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B.E/B.TECH (Full-time) End Semester Degree Examination, Nov/Dec 2011

Fifth Semester

Mechanical Engineering

ME 374 – DESIGN OF MACHINE ELEMENTS

(Regulation 2004)

Time: 3 Hours **Answer All Questions** **Max. Marks: 100**

PART-A (10 x 2 = 20 Marks)

1. What are the different modes of failure of mechanical components?
2. What is stress concentration? What are the methods of reducing stress concentration?
3. Define critical speed of shaft.
4. Differentiate coupling and clutch.
5. What is eyebolt?
6. List out the merits of welded joints in comparison with riveted joints.
7. What is spring index?
8. Explain the term 'nip' of leaf spring.
9. What is thrust bearing?
10. Define coefficient of speed fluctuation.

Part-B (5 x 16 = 80 Marks)

11. Brief about theories of elastic failure. Sate and explain the Distortion Energy theory with relevant expressions.

12. (a) The layout of a shaft carrying two pulleys 1 and 2 and supported on two bearings A and B is shown in Fig. 12a. The shaft transmits 7.5 kW power at 360 rpm from pulley 1 to pulley 2. The diameters of the pulley 1 and 2 are 250 mm and 500 mm respectively. The belt tensions act vertically downward and ratio of belt tensions on tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8 (σ_{yt} = 380 N/mm^2) and the factor of safety is 3. Estimate suitable diameter of the shaft.

[OR]

12 (b) Design a muff coupling, which s used to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 ($\sigma_{yc} = \sigma_{yc}$ = 400 N/mm^2). The sleeve is made

of grey cast iron FG 200 (σ_{yt} = 200 N/mm^2). The factor of safety for the shafts and key is 4. For sleeve, the factor of safety is 6 based on ultimate strength.

13(a) The structural connection shown in Fig. 13a is subjected to an eccentric force P of 10 kN with an eccentricity of 500 mm from the C.G of the bolts. The centre-distance between bolts 1 and 2 is 200 mm and bolts 1 and 3 is 150 mm. All the bolts are identical. The bolts are made from plain carbon steel 30C8 (σ_{yt} = 400 N/mm^2) and the factor of safety is 2.5. Determine the size of the bolts.

[OR]

13(b) A circular shaft, 50 mm in diameter is welded to a support by means of a fillet weld, as shown in Fig. 13b. Determine the size of the weld, if the permissible shear stress in the weld is limited to 100 N/mm^2.

14(a) A helical compression spring is used to absorb the shock. The initial compression of the spring is 30 mm and it is further compressed by 50 mm while absorbing the shock. The spring is to absorb 250J of energy during the process. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire with ultimate tensile strength of 1500 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. Design the spring and calculate:

i. wire diameter
ii. mean coil diameter
iii. number of active turns
iv. free length and
v. pitch of the turns

[OR]

14(b) A semi-elliptic leaf spring used for automobile suspension consists of three extra full-length leaves and 15 graduated leaves, including the master leaf. The centre-to-centre distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 kN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207 000 N/mm^2. The leaves are pre-stressed in such a way that the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine:

i. the width and thickness of the leaves
ii. the initial nip
iii. the initial pre-load required to close the gap C between extra full-length leaves and graduated-length leaves.

15(a) Following data is given for the hydrostatic step bearing of a vertical turbo generator:

Thrust load = 450kN

Shaft diameter = 400 mm

Recess diameter = 250 mm

Shaft speed = 750 rpm

Viscosity of lubricant = 30 cP

Draw a neat sketch showing the effect of film thickness on energy losses. Calculate the optimum film thickness for minimum power loss.

[OR]

15(b) The following data is given for a rimmed flywheel made of grey cast iron FG 200:

Mean radius of rim	= 1.5 m
Thickness of rim	= 200 mm
Width of rim	= 300 mm
Number of spokes	= 6
Cross-sectional area of each spoke	= 10000 mm^2
Speed of rotation	= 720 rpm

Calculate:

i. the tensile stress in rim at $\varphi = 0°$

ii. the axial stress in each spoke

The mass density of cast iron FG 200 is 7100 kg/m^3.

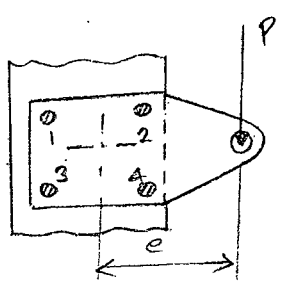
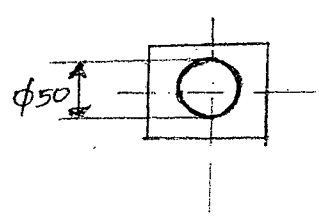


FIG 13a



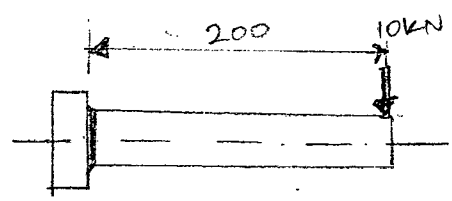
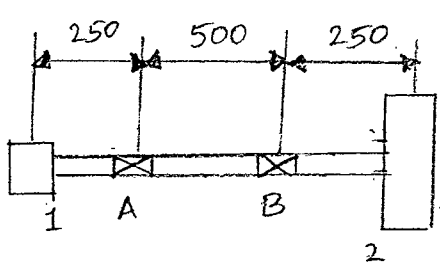


FIG 13b



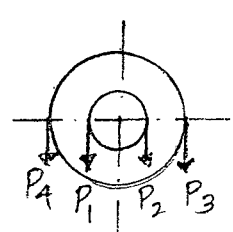


FIG. 12a