B.E / B. Tech(Full Time) END SEMESTER EXAMINATIONS, Nov / Dec 2012
FIFTH SEMESTER MECHANICAL ENGINEERING Regulation 2008

ME 9305 DESIGN OF MACHINE ELEMENTS

Time : 3 hr Max Mark : 100

Usage of Approved Design Data book is permitted

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Part A (10 X 2 = 20 mark)

1. What do you understand by endurance strength of a material? How does it differ from fatigue strength?
2. What are the reasons for the presence of stress concentration? What are the design options to reduce the same?
3. Distinguish the terms "design for strength" and "design for rigidity" in a shaft design.
4 Prove that square key is equally strong in shear and crushing.
5. Distinguish a tap bolt and stud bolt
6. What do you understand by the term efficiency of a riveted joint? What is the highest efficiency required of a riveted joint?
7. What are the advantages of Belleville springs? Give two applications of Belleville springs.
8. State the stresses induced in the rim of the flywheels restrained by the arms of the flywheels
9. Define the terms "static" and "dynamic" load capacity of a rolling element bearing.
10. List important properties required for the journal bearing materials. Give the names of two commonly used journal bearing materials in IC engine applications.

Part B (5 X 16 = 80 mark)

11. A mild steel shaft of 50 mm diameter is subjected to a bending moment of 1.5 kN.m and a torque of T. If the yield point of the material of the shaft is 210 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).

12 .(a) A rotating shaft made of AISI 1015 steel is machined to a diameter of 40 mm. It is subjected to a bending moment varying from 30 Nm to 150 Nm in addition to fluctuating torque which varies from - 50 Nm to +120 N m .The mechanical properties of AISI 1015 steel are S_{ut} = 390 MPa and S_y = 320 MPa.

Estimate (i) midrange bending and torsional stresses (6mark)

(ii) factor of safety in the design using Soderberg failure criterion (10 mark)

OR.

(b) i. Derive the expressions for the strain energy for a pure tensile and a pure torsional loading (6mark)

Contd..2

12(b) ii. A hot rolled alloy steel of specification **35 Mn 2 Mo 45** has yield strength of S yt = S yc and true strain at fracture of $\varepsilon = 0.55$. For the following principal state of stresses of an element , estimate the factor of safety using MSS and MDE theory of failure:

1. (500, 500 ,0) MPa
2. (215, 500 ,0) MPa
3. (0, 500 ,-215) MPa (10 mark)

13(a) A steel plate is subjected to a force of 3 k N and fixed to a vertical channel by means of four identical bolts as shown in the Fig Q 13(a). The bolts are made of plain carbon steel with yield strength of 380 MPa . The required factor of safety is 2. Determine the size of the bolts.

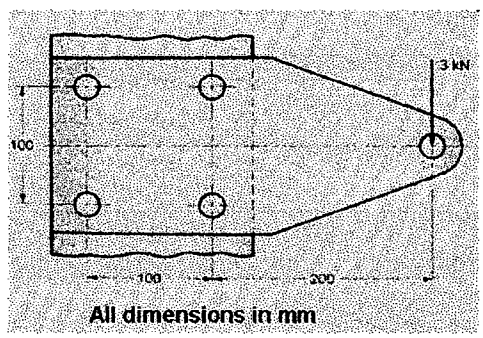

Fig Q 13(a)

OR

(b) i. Explain with the help of neat sketch the arrangement used spigot type cotter joint. (8mark)

ii. Briefly describe any four modes of failure of cotter joint. (8 mark)

14(a) The following particulars refer to the valve spring of a 4-stroke petrol engine:

Length of the spring when the valve is open	: 40 mm
Length of the spring when the valve is closed	: 49 mm
Spring load when the valve is open	: 360 N
Spring load when the valve is closed	: 220 N
Maximum inside diameter of the spring	: 25 mm
Permissible shear stress of spring material	: 400 MPa
Modulus of rigidity	: 83,000 N / mm^2

Obtain the dimensions of the spring and determine the critical operating speed of the engine

OR

(b) A flywheel is required to be designed for a multi cylinder engine with the following data :

Maximum fluctuation of energy in a working cycle , from T-θ diagram : 9,595 N.m

Mean speed of the flywheel : 800 rpm

Contd..3

Maximum allowable speed fluctuation , from speed	: $\pm$ 1%
Maximum permissible centrifugal stress	: 5.5 MPa
Density of the material of the flywheel	: 7200 kg/ m^3

The arms and hub of the flywheel provide 5% of the energy. Assuming width of the rim is twice the thickness, determine the dimensions of the rim.

15(a) The following data are pertaining to a 360 ° hydrodynamic journal bearing:

Speed	: 1490 rpm
Journal diameter	: 50 mm
Length	: 50 mm
Radial clearance	: 50 μ m
Oil viscosity at operating Temperature	: 25 Cp
Operating eccentricity	: 30 μ m

Calculate i. load capacity
ii. Friction power loss
iii. flow rate
iv. Minimum film thickness.

Assuming other operating conditions remain same, if the speed is increased to 2000 rpm , what is change load capacity of the bearing?

OR

15(b) i. With a sketch , explain the various loads that are to be considered in the design of a connecting rod of an I.C engine. (6 mark)

ii. A deep grove ball bearing having bore diameter of 60 mm and rotating at 1440 rpm is subjected to a radial force of 2500 N and an axial force of 1200 N . The radial and thrust factors are 0.56 and 2.0 respectively. If the expected life of the bearing is 25,000 hours, calculate the required dynamic capacity of the bearing and recommend a suitable bearing for this loading requirement. (10 mark)

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