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

B.E./ B.TECH. DEGREE EXAMINATIONS, MAY 2024
Sixth -Semester
ME18503 – DESIGN OF MACHINE ELEMENTS
(Mechanical Engineering)
(Regulation2018/ 2018A)
(Use of Approved Data book is permitted; Assume suitable data if needed)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Students will calculate the stresses in simple machine elements subjected to static and fatigue loading.	3
CO 2	Students will design the shafts, keys and couplings under different loading conditions for mechanical systems.	3
CO 3	Students will design the helical coil springs and flywheels for mechanical machineries.	3
CO 4	Students will design the welded joints, riveted joints and threaded joints subjected to direct and eccentric loadings.	3
CO 5	Students will select and design the bearings for the given application.	3

PART- A(10x2=20Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Write the important factor of safety in machine design.	1	3
2.	Give some methods of reducing the stress concentration in machine elements.	1	2
3.	Justify. A hollow shaft has greater strength and stiffness than solid shaft of equal weight.	2	3
4.	What are possible modes of failure of the pin in a flexible coupling?	2	2
5.	What is the function of a spring? In which type of spring the behaviour is non-linear?	3	3
6.	What is nipping in a leaf spring? Discuss its role.	3	2
7.	What is the total amount of shear stress in a double strap butt joint with equal length of straps?	4	2
8.	Name the possible modes of failure of riveted joint in real-time operating conditions.	4	2
9.	List the important mechanical properties of a bearing material.	5	2
10.	In hydrodynamic bearing, what are factors which influence the formation of wedge fluid film?	5	3

PART- B (5x 14=70Marks)

		Marks	CO	RBT LEVEL

11. (a) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to (i). Maximum principal stress theory, (ii). Maximum shear stress theory; (iii). Maximum principal strain theory, (iv). Maximum strain energy theory. Take permissible tensile stress at elastic limit is 100 MPa and poisson's ratio as 0.3.   **(14)   1   3**

(OR)

(b) A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by : ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.   **(14)   1   3**

12. (a) A shaft supported at the ends in ball bearings carries a straight tooth spur gear at its mid span and is to transmit 7.5 kW at 300 r.p.m. The pitch circle diameter of the gear is 150 mm. The distances between the centre line of bearings and gear are 100 mm each. If the shaft is made of steel and the allowable shear stress is 45 MPa, determine the diameter of the shaft. Show in a sketch how the gear will be mounted on the shaft; also indicate the ends where the bearings will be mounted? The pressure angle of the gear may be taken as 20°.   **(14)   2   3**

(OR)

(b) Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa and the allowable shear stress for a flange is 14 MPa.   **(14)   2   3**

13. (a) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 N. The wire diameter of spring is 2 mm with   **(14)   3   3**

a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: Design shear stress is 680 MPa Modulus of rigidity is 80 kN/mm^2 Determine (i). the initial torsional shear stress in the wire, (ii). Spring rate and iii. the force to cause the body of the spring to its yield strength.

(OR)

(b) A truck spring has 12 number of leaves, two of which are full length leaves. **(14)** **3** **3** 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. (a) A double riveted lap joint is made between 15 mm thick plates. The rivet **(14)** **4** **3** diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch which will rupture the joint. If the above joint is subjected to a load such that the factor of safety is 4, find out the actual stresses developed in the plates and the rivets.

(OR)

(b) A welded joint as shown in Figureis subjected to an eccentric load of 2 kN. **(14)** **4** **3** Find the size of weld, if the maximum shear stress in the weld is 25 MPa.
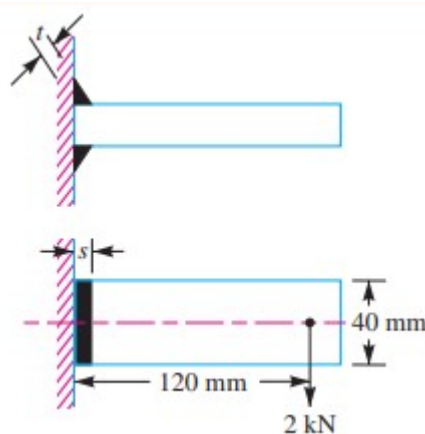
15. (a) The rolling contact ball bearings are to be selected to support the overhung **(14)** **5** **3** countershaft. The shaft speed is 720 rpm. The bearings are to have 99% reliability corresponding to a life of 24000 hours. The bearing is subjected to

an equivalent radial load of 1kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing has 90% reliability.

(OR)

(b) Design a journal bearing for a centrifugal pump from the following data :   **(14)**   **5**   **3**
Load on the journal is 20 000 N, Speed of the journal is 900 r.p.m., Type of oil is SAE 10, for which the absolute viscosity at 55°C is 0.017 kg / m-s, Ambient temperature of oil is 15.5°C , Maximum bearing pressure for the pump is 1.5 N / mm^2 . Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient is 1232 W/m^2 /°C.

PART- C (1x 10=10Marks)
(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	A gear box for truck meant for mining industry applications. Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of the bearing is 160 millions of revolutions at 300 r.p.m. Assume uniform and steady load.	**(10)**	**1**	**5**

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