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TME-502 1014

Odd Semester Examination 2018-19

B. TECH. (ME) (SEMESTER-V)

MACHINE DESIGN-I

Time: 03:00 Hours **Max Marks :100**

Note: Attempt **ALL** the questions. Marks are shown against each question. Assume any missing data suitably.

1. Attempt any **FOUR** of the following [5x4=20]

   (a) What are the advantages of square threads over trapezoidal threads?

   (b) State the relationship between active coils and total number of coils in the helical extension spring.

   (c) When the shaft is subjected to fluctuating loads, what will be the equivalent torsional moment and equivalent bending moment?

   (d) What is the cause of residual stresses in welded joint? How are they relieved?

   (e) Distinguish between stress-strain diagrams for ductile and brittle materials. Give examples of mechanical components that fail by general yielding.

   (f) A rigid coupling is used to transmit 20 kW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (ultimate tensile strength equal to 380 N/mm^2) and the factor of safety is 3. Determine the diameter of bolts. Assume that the bolts are finger tight in reamed and ground holes.

2. Attempt any **FOUR** of the following (5x4=20)

   (a) How will you design buckle proof spring?

   (b) Explain under what circumstances are hollow shaft preferred over solid shafts.

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(c) What are the advantages of welded joints compared with riveted joints?

(d) Explain modified Goodman diagram for bending stress.

(e) What is pulsating shear stress? Why are springs subjected to pulsating shear stress?

(f) A circular shaft, 50 mm in diameter, is welded to the support by means of circumferential fillet weld. It is subjected to torsional moment of 2000 N-m. Determine the size of the weld, if the permissible shear stress in the weld is limited to 140 N/mm^2.

3. Attempt any **TWO** of the following (10x2=20)

(a) It is required to design a rigid type of 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 rated torque. Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of its components.

(b) A right angled bell crank lever is designed to raise the load of 5 kN at the short arm end. The lengths of short and long arms are 100 and 450 mm respectively. The lever and pins are made of steel 30C8 (ultimate tensile strength = 400 N/mm^2) and the factor of safety is 5. The permissible bearing pressure on the pin is 10 N/mm^2. The lever has rectangular cross-section and the ratio of width to thickness is 3:1. The length of diameter ratio of fulcrum pin is 1.25:1. Calculate:

(i) the diameter and the length of fulcrum pin

(ii) the shear stress in the pin

(iii) the dimensions of the boss of the lever at the end of fulcrum and

(iv) the dimensions of the cross-section of the lever.

Assume that the arm of bending moment on the lever extends up to the axis of fulcrum.

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(c) Explain the need based developments and technology based development with examples.

4. Attempt any **TWO** of the following (10x2=20)

(a) A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500 kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design of spring and calculate

(i) wire diameter, (ii) mean coil diameter, (iii) number of active coils, (iv) total number of coils, (v) solid length, (vi) free length, (vii) pitch of the coil, (viii) required spring rate and (ix) actual spring rate.

(b) A solid circular shaft made of Fe 620 (ultimate tensile strength = 650 N/mm^2 and yield strength = 380 N/mm^2) is subjected to an alternating torsional moment, that varies from -200 N-m to +400 N-m. The shaft is ground and the expected reliability is 90%. Neglecting stress concentration and calculate the shaft diameter for infinite life. The factor of safety is 2. Use the distortion energy theory of failure.

(c) A double-threaded power screw is used to raise a load of 5kN. The nominal diameter is 60 mm and the pitch is 9 mm. The threads are acme type ($2\theta = 29°$) and the coefficient of friction at the screw threads is 0.15. Neglecting collar friction, calculate:

(i) the torque required to raise the load

(ii) the torque required to lower the load and

(iii) the efficiency of the screw for lifting load

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5. Write short notes on any **FOUR** of the following : (5x4=20)

(a) What is the objective of shot peening of spring?

(b) What is the purpose of spigot and recess in rigid flange coupling?

(c) What is relationship between leg and throat of fillet weld?

(d) What are the three basic modes of failure of mechanical components?

(e) What are the factors that affect the endurance limit of machine parts?

(f) How will you designate alloy steel with following composition?

Carbon = 0.12% – 0.20 %, Nickel = 0.80% – 1.2 % and Chromium = 0.60% - 1.0%.

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