical Engineering
Course Code : BMEE304L
Course Name : Metal Forming and Machining
Faculty Names : Dr Jeyapandiarajan P, Dr Anoj Giri, Dr Seenuvasaperumal P, Dr Venkateshwarlu B, Dr Rijesh M
Class Numbers : VL2024250103794, VL2024250103796, VL2024250103797, VL2024250103798, VL2024250103799
Date of Examination : 16-10-2024
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction:

- Answer **ALL** the Questions
- M - Max mark; CO – Course Outcome; BL – Bloom's Taxonomy Level (1 – Remember, 2 – Understand, 3- Apply, 4 – Analyze, 5- Evaluate, 6- Create)
- Course Outcomes:

CO2: Evaluate various bulk and sheet metal forming processes for different functional requirements.

CO3: Demonstrate various machine tools and machining operations

CO4: Analyse the mechanics of metal cutting processes.

Q. No	Question	M	(CO)	(BL)
1.	A cup is to be drawn using a deep drawing process with a height of 75 mm and an inner diameter of 100 mm using a 2mm thick sheet. Determine the drawing ratio, reduction, and thickness to diameter ratio if the blank diameter is (a) 225 mm or (b) 175 mm. Evaluate the feasibility of fabricating the cup in both cases.	10	2	BL4
2.	The minimum bend radius during sheet metal bending may be predicted by the tensile reduction of area. Justify the statement.	10	2	BL4
3.	Elaborate on the significance of reconditioning abrasive wheels in machining. Explain with neat sketches the problems associated with the uninterrupted or prolonged use of the grinding wheel with a brief demonstration of their remedial measures.	10	3	BL4
4.	Classify the cutting models with respect to the angle between the cutting edge of the tool and the direction of tool motion with the help of neat sketches.	10	3	BL4

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5.	The following observations were made during an orthogonal cutting operation. a. Tool rake angle - 12° b. Coefficient of friction – 0.8 c. Chip thickness – 2 mm d. Width of cut – 15 mm e. Cutting speed – 36 m/min f. Feed rate – 1.2 mm/rev. g. Shear strength of the metal – 650 N/mm^2 Determine the following data. i). Shear angle ii). Chip thickness ratio iii). Shear force iv). Friction angle v). Cutting force vi). Power consumed by the cutting tool.	10	4	BL5

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Q. No	Question	M	(CO)	(BL)
1.	A cup is to be drawn using a deep drawing process with a height of 75 mm and an inner diameter of 100 mm using a 2mm thick sheet. Determine the drawing ratio, reduction, and thickness to diameter ratio if the blank diameter is (a) 225 mm or (b) 175 mm. Evaluate the feasibility of fabricating the cup in both cases.	10	2	BL4

Ans:

1.True. The drawing ratio is the ratio of blank diameter to inside diameter, namely

$$DR = \frac{D_b}{D_p} = \frac{225}{100} = \boxed{2.25}$$

2.True. The reduction is given by

$$r = \frac{D_b - D_p}{D_b} = \frac{225 - 100}{225} = \boxed{55.6\%}$$

3.False. The thickness-to-diameter ratio is

$$\frac{t}{D_b} = \frac{2}{225} = 0.00889 = \boxed{0.89\%}$$

Note
It is important to appreciate that these data may not indicate a feasible drawing operation. Approximate upper limits are 2.0 for the drawing ratio and 0.5 for the reduction; the thickness-to-diameter ratio should be greater than 1%. Since the values at hand satisfy none of these requirements, we surmise that this system does not represent a viable drawing operation.

4.True. The drawing ratio is now

$$DR = \frac{D_b}{D_p} = \frac{175}{100} = \boxed{1.75}$$

5.False. The reduction, in turn, now becomes

$$r = \frac{D_b - D_p}{D_b} = \frac{175 - 100}{175} = \boxed{42.9\%}$$

6.True. The thickness-to-diameter ratio is

$$\frac{t}{D_b} = \frac{2}{175} = \boxed{1.14\%}$$

In this case, $DR < 2.0$, $r < 50\%$, and $t/D_b > 1\%$. However, Groover observes that the operation is not feasible because the 175 mm diameter blank size does not provide sufficient metal to draw a 75 mm cup height. The actual cup height possible with a 175 mm diameter blank can be determined by comparing surface areas (one side only for convenience) between the cup and the starting blank. The blank area = $\pi \times 175^2/4 = 24{,}100$ mm². To compute the cup surface area, let us divide the cup into two sections: (1) walls and (2) base, assuming the corner radius on the punch has a negligible effect in our calculations and there is no earing of the cup. The cup area = $\pi D_p h + \pi D_p^2/4 = \pi \times 100h + \pi \times 100^2/4 = 314h + 7850$. Setting the surface area of cup = surface area of the blank, it follows that

$$A_{\text{cup}} = A_{\text{blank}} \rightarrow 314h + 7850 = 24{,}100$$

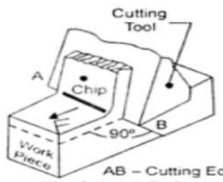
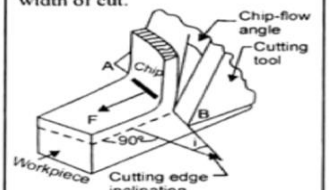
$$\therefore 314h = 16{,}300$$

$$\therefore h = 51.9 \text{ mm}$$

This is less than the specified 75 mm height.

