Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2017

(Regulation 2014)

Sixth Semester

MECHATRONICS ENGINEERING

U14MCT602**:** Design of Machine Elements

COURSE OUTCOMES

CO1: Recognize the design process and the factors influencing it and design the simple components for static loading

CO2: Estimate the life of the components subjected to varying loads

CO3: Design the circular shafts based on strength and rigidity, keys and couplings for power transmission

CO4: Design the welded joints, threaded joints and springs subjected to static loads

CO5: Select the rolling contact bearings for static and cyclic loads, select the lubricants and bearing dimensions for hydrodynamic lubrication

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Match List I (structural behaviour) with List II (structural property) CO1 [K_2]

List I	List II
A. Bending of beams	i. Polar moment of inertia
B. Torsion of circular shafts	ii. Cross sectional area
C. Tension of a bar	iii. Eccentricity of neutral axis
D. Curved beam bending	iv. Bending Moment of inertia

	A	B	C	D
a)	iv	iii	ii	i
b)	iv	i	ii	iii
c)	ii	i	iv	iii
d)	ii	iii	i	iv

2. Which among the following is the last step in product development cycle? CO1 [K_2]

a) Analysis b) Evaluation

c) Optimization d) Synthesis

3. Consider the following statements CO2 [K_2]

i. Stress concentration factors are always greater than 1

ii. Stress concentration occurs only at one location in a component

iii. Stress concentration does not influence the design of machine elements

iv. Stress concentration can be minimized by gradual geometric transitions

Which of these statements is correct?

a) i, ii b) ii, iv

c) i, ii, iii d) i, iv

4. Identify the one which has the least influence on fatigue life of a material CO2 [K_2]

a) Stress concentration b) Surface characteristics

c) Number of cycles d)

5. Assertion (A): In Stribeck curve of lubrication, the region to the left of minimum friction line represents stable lubrication. CO5 [K_3]

Reasoning (R): As temperature rises, viscosity reduces.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

6. The key preferred for heavy duty applications is CO3 [K_2]

a) Square key b) Woodruff key

c) Gib-head key d) Kennedy key

7. Consider the following procedure in the design of a Rolling contact bearings: CO5 [K_2]

i. Calculate dynamic load carrying capacity
ii. Find X and Y factor
iii. Choose bearing series for given diameter of shaft
iv. Calculate 'L' life in millions of revolution

The proper sequence is:

a) i-iv-iii-ii b) i-iv-iii-ii

c) iv-iii-i-ii d) iii-iv-ii-i

8. The stress induced in the spring wire of a helical extension spring subjected to tensile load is CO4 [K_5]

a) Tensile stress b) Compressive stress

c) Bending stress d) Shear stress

9. Assertion (A): Coarse threads are preferred for industrial applications. CO4 [K_3]

Reasoning (R): Coarse threads have greater resistance to stripping.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

10. Identify the flange type flexible coupling from the four coupling given below CO3 [K_2]

a) Oldham coupling b) Tyre coupling

c) Universal coupling d) Bushed pin type coupling

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11.	Brief the necessity of factor of safety in design.	CO1	[K_2]
12.	Why normal stress theory is not suitable for ductile materials?	CO1	[K_2]
13.	What do the terms design for finite life and design for infinite life mean?	CO2	[K_2]
14.	Define the terms endurance limit and notch sensitivity.	CO2	[K_1]
15.	Whether hollow shafts or solid shafts are preferred in power transmission? Justify.	CO3	[K_2]
16.	A shaft, having 8 splines is transmitting 120 Nm torque. If the major and minor diameters of the shaft are 32 mm and 28 mm respectively, determine the tangential force on each spline.	CO3	[K_3]
17.	What is meant by a bolt of uniform strength?	CO4	[K_2]
18.	Differentiate leaf springs from helical springs.	CO4	[K_2]
19.	Illustrate design of a bearing subjected to varying loads with an example.	CO5	[K_2]
20.	List a few properties required of lubricants used in bearings.	CO5	[K_2]

Answer any FIVE Questions:-

PART C (5 x 14 = 70 Marks)

(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. The layout of a shaft carrying two pulleys 1 & 2, and supported on two bearings A and B is shown in fig. 1. The shaft transmits 7.5 kW power at 360 rpm from the pulley 1 to the pulley 2. The diameters of pulleys 1 and 2 are 250 mm and 500 mm respectively. The masses of pulleys 1 and 2 are 10 kg and 30 kg respectively. The belt tensions act vertically downward and the ratio of belt tensions on the tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8 (yield strength = 380 N/mm^2) and the factor of safety is 3. Estimate suitable diameter of shaft. CO3 [K_3]

If the permissible angle of twist is 0.5^o per meter length, calculate the shaft diameter on the basis of torsional rigidity. Assume G = 79300 N/mm^2.

