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B.E / B. Tech(Full Time) END SEMESTER EXAMINATIONS, Nov / Dec 2013
 FOURTH SEMESTER INDUSTRIAL ENGINEERING Regulation 2004/2008
ME 552 / ME 9305 DESIGN OF MACHINE ELEMENTS

Time : 3 hr

Max Mark : 100

Usage of Approved Design Data book is permitted

Part A (10 X 2 = 20 mark)

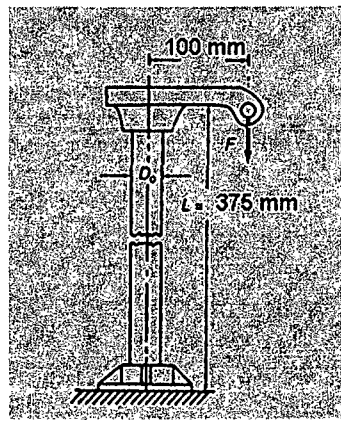
- . Distinguish clearly between direct stress and bending stress.
- . State the hypothesis of maximum shear stress failure theory. For what type of material , this theory may be used ?
- . How the selection of diameter in shaft design influence the critical speed of the shaft?
- .What are the stresses experienced by a crank shaft?
- .What types of riveted joints are used for boiler joints?
- .Distinguish between cotter and knuckle joint.
- .Define spring rate and spring index of a helical spring.
- . What are the three components of stresses induced in the arm of a flywheel?
- . . For what situations, the following type of rolling bearings are selected?

- i. Angular contact ball bearings ii. Self aligning ball bearings

0. Define i. eccentricity ratio ii. Attitude angle in hydrodynamic journal bearings.

Part B (5 X 16 = 80 mark)

1. Determine the stress in the $D_o = 50$ mm diameter short vertical column shown in the FigureQ11(a) below for load $F = 44.5$ k N



FigQ12(a)

Contd..2

2.(a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 1.5 kN.m and a torque of T. The yield point of the material of the shaft is 200 MPa, determine the maximum value of torque that can be transmitted without causing yielding of the shaft material using

- i. Maximum shear stress theory (8 mark)
- ii. maximum principle stress theory (8 mark).

OR

3) A cantilever beam of I-section supports an electric motor weighing 1000 N at a distance 400 mm from the fixed end. The allowable strength of beam material is 100 N/mm^2 . The proportions of the I-section are width, $B = 4t$ and height, $H = 6t$ where t is the thickness of the flange as well as the that of the web of the I-section. Determine the required dimensions of the I-section.

3(a) A hollow shaft with inner and outer diameters of 100 mm and 150 mm respectively is used to connect a motor and a generator. The allowable shear stress is 100 N/mm^2 . Using a factor of safety of 2.0, determine the maximum torque that can be transmitted by the shaft. If a solid shaft is used instead of hollow shaft of same weight, determine the amount of torque that can be transmitted

OR

- 3) i. Explain with the help of neat sketch the arrangement used in spigot type cotter joint. (8mark)
- ii. Briefly describe any four modes of failure of cotter joint. (8 mark)

4(a) . A close coiled helical compression spring is to have spring index of 8. Axial deflection of the spring is not to exceed 80 mm under an axial load of 2200 N and the shear stress developed in the spring is not to exceed 400 MPa. The diameters of steel wires available for selection are from 5mm to 15 mm in steps of 1 mm. Ignoring the effect of direct shear stress and curvature effect, determine the most suitable diameter of the wire, mean coil diameter, number of coils and pitch of the spring. Given $G = 84 \text{ GPa}$

OR

4) Obtain the dimension of a flywheel for an I.C engine, given the following data :

Material	: Cast Iron
Maximum velocity	: 25 m/s
Allowable coefficient of fluctuation of speed	: 0.01
Allowable coefficient of fluctuation of energy	: 2.35
Rim width to thickness ratio	: 1.5
Web thickness to width ratio	: 1/20

5(a) A turbine bearing is having the following conditions:

Journal diameter	:	150 mm
Radial clearance	:	150 microns
Eccentricity ratio	:	0.5
Speed	:	3000 rpm
Length	:	150 mm
Operating viscosity of the oil	:	50 cP.

Determine the following :

- i. load capacity
- ii. Friction coefficient
- iii. temperature rise

OR

c) i. Explain the terms static load rating and dynamic load rating of rolling bearings (4mark)

ii. Recommend a suitable rolling bearing for the following requirement:

Shaft diameter: 45 mm , speed : 1500 rpm, radial load : 8000 N ,

Axial load : 5000 N , required life : 500 hours, inner race rotating , steady load

(12 mark)

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