PRN:		Course Code :	MET27051

Final Year **B. Tech** End Semester Examination Winter 2023

Design of Mechanical System

Day and Date: Thursday, 07/12/2023 Max Marks: **100**

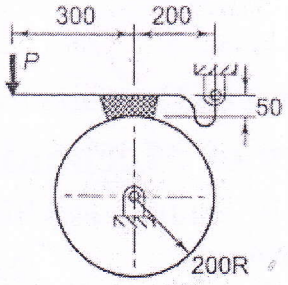
Time : 2.00 to 5.00 PM Duration: **03** hrs

Instructions: All questions are compulsory.

			Marks	Bloom's Level	CO
Q.1		**Attempt the following**			
	a)	With suitable examples, explain the importance of aesthetics design of product.	08	1	1
	b)	Explain the relationship between man, machine and environment.	08	1	1
		OR			
	b)	Explain the importance of ergonomic considerations in the design of displays and controls.	08	1	1
Q.2		**Attempt the following**			
	a)	Explain clearly with neat sketches the various types of end closures used in the pressure vessels. Write the design equations for tori-spherical end closure and hemi-spherical end closures.	08	2	2
	b)	Explain with neat sketches various types of stresses acting in the thin pressure vessels subjected to internal pressure.	08	1	2
		OR			
	b)	A high-pressure cylinder consists of a steel tube with inner and outer diameters of 20mm and 40 mm respectively. It is jacketed by an outer steel tube, having an outer diameter of 60mm. the tubes are assembled by a shirking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm^2. Calculated the shrinkage pressure and original dimensions of the tubes. (E = 207 kN/mm^2). Also find the stresses induced in the jacket due to shrink fit.	08	2	2
Q.3		**Attempt any two from the following**			
	a)	What is braking torque? Discuss various energy equations used in the design of brakes.	08	1	3
	b)	Explain with neat sketches self-energizing, self-locking and uncontrolled breaking conditions in external block brake with short shoe.	08	1	3
	c)	A single block brake with a with a torque capacity of 250 Nm is as shown in figure. The brake drum rotates at 100rpm and the coefficient of friction is 0.35. Calculate a) The actuating force and the hinge pin reaction for clockwise rotation of the drum. b) The actuating force and the hinge pin reaction for anti-clockwise rotation of the drum. c) The rate of heat generated during the braking action.	08	2	3

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Q.4 **Attempt any two from the following**

a) Explain briefly need of speed deviation diagram in the design of multi speed machine tool gear box. 08 1 4

b) Explain general guidelines in developing kinematic or gearing diagram for multi speed gear box. 08 1 4

c) A three-stage gear box with twelve speeds is to be designed on R10 series with a minimum spindle speed of 125rpm. The electric motor is connected to rear box through a belt drive and runs at 1440rpm and transmits power of 5kW. Using standard spindle speeds, 08 2 4

a) Draw the structure and speed diagram for the arrangement.
b) Draw the gear box layout

Q.5 **Attempt any Two of the following**

a) Explain Briefly following terms in the design of mechanical systems. 09 1 5

a) Functional parameters group
b) Material parameters group
c) Geometrical parameters group

b) Explain the following terms in Johnson method of optimization 09 1 5

a) Primary design equation (PDE)
b) Subsidiary design equations (SDE)
c) Limit equations (LE)

c) Design a tensile bar of length of 200mm to carry a tensile load of 5kN for minimum cost out of following materials. (assume factor of safety as 2) 09 2 5

Material	Mass density (Kg/m^3)	Material cost (Rs/ N Weight)	Yield strength (MPa)
Steel	7500	16	130
Aluminum Alloy	3000	32	50
Titanium Alloy	4800	480	90
Magnesium Alloy	2100	32	20

Q.6	**Attempt any Two of the following**				
a)	Explain briefly guidelines for design of piston rings.	09	1	5
b)	Explain step by step procedure for finding out the dimensions of the I section of the connecting rod.	09	1	5
c)	The following data is given for the piston of a four stroke diesel engine: Cylinder bore= 250mm, Maximum gas pressure for skirt = 4MPa, ratio of side thrust on liner to maximum gas load on piston = 0.1, width of top land = 45mm, width of ring grooves = 6mm, total number of piston rings =4 , axial thickness of piston rings = 7mm Calculate: a. Length of the skirt: and b. Length of the piston.	09	2	5

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