Printed Pages : 4

EME-501

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140501

Roll No.

# B. Tech.

## (SEM. V) (ODD SEM.) THEORY EXAMINATION, 2014-15

## MACHINE DESIGN-I

Time : 2 Hours] [Total Marks : 50

**Note :** All questions carry equal marks.

1 Attempt any four parts :

a) Write short notes on the design process.

b) Explain theories of failure.

c) How will you select the material for shaft? Justify.

d) Define woodruff key.

e) Define the law of solid friction and fluid friction.

f) Write the design procedure for helical springs.

2 Attempt any two parts :

a) A bolt is subjected to a tensile load of 25kN and a shear load of 10kN. Determine the diameter of the bolt according to (i) Maximum principal stress theory (ii) Maximum principal strain theory (iii) Maximum stress theory. Assume factor of safety as 2.5, yield point stress in simple tension = 300N/mm$^2$ , Poisson's ratio = 0.25

b) The stress state in a machine member is given as follows. $\sigma_x$ = 20MPa ; $\sigma_y$ = 7MPa ; $\tau_{xy}$ = 4MPa. Find the principal normal and shear stresses. Locate the angle of $\sigma_1$ and $\sigma_2$ from x-axis.

c) Write short notes on factors influencing machine design.

d) A bolt with a square threaded screw has mean diameter of 25 mm and a pitch of 3 mm. It carries an axial thrust of 10 kN on the bolt head of 25 mm mean radius. If $\mu$ = 0.12, find the force required at the end of a spanner 450 mm long in tightening up the bolt.

**3** Attempt any two parts :

a) Design a lap joint to carry a load of 350kN. The rivets are 2 cm in diameter and placed in a double row. Given $\sigma_t$ = 150MN/m$^2$ ; $\tau$ = 100MN/m$^2$ ; $\sigma_c$ = 246 MN/m$^2$.

b) A transmission shaft is subjected to a fluctuating torque that varies from -120N-m to 500 N-m. Let the stress concentration factor be 1.5 and factor of safety be 2. Determine the required diameter of shaft. Shaft material is C45 steel.

c) A spherical pressure vessel with 400 mm inner diameter is welded from steel plates. The vessel is subjected to internal pressure varying from 0 to 50 bar. Assuming the ultimate tensile strength as 440 MPa, yield strength 240MPa and factor of safety 3, calculate the plate thickness.

d) A spring made from a wire of 1.25mm diameter and 750N/mm$^2$ as its yield strength has a mean diameter of 12.5mm and 14 active coils. Find (i) spring stiffness (ii) Solid height assuming that the ends are squared and ground. Take modulus of rigidity as $0.85 \times 10^5$ N/mm$^2$.

**4** Attempt any two parts :

a) A solid shaft is subjected to a bending moment of 3.46 kN-m and a torsional moment of 11.5 kN-m. The shaft is made of C45 steel and factor of safety is 6. Find the diameter of shaft.

b) Design a taper key for a shaft of diameter 100 mm transmitting 60kW at 300 rpm. The allowable compressive stress may be taken as 175 N/mm$^2$.

c) A rigid type of coupling is used to connect two shafts transmitting 15kW at 200rpm. The shaft keys and bolts are made of C45 steel and the coupling is of cast iron. Design the coupling.

d) A helical spring made of C50 steel has an outside diameter of 80mm and a wire diameter of 12mm. The spring has to support a maximum axial load of 1kN. Determine the maximum stress and total deflection. If the springs have 10.5coils with ends ground flat. Determine also the factor of safety.
Take $G = 0.89 \times 10^2$ kN/mm$^2$.

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