Reg. No. | | | | | | | | | | | | | |

B.E / B.TECH. DEGREE EXAMINATIONS, MAY 2023

Fifth Semester

ME18503 DESIGN OF MACHINE ELEMENTS

(Mechanical Engineering)

(Regulation 2018)

(Use of Approved Design Data Book is permitted)

TIME: 3 HOURS **MAX. MARKS: 100**

CO 1 The students will be proficient to apply the design process, material selection, and calculation of stresses under static and variable loading conditions with the effect of stress concentrations

CO 2 The Students will be capable to analyze and apply the design of solid, hollow shafts keys and couplings. Also understand the knowledge of fits and tolerance and its analysis

CO 3 The students will learn and analyze the close coil helical springs under variable loading. Also will acquire the knowledge of leaf, disc and torsion springs.

CO 4 Students will be able to understand and evaluate the design of riveted joint and welding joints under eccentric loading.

CO 5 The Students will apply design knowledge on sliding and rolling contact bearing and will learn the basics of EHD Journal Bearing

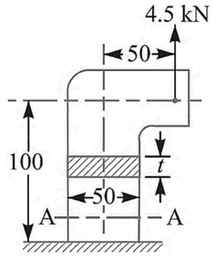
PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	What are the factors to be considered in the selection of materials for machine elements?	**1**	**1**
2.	What are the methods used to improve fatigue strength?	**1**	**2**
3.	Distinguish clearly, giving examples between axle and shaft.	**2**	**2**
4.	Under what circumstances flexible couplings are used?	**2**	**2**
5.	What is meant by solid length of helically coiled spring? If the total number of turns is 7 and coil diameter is 4 mm, what is the solid length of the spring?	**3**	**1**
6.	What is the purpose of leaf spring that is used in automobiles?	**3**	**2**
7.	What is the reason of replacing riveted joint by welded joint in modern equipment?	**4**	**2**
8.	Differentiate with a neat sketch the fillet welds subjected to parallel loading and transverse loading.	**4**	**1**
9.	What is known as self-acting bearing?	**5**	**2**
10.	Differentiate the rated life of bearing with its average life.	**5**	**2**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	A steel bracket is subjected to a load of 4.5 kN, as shown in Fig. -11a. Determine the required thickness of the section at A-A in order to limit the tensile stress to 70 MPa.	**(14)**	**1**	**3**



All dimensions in mm -Figure11a

(OR)

(b)	A steel cantilever beam, as shown in Fig. 11b, is subjected to a transverse load at its end that varies from 45 N up to 135 N down as the axial load varies from 110 N (compression) to 450 N (tension). Determine the required diameter at the change of section for infinite life using a factor of safety of 2. The strength properties are as follows: Ultimate strength = 550 MPa Yield strength = 470 MPa Endurance limit = 275 MPa The stress concentration factors for bending and axial loads are 1.44 and 1.63 respectively, at the change of cross-section. Take size factor = 0.85 and surface finish factor = 0.9	**(14)**	**1**	**3**

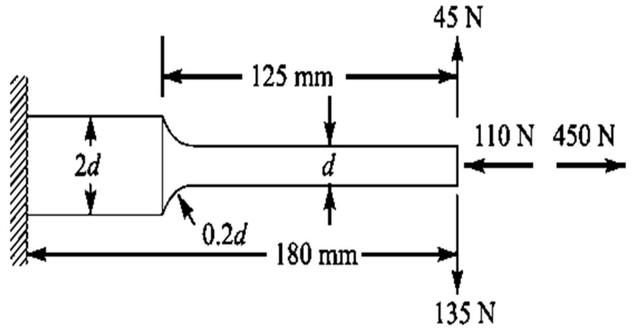


Figure 11b

12. (a)	A steel solid shaft transmitting 15 kW at 200 r.p.m. 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 mm 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.	**(14)**	**2**	**3**

`**(OR)**

(b)	Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.	**(14)**	**2**	**3**
13. (a)	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, G = 84 KN/mm^2	**(14)**	**3**	**3**

(OR)

(b)	A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring.	**(14)**	**3**	**3**
14. (a)	A 50 mm diameter solid shaft is welded to a flat plate as shown in Figure 14 a. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.	**(14)**	**4**	**3**

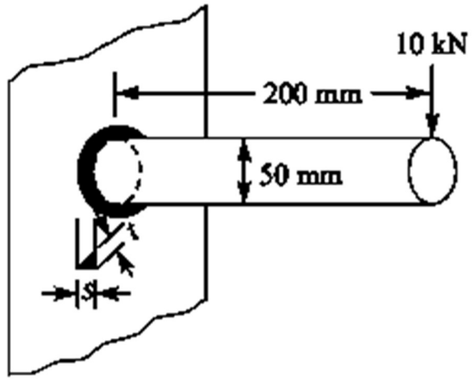


Figure 14 a

(OR)

(b)	A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. Permissible tensile stress in plate = 120 MPa , Permissible shearing stress in rivets = 100 MPa and Permissible crushing stress in rivets = 150 MPa . Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear.	**(14)**	**4**	**3**

15. (a)	A single row deep groove ball bearing operating at 2000 r.p.m. is acted by a 10 kN radial load and 8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing.	**(14)**	**5**	**4**

(OR)

(b)	A journal bearing is proposed for a steam engine. The load on the journal is 3 kN, diameter 50 mm, length 75 mm, speed 1600 r.p.m., diametral clearance 0.001 mm, ambient temperature 15.5°C. Oil SAE 10 is used and the film temperature is 60°C. Determine the heat generated and heat dissipated. Take absolute viscosity of SAE10 at 60°C = 0.014 kg/m-s.	**(14)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	**CO**	**RBT LEVEL**
16.	Explain the detailed step by step procedure for designing a Electric Vehicle rear axle. Also discuss the possible type of load involved, material preferred and required Factor of safety for its operating conditions, with simple rear axle diagram.	**(10)**	**5**	**5**

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