Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(CHE-OLD)/SEM-5/CHE-501/2012-13

2012

MACHINE DESIGN

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) The material having same elastic properties in all directions is called

a) ideal material

b) uniform material

c) isotropic material

d) elastic material

e) none of these.

ii) The maximum axial compressive load, which a column can take without failure by lateral deflection is called

a) critical load b) buckling load

c) crippling load d) any one of these.

iii) When a shaft is subjected to torsion, the relation between maximum shear stress (τ), modulus of rigidity of the shaft (G) and angle of twist (θ) is given by

a) $\frac{G\theta}{\tau} = \frac{R}{L}$ b) $\frac{G\theta}{L} = \frac{\tau}{R}$

c) $\frac{G\theta}{R} = \frac{\tau}{L}$ d) $\frac{G}{L\theta} = \frac{\tau}{R}$.

iv) Polar moment of inertia of a solid circular shaft of diameter D is equal to

a) $\frac{\pi}{32} D^3$ b) $\frac{\pi}{32} D^4$

c) $\frac{\pi}{64} D^3$ d) $\frac{\pi}{64} D^4$.

v) A cantilever beam is with

a) both ends fixed

b) one end fixed and other end free

c) both ends simply supported

d) one end hinged and other simply supported.

vi) Maximum bending stress occurs at

a) uppermost fibre b) the neutral fibre

c) lower-root fibre d) none of these.

vii) Flange coupling is used to

a) join two shafts

b) join two pipes

c) transmit power from one shaft to another

d) join two plates.

viii) Finite life of a machine member made of steel subjected to cyclic loading is generally taken as

a) $10^2 - 10^3$ cycles

b) 10^6 cycles and above

c) $10^3 - 10^6$ cycles

d) below 10^6 cycles.

ix) The efficiency of a welded joint, compared to riveted joint is
   a) more b) less
   c) equal d) unpredictable.

x) In welded joint the throat of weld as compared to size of weld is
   a) about same in size
   b) about 0·7 times
   c) about 0·5 times
   d) about 0·25 times.

xi) In thick cylinders, the radial stress across the thickness of cylinder is
   a) zero at outside and maximum at inside
   b) minimum at outside and maximum at inside
   c) maximum at outside and minimum at inside
   d) uniform throughout.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Discuss the function of a coupling. Give at least four practical applications. What are the types of shaft coupling ? 1 + 2 + 2

3. Show that in case of a thin cylindrical shell subjected to an internal fluid pressure, the tendency to burst lengthwise is twice as great as at a transverse section. 5

4. a) What is stress concentration ?
   b) Explain different types of cyclic loads and stresses. 1 + 4

5. a) How do you specify a rivet ?
   b) Write short notes on types of rivet failure. 1 + 4

6. Considering a shaft subjected to torque causing distortion, derive the simple torsion formula

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}.$$

Notations bear their usual significance. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions. $3 \times 15 = 45$

7. a) Explain Soderberg and Goodman criterion for fatigue loading. 7

   b) A cast iron pipe is to deliver water at the rate of 125 m^3/min and the velocity is 0·5 m/s. The maximum pressure in the pipe is 0·875 N/mm^2. The permissible stress in the C.I. is 21 N/mm^2. Determine the pipe diameter and the wall thickness. 8

8. a) Discuss the design procedure of all components in the flat belt based on strength. 7

   b) A thin cylinder of bronze with 200 mm internal diameter has a thickness of 3 mm. It has its end closed and is filled with water. On the application of an external pull of 80 kN at its ends, it was found that water pressure decreased by 0·15 N/mm^2. Determine the value of Poisson's ratio if $E = 120$ GN/m^2 and $k = 2·2$ GN/m^2. 8

9. Design a cotter joint to connect two mild steel rods. The joint is subjected to 24 kN tensile forces. The allowable limits of tensile, shear and crushing strength are 60 N/mm^2, 40 N/mm^2 and 75 N/mm^2 respectively. 15

10. a) Two 100 mm diameter shafts are to be connected by means of flanges with 20 mm diameter bolts equally spaced in a circle of diameter 200 mm. If the maximum shear stress in the shaft is not to exceed 75 MPa and the average shear stress in the bolts is not to exceed 60 MPa, determine the No. of bolts.

    b) If the key is 20 mm wide, determine its length assuming the key is rectangular. 10 + 5