

# Model Question Paper with effect from 2022(CBCS Scheme)

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## 6<sup>th</sup> Semester B.E. Degree Examination MACHINE DESIGN

TIME: 03 Hours

Max. Marks: 100

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**

Module -1			*Bloom's Taxonomy Level	COs	Marks
Q.01	a	Define standards & codes. Also briefly explain the phases of design process.	L2	CO1	10
	b	<p>A circular rod of diameter 50 mm is subjected to loads as shown in figure Q 1 (b). Determine the nature &amp; magnitude of stress at critical points.</p> <div style="text-align: center;"> <p style="text-align: center;">Figure Q1 (b)</p> </div>	L3	CO1	10
OR					
Q.02	a	<p>A flat plate is subjected to a tensile force of 5 kN as shown in Figure Q 2(a). The plate material is grey cast iron having (<math>\sigma_u = 200</math> MPa). Determine the thickness of the plate. Take FOS as 2.5</p> <div style="text-align: center;"> <p style="text-align: center;">Figure Q2 (a)</p> </div>	L3	CO2	10
	b	<p>A steel cantilever is 200 mm long. It is subjected to an axial load which varies from 150 N (Compression) to 450 N (Tension) and a transverse load at its free end which varies from 80 N (Up) to 120 N (Down). The cantilever beam is of circular section having a diameter of 2d for the first 50 mm and diameter d for the remaining length. Determine the diameter assuming the following: FOS 2, Yield stress = 330 MPa, Endurance limit = 300 MPa, Stress concentration factor for bending = 1.44, Stress concentration factor for axial loading = 1.64, Size factor = 0.85, Surface factor = 0.9 and notch sensitivity = 0.9.</p>	L3	CO2	10
Module-2					
Q.03		<p>The layout of a shaft carrying two pulleys 1 &amp; 2, and supported on two bearing A &amp; B is as shown in Figure Q 3. The shaft transmit 7.5 KW power at 360 rpm from pulley 1 to 2. The diameters of pulley 1 &amp; 2 are 250mm and 500 mm respectively. The masses of pulley 1 and 2 are 100 N and 300 N respectively. The belt tension acts vertically downwards and the</p>	L3	CO3	20

ratio of belt tension is 2.5. The shaft is made of plain carbon steel ( $\sigma_y = 380 \text{ MPa}$ ) & the FOS is 3. Estimate suitable diameter of the shaft. If the permissible angle of twist is  $0.5^\circ$  per meter length, calculate the diameter of the shaft on the basis of torsional rigidity. Assume  $G = 79.3 \text{ GPa}$ .

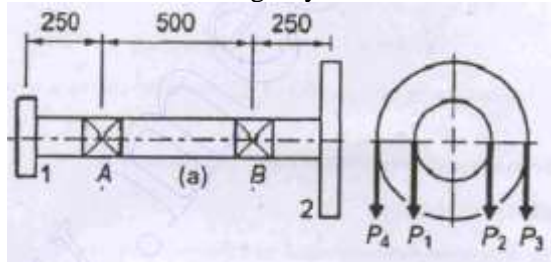


Figure Q 3

OR

Q.04 a Design a flange coupling to connect a shaft to motor with the following specifications. Take pump output 3000 liter/min, total head = 20 mm, pump speed = 600 rpm. Take  $\eta = 70 \%$ . Select C40 steel for shaft, C35 for keys with FOS 2. Assume allowable shear stress in cast iron flange is 15 Mpa.

L3 CO3 12

b A rectangular key of 15 mm width and 12 mm thickness is required to transmit a torque of 800 Nm from a shaft 40 mm diameter, taking allowable values of stresses in shear and compression as 58 Mpa and 110Mpa respectively. Determine the length of the key, also find the length of the key for 12 mm width and 15 mm thickness.

