

Reg. No. :

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Question Paper Code: 44703

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Fifth Semester

Mechanical Engineering

14UME503 - DESIGN OF MACHINE ELEMENTS

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Factor of safety for fatigue loading is the ratio of
 - elastic limit to the working stress
 - Young's modulus to the ultimate tensile strength
 - endurance limit to the working stress
 - elastic limit to the yield point
- The design of shafts made of brittle materials is based on
 - Guest's theory
 - Rankine's theory
 - St. Venant's theory
 - Von Mises Theory
- A keyway lowers
 - The strength of the shaft
 - The rigidity of the shaft
 - Both the strength and rigidity of
 - The ductility of the material the shaft of the shaft
- The sleeve or muff coupling is designed as a
 - thin cylinder
 - thick cylinder
 - solid shaft
 - hollow shaft
- The transverse fillet welded joints are designed for
 - Tensile strength
 - Compressive strength
 - Bending strength
 - Shear strength

6. The transverse fillet welded joints are designed for
 - (a) Tensile strength
 - (b) Compressive strength
 - (c) Bending strength
 - (d) Shear strength
7. The cross-section of the flywheel arms is usually
 - (a) Elliptical
 - (b) Rectangular
 - (c) I-section
 - (d) L-section
8. The stress in the full length leaf is _____% more than the stress induced in the graduated leaf
 - (a) 50%
 - (b) 25%
 - (c) 40%
 - (d) 0%
9. The bearing used to connect the big end of connecting rod to crank Shaft is
 - (a) Needle roller bearings
 - (b) Tapered roller bearings
 - (c) Sliding contact bearings
 - (d) Cylindrical roller bearings
10. Which of the following is antifriction bearing?
 - (a) Journal bearing
 - (b) Pedestal bearing
 - (c) Collar bearing
 - (d) Needle bearing

PART - B (5 x 2 = 10 Marks)

11. List the various phases of design process.
12. Write down the Dunkerley's equation for the critical speed of the shaft.
13. How is a bolt designated?
14. What is the objective of the nipping in the leaf spring?
15. State the required properties of bearing materials.

PART - C (5 x 16 = 80 Marks)

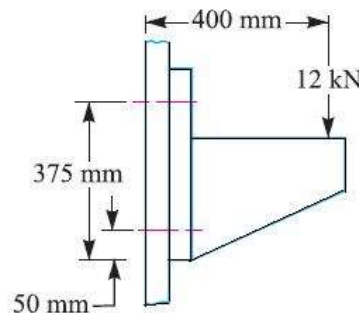
16. (a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T . If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum principal stress; 2. The maximum shear stress; and 3. The maximum distortion strain energy theory. (16)

Or

- (b) A machine component is subjected to a flexural stress which fluctuates between $+300 \text{ MN/m}^2$. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength, Endurance strength = 0.5 Ultimate strength; and factor of safety = 2. (16)
17. (a) 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 . (16)

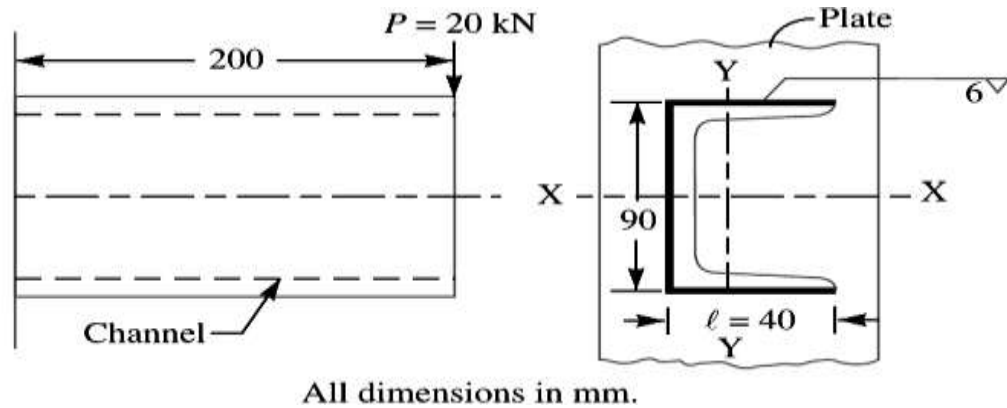
Or

- (b) A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa . A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2. (16)
18. (a) For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in fig 1. The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolt if the permissible value of the tensile stress for the bolt material is 84 MPa . Also find the cross-section of the arm of the bracket which is rectangular. (16)



Or

- (b) Find the maximum shear stress induced in the weld of 6 mm size when a channel, as shown in figure, is welded to a plate and loaded with 20 kN force at a distance of 200 mm. (16)



19. (a) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 Mpa and modulus of rigidity 84 KN/mm², Find the axial load which the spring can the deflection per active turn. (16)

Or

- (b) The intercepted areas between the output torque curve and the mean resistance line a turning moment diagram for a multi cylinder engine, taken in order from one end are as follows: -35, + 410, - 285, + 325, -335, + 260, - 365, +285, - 260 mm². The diagram has been drawn to a scale of 1 mm = 70 N-m and 1 mm = 4.5°. The engine speed is 900 r.p.m and fluctuation in speed is not to exceed 2 % of the mean speed. Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken as 7200 kg/m³. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc. (16)

20. (a) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r.p.m. Determine the following : 1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm², and 2. Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm. (16)

Or

- (b) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. (16)

