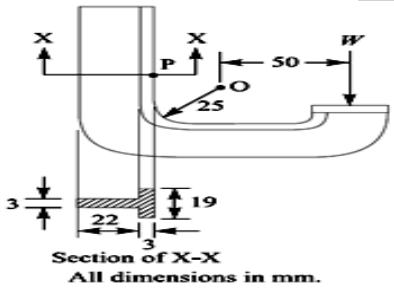
ASSIGNMENT

Academic Year 2017 – 2018

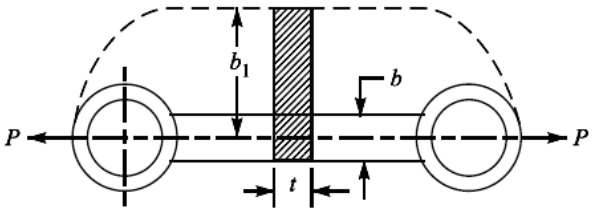
Department: MECH | Subject Code: ME6503

Semester: 05 | Subject Name: Design of Machine Elements

Section: C

Sl.No	UNIT		CONTENT	Reg. No.	Date of Submission
1	I	1	A C-clamp is subjected to a maximum load of W, as shown in Fig. If the maximum tensile stress in the clamp is limited to 140 MPa, find the value of load W. 	4108-122	17.07.17
		2	A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm clockwise to 110 Nm counterclockwise and an applied bending moment at a critical section varies from 440 Nm to – 220 Nm. The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and yield strength of 410 MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety as 2, size factor of 0.85 and a surface finish factor of 0.62.	4123-138	
		3	A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm clockwise to 110 Nm counterclockwise and an applied bending moment at a critical section varies from 440 Nm to – 220 Nm. The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and yield strength of 410 MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety as 2, size factor of 0.85 and a surface finish factor of 0.62.	4139-150	
		4	A mild steel link, as shown in Fig. by full lines, transmits a pull of 80 kN. Find the dimensions b and t if b = 3t. Assume the permissible tensile stress as 70 MPa. If the original link is	4151-159, 701, 304	

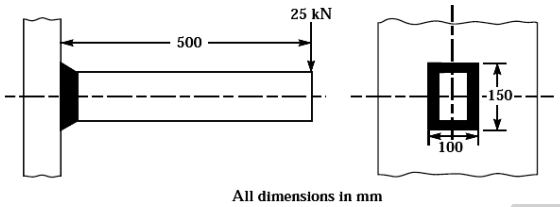
replaced by an unsymmetrical one, as shown by dotted lines in Fig, having the same thickness t, find the depth b1, using the same permissible stress as before.



2	II	1	A steel solid shaft transmitting 15 kW at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 min to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft.	4108-122	01.08.17
		2	Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the center of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180^o and coefficient of friction between the belt and the pulley is 0.3. The shock fatigue factors for bending and twisting are 1.5 and 2 respectively. The allowable shear stress in the shaft may be taken as 35 MPa.	4123-138	
		3	Design a cast iron protective type flange coupling to transmit 15 kW at 900 rpm from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stress may be used: Shear stress for the shaft, bolt and key material = 40 MPa, Crushing stress for bolt and key = 80 MPa, Shear stress for cast iron = 8 MPa.	4139-150	
		4	Design a bushed – pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20 percent more than the mean torque. The material properties are as follows: a) The allowable shear and crushing stress for shaft and key material is 40Mpa and 80 Mpa respectively b) The allowable shear stress for cast iron is 15 Mpa c) The allowable bearing pressure for rubber bush is 0.8 N/mm2	4151-159, 701, 304	

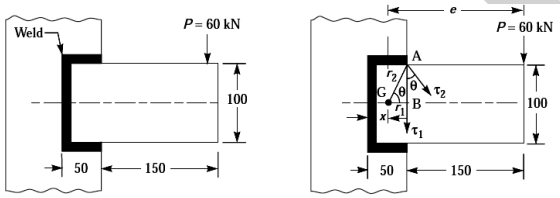
The material of the pin is same as that of shaft and key.

3	III	1	A rectangular cross-section bar is welded to a support by means of fillet welds as shown in Fig. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 MPa.	4108-122	24.08.17



All dimensions in mm

		2	A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in Fig. Determine the weld size if shear stress in the same is not to exceed 140 MPa.	4123-138	



All dimensions in mm.

		3	Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.	4139-150	
		4	A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 N/mm^2. The cylinder head is connected by 8 bolts having yield point of 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5.	4151-159, 701, 304	
4	IV	1	Design a helical spring for spring loaded safety valve of the following conditions: Diameter of valve seat = 65 mm, operating pressure = 0.7 N/mm2, maximum pressure when the valve blows freely = 0.75 N/mm2, maximum lift of the valve when the pressure = 3.5 mm rises from 0.7 to 0.75 N/mm2, maximum allowable stress = 550 MPa, Modulus of rigidity = 84 kN/mm^2 and spring index = 6. Draw a neat sketch of the free spring showing the main dimensions.	4108-122	18.09.17
		2	A multi-cylinder engine is to run at a constant load at a speed of 600 rpm. On drawing the crank effort diagram to a scale of 1 m = 250 Nm and 1 mm = 3º, the areas in square mm above and below the mean torque line are as follows, +160, -172, +168, -191, +197, -162 sq. mm. The speed is to	4123-138	

			be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine suitable dimensions for cast iron flywheel with a rim whose breadth is twice its radial thickness. The density of cast iron is 7250 kg/m^3, and its working stress in tension is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.		
		3	An engine runs at a constant load at a speed of 480 rpm. The crank effort diagram is drawn to a scale of 1 mm = 200 Nm torque and 1 mm = 3.6^o crank angle. The areas of the diagram above and below the mean torque line in sq. mm are in the following order: +110, -132, +153, -166, +197,-162. Design the flywheel if the total fluctuation of speed is not to exceed 10 rpm and the centrifugal stress in the rim is not to exceed 5 MPa. Assume that the rim breadth is approximately 2.5 times the rim thickness and 90% of the moment of inertia is due to rim. The density of the material of the flywheel is 7250 kg/m^3. Make a sketch of the flywheel giving the dimensions of the rim, the mean diameter of the rim and other estimated dimensions of spoke, hub etc.	4139-150	
		4	Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity is G = 84 kN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils.	4151-159, 701, 304	
5	V	1	Select a bearing for a 40mm diameter shaft rotates at 400 rpm. Due to bevel gear mounted on the shaft, the bearing will have to withstand a 5000 N radial load and a 3000N thrust load. The life of the bearing expected to be at least 1000 hrs.	4108-122	26.10.17
		2	Design a journal bearing for a centrifugal pump with the following data: Diameter of the journal = 150 mm Load on bearing = 40 kN Speed of journal = 900 rpm	4123-138	
		3	Design a journal bearing for a centrifugal pump from the following data: Load on the journal = 20000 N Speed of the journal = 900 rpm Type of oil is = SAE10 For which absolute viscosity at 55^{o}C = 0.017 kg/m-s Ambient temperature of oil = 15.5^{o}C Maximum bearing pressure for the pump = 1.5 N/mm^2	4139-150	

Calculate also mass of the lubricating oil required for artificial cooling if rise of temperature of oil be limited to 10^0C. Heat dissipation coefficient = 1232 W/$m^2/^0$C

4 A single row deep groove ball bearing no: 6002 is subjected to an axial thrust load of 1000 N and a radial load of 2200 N. Calculate the expected life that 50% of the bearing will complete under this condition. 4151-159, 701, 304