L3 CO3 8

Module-3

Q. 05 a Design a triple riveted butt joint to join two plates of thickness 10 mm, the pitch of rives in the extreme rows which are in single shear is twice the pitch of rivets in the inner rows which are in double shear. The design stresses of the materials of the main plate and rivets are as follows  
 For plate material in tension is 120 MPa  
 For rivet material in compression is 160 MPa  
 For rivet material in shear is 80 MPa  
 Draw a neat sketch of the joints in 2 views.

L3 CO3 10

b A steel bracket is welded to a structure as shown in Figure Q 5 (b). Calculate the size of the weld taking permissible stress in the weld to be 80 MPa.

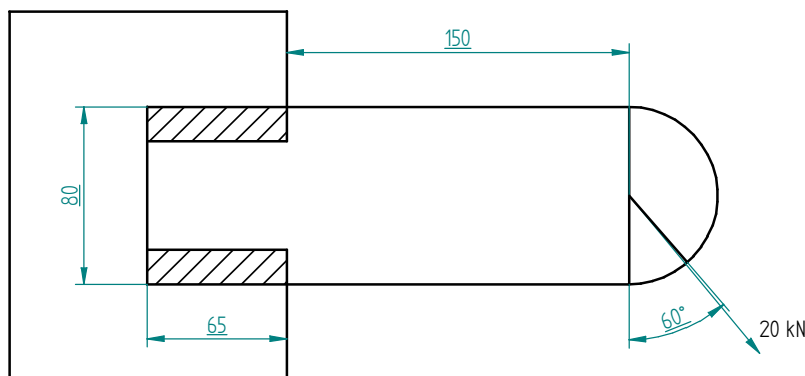


Figure Q 5 (b)

L3 CO3 10

OR

Q. 06 Select a suitable gear pair made of spur gear  $20^\circ$  involute to transmit 30 kW at 600 rpm of pinion. Number of teeth on pinion is 15 and reduction ratio is 5:1. Take pinion material as cast steel untreated and that of gear as high grade cast iron

L3 CO4 20

Module-4

Q. 07		Solve for the helical gear pair to transmit 15 kW of power at 1400 rpm of pinion with a transmission ratio of 5:1. Pinion is made of 0.4 % carbon steel untreated and gear is made of cast iron. Helix angle is $20^{\circ}$ and gear is made of $20^{\circ}$ FDI and taking not less than 24 teeth are to be used on either gear. Check for dynamic and wear load.	L3	CO4	20
OR					
Q. 08		A pair of straight bevel gears transmits 15Kw at 1250 rpm of 120 mm diameter pinion. The speed reduction is 3.5. Use 14.50 FD involute system. The pinion is made of alloy steel of case hardened and gear is cast steel 0.2% C heat treated (SAE 2320). Determine module, face width and number of teeth on pinion and gear. Suggest suitable hardness if the wear strength has to be more than dynamic load.	L3	CO4	20
<b>Module-5</b>					
Q. 09	a	A single plate clutch is used in the automobile to transmit 25 kW at 1000 rpm. The outer diameter of the disc is limited to 300 mm. Solve for the dimension of the clutch.	L3	CO3	10
	b	A single block brake which as a torque capacity of 15 N-m is as shown in figure. Take COF 0.3, max. Pressure in brake lining is 1 MPa, width of the block equals to length. Solve for actuating force, dimensions of the block and resultant hinge pin reactions.	L3	CO3	10
OR					
Q. 10	a	Derive the Petroffs equation for hydrodynamic bearing. State its limitations	L3	CO5	10
	b	The following data refers to short hydrodynamic full Journal bearing: Radial Load = 1000N Journal speed = 2100 RPM (1/d) Ratio=0.5 Eccentricity ratio=0.65 Radial clearance=0.002×journal radius Flow rate of lubricant = 3.45 litres per hour Calculate, i) the diameter of journal ii) the radial clearance iii) the dimensions of bearing iv) the minimum oil film thickness v) the absolute viscosity of lubricant	L3	CO5	10