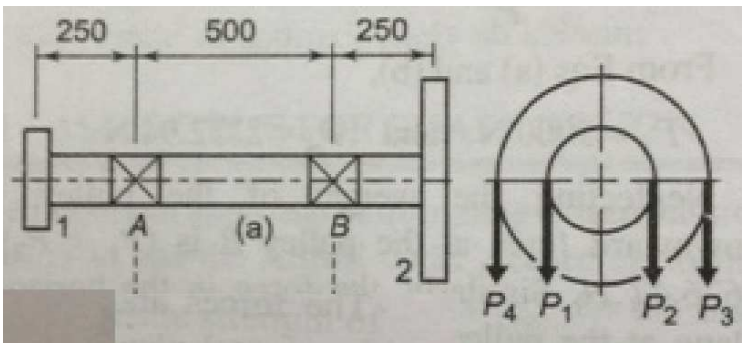

Fig. 1.

22. a) The stresses in the region of stress concentration in a machine component are: σ_{xx} = 100 MPa; σ_{yy} = 40 MPa; τ_{xy} = 80 MPa. Calculate the factors of safety using maximum principal stress theory, maximum shear stress theory and Von Mises stress theory, if the tensile strength of the material is 400 MPa. Make suitable assumptions for missing data. (7) CO1 [K_3]

b) A hook with a circular cross section of diameter 20 mm is curved to a radius of 60 mm. If the hook carries a load of 100 N, determine the location and magnitude of maximum bending stress in the hook. (7) CO1 [K_3]

23. A transmission of shaft made C45 steel subjected to a fluctuating torque varying from -100 Nm to +500 Nm. Also a fluctuating bending moment acts on the shaft which varies from +500 Nm to -500 Nm. The shaft is machined for a factor of safety 1.5. Taking the stress concentration factor be 2, determine the required diameter of the shaft. CO2 [K_3]

24. It is required to design a rigid type flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5. i.e. the design torque is 1.5 times of the rated torque. Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of its components. CO3 [K_3]

25. A helical tension spring is used in spring balance to measure the weights. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight attached to the spring balance is 1500 N and the length of the scale should be approximately 100 mm. Spring index can be taken as 6. The spring is made up of oil-hardened and tempered steel wire with ultimate tensile strength 1360 N/mm^2 and modulus of rigidity is 81370 N/mm^2. The permissible shear stress in the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate (i) wire diameter (ii) mean coil diameter (iii) no. of active coils (iv) required spring rate (v) actual spring rate. CO4 [K_3]

26. An eccentrically loaded plate is welded to a frame as shown in fig. 2. Design the welded joint. If the tensile stress in the plate should not exceed 100 N/mm^2 and that in weld is 80 N/mm^2. CO4 [K_3]

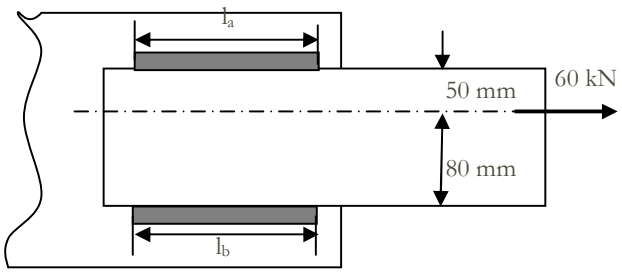

Fig. 2.

27. A tentative design for a full journal bearing calls for a diameter of 75 mm and a length of 125 mm to support a load of 20 kN. The shaft is to operate at 1000 rpm. It is desired to operate at a bearing surface temperature not to exceed 75°C in a room temperature of 35°C. The oil used has a viscosity of 0.01 kg/ms at 115°C. Determine the amount of artificial cooling required, by means of an external cooler. CO5 [K_3]

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