Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Fifth Semester

MECHTRONICS ENGINEERING

U18MCT5105**:** Design of Machine Elements

COURSE OUTCOMES

CO1: Recognize the design process and the factors influencing it and design
CO2: Apply the basic concepts of design to Estimate the life of the components
CO3: Design the circular shafts based on strength and rigidity, keys and couplings for power transmitting elements
CO4: Apply the basics of power transmission to select the belts
CO5: Design the welded joints, threaded joints and springs subjected to static and
CO6: Select the rolling contact bearings for static and cyclic loads

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Sequence the various phases of design process.	CO1	[K_2]
2.	Describe material properties hardness stiffness and resilience.	CO1	[K_2]
3.	Differentiate between repeated stress and reversed stress.	CO2	[K_1]
4.	Explain size factor in endurance strength.	CO2	[K_2]
5.	Write the bending and the torsion equations used in the shaft design.	CO3	[K_2]
6.	State the applications of couplings.	CO3	[K_1]
7.	When will the weld deposit be weaker? Justify.	CO5	[K_2]
8.	Discuss the different applications of screwed fasteners	CO5	[K_1]
9.	What is Sommerfeld number? What importance it has in context of journal bearing design?	CO6	[K_2]
10.	Explain about surge in springs?	CO5	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. CO1 [K_4]

(i) Find the diameter of the bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal strain theory; 4. Maximum strain energy theory; and 5. Maximum distortion energy theory. Take permissible tensile stress at elastic limit = 100 MPa and Poisson's ratio = 0.3.

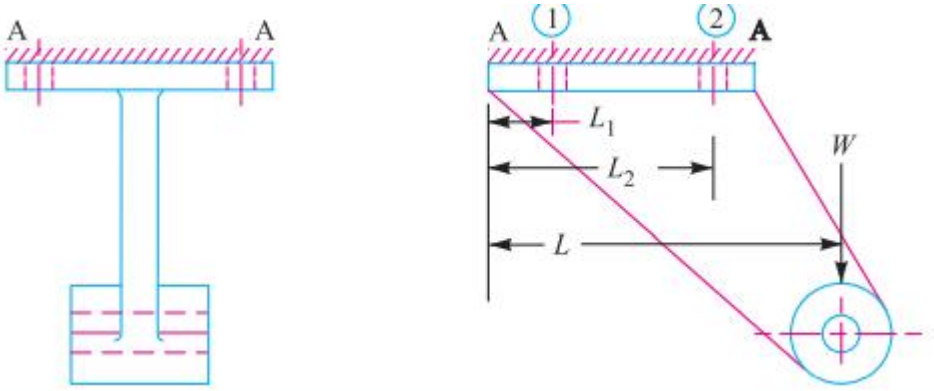
(ii) Analyze bolt material and loading condition with the results obtained

12. 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. CO2 [K_3]

13. A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the center line of the left and right bearings. The pitch diameter of gear C is 600 mm and that of gear D is 200 mm. The distance between the center line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 r.p.m. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure F_{tC} of gear C and F_{tD} of the gear D act vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weigh 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. CO3 [K_3]

14. A shaft rotating at 200 r.p.m. drives another shaft at 300 r.p.m. and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Analyze the stress in the belt, if it is 1. An open belt drive, and 2. A cross belt drive. Take μ = 0.3. CO4 [K_3]

15. A bracket, as shown in Fig. supports a load of 30 kN. Determine the size of bolts, if the maximum allowable tensile stress in the bolt material is 60 MPa. The distances are: L1 = 80 mm, L2 = 250 mm, and L = 500 mm. CO5 [K3]



16. a) A simply supported shaft, diameter 50mm, on bearing supports carries a load of 10kN at its center. The axial load on the bearings is 3kN. The shaft speed is 1440 rpm. Select a bearing for 1000 hours of operation. 10 CO6 [K4]

b) Discuss the bearing performance and types of lubrication related to the bearing parameter, μn/p. 6 CO6 [K2]

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