USN | | | | | | | | | | |

10CV/EV/CT33

Third Semester B.E. Degree Examination, June/July 2015

Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Define: i) Stress ii) Strain. (04 Marks)

b. Derive the relation between modulus of rigidity and Young's modulus of Elasticity and define elastic constants. (08 Marks)

c. The modulus of rigidity for a material is 51GPa. A 10mm diameter rod of the material was subjected to an axial load of 10kN and the change in diameter was observed to be 3×10^{-3}mm. Calculate the Poisson's ratio and the modulus of elasticity. (08 Marks)

2 a. A reinforced concrete column 300mm × 300mm has 4 reinforcement bars of steel each 20mm in diameter. Calculate the safe load the column can take if the permissible stress in concrete 5.2 N/mm^2 and $\frac{E_{steel}}{E_{concrete}} = 18$. (08 Marks)

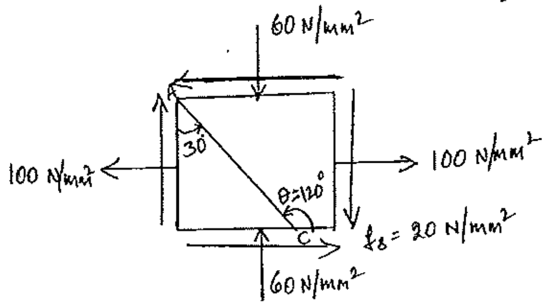
b. A compound bar made of steel plate 60mm wide and 10mm thick to which the copper plate 60mm wide and 5mm thick are rigidly connected to each other. The length of the bar is 0.7m. If the temperature is raised by 80°C. Determine the stress in each metal and the change in the length.

Take: $E_s = 200$ GPa $\alpha_s = 12 \times 10^{-6}/°C$
$E_{cu} = 100$ GPa $\alpha_{cu} = 17 \times 10^{-6}/°C$. (12 Marks)

3 a. Derive expressions for principal stresses and their planes for two dimensional stress systems. (08 Marks)

b. At a point in a strained material, the state of the stress is as shown in the Fig.Q.3(b). Calculate the normal and the shearing stress on the plane AC. Also find the principal stresses and their planes. Determine the maximum shear stress and their planes. (12 Marks)

Fig.Q.3(b)



4 a. Define: i) Shear force ii) Bending moment iii) Point of contra flexure. (06 Marks)

b. A beam ABCD, 8m long has supports at 'A' and at 'C' which is 6m from 'A'. The beam carries a UDL of 10kN/m between 'A' and 'C' at point B a 30kN concentrated load acts 2m from the support A and a point load of 15kN acts at the free end 'D'. Draw the SFD and BMD giving salient values. Also locate the point of contra-flexure if any. (14 Marks)

PART – B

5 a. Derive Bernoulli-Euler bending equation $\frac{M}{I}=\frac{f}{y}=\frac{E}{R}$. **(06 Marks)**

b. The cross section of a beam is shown in Fig.Q.5(b). The shear force on the section is 410kN. Estimate the shear stresses at various points and plot the shear distribution diagram. **(14 Marks)**

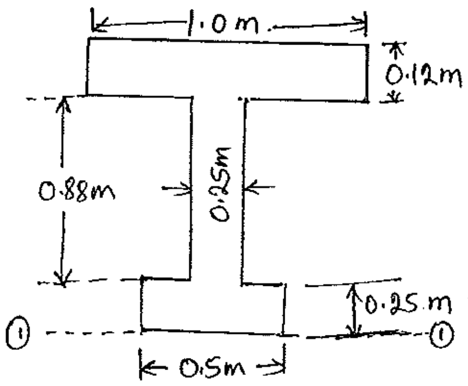


Fig.Q.5(b)

6 a. Derive the equation $EI\frac{d^2y}{dx^2}=M_x$ with usual notation. **(06 Marks)**

b. A beam of constant C/S 10m long is freely supported at its ends and loaded with 2 loads of 60kN each at 3m from either end. Find the slope at the support and the deflection under any one load. Take EI constant. **(14 Marks)**

7 a. List the assumptions made in the theory of pure torsion. **(04 Marks)**

b. Explain: i) Polar modulus; ii) Torsional rigidity; iii) Polar moment of inertia. **(06 Marks)**

c. A solid shaft is to transmit 340 kN-m at 120rpm. If the shear stress of the material should not exceed 80MPa. Find the diameter required. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose $d_i = 0.6d_o$, the length, material and shear stress remaining same. **(10 Marks)**

8 a. Distinguish between short column and long column. **(04 Marks)**

b. Explain:
i) Effective length of column
ii) Slenderness ratio
iii) Buckling load. **(06 Marks)**

c. Determine the Euler's crushing load for a hollow cylindrical cast iron column 150mm external diameter and 20mm thick. If it is hinged at both the ends and 6m long compare this load with the crushing load as given by Rankine's formula. Use the constants:

$f_c = 550MPa$ $\alpha = \frac{1}{1600}$ $E = 80$ GPa. **(10 Marks)**

* * * * *