PVP 20

Code: 20ME3503

III B.Tech - I Semester – Regular / Supplementary Examinations
NOVEMBER 2024

DESIGN OF MACHINE ELEMENTS
(MECHANICAL ENGINEERING)

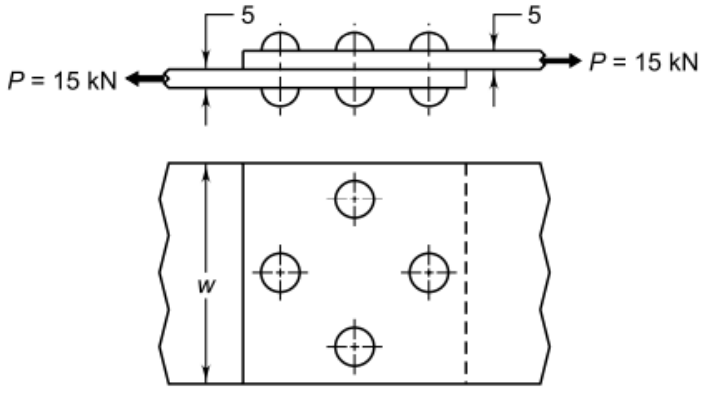
Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

**** Use of Approved Design data book is permitted ****

			BL	CO	Max. Marks
UNIT-I					
1	a)	Explain the design considerations for the selection of engineering materials and their properties.	L2	CO1	7 M
	b)	Explain the basic requirements of machine elements.	L2	CO1	7 M
OR					
2	a)	Explain the steps involved in general machine design process.	L2	CO1	7 M
	b)	What are preferred numbers? It is required to standardize eleven shafts from 100mm to 1000mm diameter. Specify their diameters.	L2	CO1	7 M
UNIT-II					
3	a)	Explain the concept of stresses induced in tension, bending, torsion and combined situations for a circular cross section members.	L2	CO2	7 M
	b)	Explain the influence of stress concentration in the design of machine elements. What are the principal causes of stress concentration? Explain with suitable sketches.	L2	CO2	7 M

		OR			
4	a)	The stresses at a point in a body are σ_x = 90 N/mm^2, σ_y = 20 N/mm^2, and τ_{xy} = 80 N/mm^2. The material tests σ_{yp} = 280 N/mm^2. Find the factor of safety according to the**:** (i) Maximum principal stress theory of failure, (ii) Maximum shear stress theory of failure, (iii) Maximum strain energy theory of failure.	L3	CO2	7 M
	b)	A stepped shaft transmits a torque varying from 800 N-m to 1200 N-m. The ratio of diameters is 1.5 and the stress concentration factor is 1.2. Determine the diameter of the shaft for infinite life for a design factor of safety 1.8. The value of σ_{ut} = 600 N/mm^2, and σ_{yt} = 450 N/mm^2.	L3	CO2	7 M
		UNIT-III			
5	a)	Two plates, each 5 mm thick, are connected by means of four rivets as shown in Figure. 1. The permissible stresses for rivets and plates in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. Calculate: (i) diameter of the rivets; (ii)width of the plate; and (iii) efficiency of the joint.  Figure.1	L3	CO3	7 M

	b)	How the strength of transverse fillet weld is evaluated? Briefly discuss about maximum shear stress in parallel fillet weld.	L3	CO3	7 M
		OR			
6	a)	Determine the safe tensile, shear and bearing loads and the efficiency for a 300 mm section of single-riveted lap joint made from 6 mm plates using six 16 mm diameter rivets. Assume that the drilled holes are 1.5 mm larger in diameter than the rivets. The values for the design limits for tensile, shear and bearing stress can be taken as 75, 60 and 130 MPa, respectively.	L3	CO3	7 M
	b)	A circular shaft, 75 mm in diameter, is welded to the support by means of a circumferential fillet weld. It is subjected to a torsional moment of 3 kN – m. Determine the size of the weld, if the maximum shear stress in the weld is not to exceed 70 N/mm^2.	L3	CO3	7 M
		UNIT-IV			
7		Design a cotter joint of socket and spigot type, which may be subjected to a pull or push of 30 kN. All the parts of the joint are made of the same material with the permissible stresses, 55 MPa in tension, 70 MPa in compression and 40 MPa in shear. Draw a neat sketch of the cotter joint.	L4	CO3	14 M
		OR			
8	a)	A bolt in a steel structure is subjected to a tensile load of 9 kN. The initial tightening load on the bolt is 5 kN. Determine the size of the bolt taking allowable stress for the bolt material to be 80 MPa.	L3	CO3	7 M

	b)	Describe the design procedure of a knuckle joint with neat sketch.	L2	CO3	7 M
		UNIT-V			
9	a)	Define the following terms of the spring : (i) Spring rate; (ii) Active and inactive coils; (iii) Spring index.	L2	CO4	4 M
	b)	A helical compression spring is required to deflect through approximately 25 mm when the external force acting on it varies from 500 to 1000 N. The spring index is 8. The spring has square and ground ends. The spring is made of cold-drawn steel wire with ultimate tensile strength of 1000 N/mm^2 and permissible shear stress in the spring wire should be 50% of the ultimate tensile strength. Take G = 81370 N/mm^2. Design the spring and calculate: (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length; (vi) free length; (vii) required spring rate; and (viii) actual spring rate.	L4	CO4	10 M
		OR			
10	a)	Explain the stresses and deflection in leaf springs with a neat sketch.	L2	CO4	7 M
	b)	A rail wagon of mass 20 tonnes is moving with a velocity of 2 m/s. It is brought to rest by two buffers with springs of 300 mm diameter. The maximum deflection of springs is 250 mm. The allowable shear stress in the spring material is 600 MPa. Design the springs for the buffers.	L4	CO4	7 M