2.	The minimum bend radius during sheet metal bending may be predicted by the tensile reduction of area. Justify the statement.	10	2	BL4
Ans:	The minimum bend radius for a given thickness of sheet can be predicted fairly accurately from the reduction of area measured in a tension test q. If q is less than 0.2, then the shift in the neutral axis can be neglected and R_{min} is given by $\frac{R_{min}}{h} = \frac{1}{2q} - 1 \quad \text{for } q < 0.2$ When q is greater than 0.2, then the shift in the neutral axis must be taken into consideration and Rmin is given by $\frac{R_{min}}{h} = \frac{(1-q)^2}{2q-q^2} \quad \text{for } q > 0.2$			
3.	Elaborate on the significance of reconditioning abrasive wheels in machining. Explain with neat sketches the problems associated with the uninterrupted or prolonged use of the grinding wheel with a brief demonstration of their remedial measures.	10	3	BL4
Ans:	After prolonged use, the machining efficiency of the abrasive wheel will be reduced, and it results in poor surface finish. Hence periodical reconditioning of the abrasive wheels is essential while machining. The problems associated with the uninterrupted or prolonged use of grinding wheel are: (1) Loading and (2) Glazing **Loading:** The opening and pores of the wheel face are **found filled with work piece material particles, preventing the grinding action.** Loading takes place while grinding work pieces of softer materials. **Glazing:** After the continuous use the grinding wheel becomes dull or glazed. Glazing of the wheel is a condition in which the face or cutting edge acquires a glass like appearance. That is, the cutting points of the abrasives have become dull and worn down to bond. Glazing makes the grinding face of the wheel smoother and that stops the process of grinding. To overcome these issues, we perform the following dressing and truing operations on the grinding wheel.			

	Dressing: The remedies of glazing and loading is dressing of grinding wheels. Dressing removes the loading and breaks away the glazed surface so that sharp abrasive particles can be formed again ready for grinding. **Truing:** Truing is the process of restoring the shape of grinding wheel when it becomes worn and break away at different points. Truing makes the wheel true and concentric with the bore.			
4.	Classify the cutting models with respect to the angle between the cutting edge of the tool and the direction of tool motion with the help of neat sketches.	10	3	BL4
Ans:	**Table 9.3.** Comparative Features of Orthgonal Cutting and Oblique Cutting Process.			

S.No.	Basis	Orthogonal cutting process	Oblique cutting process
1.	2D/3D cutting process	It is a two-dimensional cutting process.	It is a three-dimensional cutting process.
2.	Cutting edge and direction of feed	The cutting edge of the tool remains at 90 degree to the direction of feed.	The cutting edge of the tool remains inclined at an acute angle to the direction of feed.
3.	Direction of chip flow	The chip flows in a direction normal to the cutting edge of the tool.	The chip flows in a direction at an angle with normal to the cutting edge of the tool.
4.	Components of cutting forces	There are only two-mutually perpendicular components of cutting forces acting on the tool.	There are three-mutually perpendicular components of cutting forces acting on the tool.
5.	Heat developed due to friction	During the process, the heat developed due to friction per unit area is more.	During the process, the heat developed due to friction per unit area is less.
6.	Tool life	Thus, tool life is smaller than obtained in oblique cutting (for same cutting conditions).	Thus, tools have longer life.
7.	Shear force	The shear force acts on a smaller area.	The shear force acts on a larger area of the cutting edge.
8.	Amount of metal removed	Results in less metal removal compared to oblique cutting.	Results in faster and more metal removal compared to orthogonal cutting.
9.	Relation between cutting edge and width of cut	The cutting edge is bigger than the width of cut.	The cutting edge is smaller than the width of cut.
10.	Figures	 Fig. 9.4. (*a*) Orthogonal Cutting.	 Fig. 9.4. (*b*) Oblique Cutting.

5.	The following observations were made during an orthogonal cutting operation. a. Tool rake angle - 12° b. Coefficient of friction – 0.8 c. Chip thickness – 2 mm d. Width of cut – 15 mm e. Cutting speed – 36 m/min f. Feed rate – 1.2 mm/rev. g. Shear strength of the metal – 650 N/mm^2	10	4	BL5

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	Determine the following data. i). Shear angle ii). Chip thickness ratio iii). Shear force iv). Friction angle v). Cutting force vi). Power consumed by the cutting tool.			
Ans:				