Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (AUE)/SEM-3/AUE-301/2010-11

2010-11
STRENGTH OF MATERIALS

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 the following : $10 \times 1 = 10$

   i) Power transmitted by a shaft rotating at N rpm under a mean torque of T (Nm) is

   a) $2\pi NT/60$ watts b) $2\pi NT/60$ kilowatts

   c) $2\pi NT/60$ HP d) none of these.

   ii) Where shear force changes sign, the bending moment is

   a) zero b) increasing

   c) maximum d) minimum.

   iii) The property which enables a material to spring back to its original shape and size after the removal of load is called

   a) Elasticity

   b) Plasticity

   c) Ductility.

iv) The point in a stress strain curve at which neck formation starts is called

a) Ultimate stress

b) Breaking stress

c) Yield stress.

v) The ratio of lateral strain to longitudinal strain in any member is called

a) Poisson's ratio

b) Young's modulus

c) Elastic constant.

vi) In a cantilever with U.D.L. the shear force diagram is

a) Parabolic b) Linear

c) Cubic d) Any of the above.

vii) For circular section of diameter d, the section modulus is

a) $\pi d^4/64$ b) $\pi d^3/32$

c) $\pi d^4/16$ d) $\pi d^4/4$.

viii) A strut is a member which carries

a) Tensile load b) Compressive load

c) Both tensile and compressive loads.

ix) Slenderness ratio of a column may be defined as the ratio of its length to the

a) Diameter b) Radius

c) Radius of gyration d) Cross section.

x) The values of Poisson's ratio of materials lie between

a) 0 and 1

b) 0 and $^1/_2$

c) 1 and 2.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$3 \times 5 = 15$

2. Establish a relation between Young's modulus and bulk modulus.
3. A rod of cross sectional area *a* and length L is hanging freely from ceiling. If the unit weight of the rod material is γ, find out elongation due to its own weight.
4. Derive the relation between shear force, bending moment and intensity of load at a section of a beam.

5. For pure bending, establish the relationship : $\frac{\sigma_{max}}{y} = \frac{M}{I} = \frac{E}{\rho}$.

6. Find out the expression for Euler's critical load for columns, the ends of which are both hinged.

GROUP – C

(Long Answer Type Questions)

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

7. a) In Fig. A, a lever is attached to a spindle by means of a square key 6mm × 6mm by 2.5 cm long. If the average shear stress in the key is not to exceed 700 kg/cm^2, what is the safe value of the load P applied to the end of the lever ? 5

   b) What is thermal stress ? Calculate the stress for each segment of the compound bar, as shown in Fig. B, if the temperature is decreased to 21°C from an initial temperature of 38°C (at which the bars are stress free). Given, $E_{st} = 2.06 \times 10^{11} N/m^2$, $E_{AL} = 0.73 \times 10^{11} N/m^2$, $\alpha_{st} = 11.7 \times 10^{-6}/°C$, $\alpha_{AL} = 23.4 \times 10^{-6}/°C$. 3 + 7

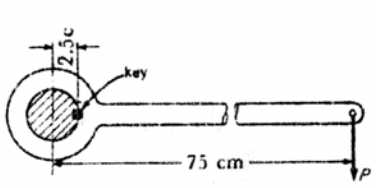

Fig.A

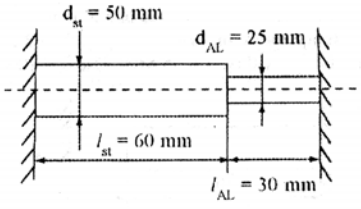

Fig.B

8. a) A thin walled cone (wall thickness *t*) is supported on a horizontal base as shown in Fig.C and subjected to internal gas pressure *p*. Neglecting the weight of the cone itself, find the principal membrane stresses σ_1 and σ_2 at the level *h* below the apex. The apex angle of the cone is 2α as shown. 7

b) A state of plane stress consist of a tensile stress σ_0 = 56MPa exerted on vertical surfaces and of unknown shearing stresses (Fig.D). Determine

i) The magnitude of shearing stress τ_0 for which the largest normal stress is 70MPa.

ii) The corresponding maximum shearing stress. 8

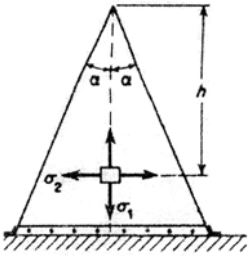

Fig.C

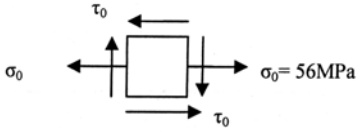

Fig.D

9. a) The W 360 × 79 rolled steel beam AC is simply supported and carries the UDL as shown (Fig.E). Draw the shear and bending moment diagram for the beam. 6

b) A timber beam AB of span 3 m and nominal width 100 mm (actual width = 90 mm) is to support the 3 concentrated loads shown (Fig.F). Knowing that for the grade of timber used σ_{all} = 12 MPa and τ_{all} = 0.75 MPa, determine the minimum required depth d of the beam. 9

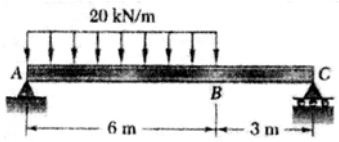

Fig.E

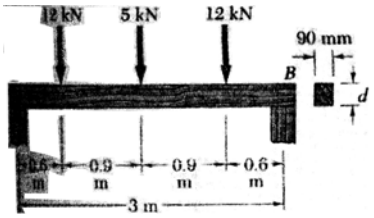

Fig.F

10. a) A hollow steel tube (outside diameter d_0 and inside diameter d_i) is to be used as a torque dynamometer. It is desired to attain an angle of twist of 1° per 30 cm of length per 100 kg-cm of torque without exceeding an allowable shear stress τ_w = 420 kg/cm^2. What are the required value for d_0 and d_i ? 7

b) A simple supported prismatic beam AB carries a uniformly distributed load of intensity ω over its span l as shown in Fig. G. Develop the equation of the elastic line and find the maximum deflection δ at the middle of the span. 8

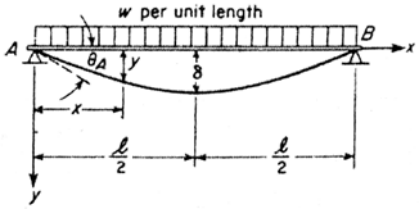

Fig.G

11. Write short notes on any *three* of the following : 3 × 5

a) Point of cotraflexure.

b) Pure shear.

c) Slenderness ratio.

d) Euler's column formula.