

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-III (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 130604

Date: 07/06/2017

Subject Name: Structural Analysis-1

Time: 10:30 AM to 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) A 6 m long fixed ended column of hollow square cross section with 480 mm external dimension and 60mm thickness is made up of mild steel. Using Euler's formula, find out the safe axial load on this column using factor of safety 1.5. Take $E = 200 \text{ GPa}$. **07**

(b) A steel bar 80 cm long and rectangular in section of size 40 mm x 60 mm is subjected to an axial load of 2.4 kN. Find the maximum stress if (a) The load is applied gradually. (b) The load is applied suddenly, and (c) The load is applied after falling through a height of 8 cm. **07**

Q.2 (a) A cantilever beam having span of 4m is subjected to UDL of 16 kN/m over entire span along with a point load of 24 kN at center of span. Determine slope and deflection at the free end if $E = 14 \text{ GPa}$ and $I = 2 \times 10^8$. Use method of your choice. **07**

(b) Analyse a plane frame loaded and supported as shown in figure – 1 and draw S.F. and B.M. diagram. **07**

OR

(b) A shaft is to be designed to transmit 1500 kW power at a speed of 180 RPM. The permissible stress in shaft material is limited to 60 MPa. Determine the size of shaft if it is solid in section. Also calculate the percentage reduction in material consumption if it is made up of hollow shaft having internal diameter as 0.6 times the external diameter. **07**

Q.3 (a) A mild steel cantilever beam ABC having span of 1m, is subjected to a set of 2 clockwise couple of 2kNm one at free end C while the other at mid span point B. The cross section of beam is 40mm wide and 60mm deep. Calculate slope and deflection at points B and C using conjugate beam method. Take $E = 200 \text{ GPa}$. **07**

(b) Solve the above example of Q -3 (a) using Macaulay's method. **07**

OR

Q.3 (a) A simply supported beam ABC is having span 8m. The left 4m portion AB is subjected to UDL of 10 kN/m. Calculate slopes at supports A and C. Also calculate deflection at point B. Use moment area method. **07**

(b) A thin cylindrical shell having 500mm diameter is 2m long with shell thickness of 15mm. It is subjected to an internal pressure of 3 MPa. Calculate the change in length, diameter and volume if $E = 200 \text{ GPa}$ and $1/m = 0.27$ **07**

Q.4 (a) A thin spherical shell is 1200 mm in diameter. It is filled with a fluid which develops internal pressure of 3 MPa, calculate the **07**

required shell thickness if the the change in volume of shell is not to exceed 3% of original volume. $E = 200 \text{ GPa}$ and $1/m = 0.27$.

- (b) Explain “No Tension Condition” for a column member and derive core area for any two standard sections. **07**

OR

- Q.4 (a)** A masonry dam is 1m wide at top while 4m wide at base and 6m high. The wall face exposed to water is vertical and the water may reach top of the wall. Find the maximum and minimum stress at the base if unit weights of masonry is 20 kN/m^3 while that of water is 9.8 kN/m^3 . Also calculate the stress when reservoir is empty. **07**
- Q.4 (b)** A mild steel column having cross section as I section with flanges of size $200\text{mm} \times 10\text{mm}$ and web is $10\text{mm} \times 180\text{mm}$ is 10m long. It is hinged at top and fixed at base. Calculate Euler’s crippling load and compare the crippling load given by Rankine’s formula taking $\sigma_c = 550\text{MPa}$ and $\alpha = (1/1600)$. Take $E = 200 \text{ GPa}$. **07**

- Q.5 (a)** A three hinged parabolic arch of span 12 m and rise 2.5m carries a UDL of 20 kN/m on the left half portion of the arch. Determine reactions at end supports. Also find normal thrust, radial shear and bending moment at 3m and 9 m from left support. **07**
- (b) A short column has a square section $300\text{mm} \times 300\text{mm}$ with a square hole of $150 \text{ mm} \times 150 \text{ mm}$ as shown in Figure 2. It carries an eccentric load of 2000kN located as shown in figure. Determine the values of stresses across the section. **07**

OR

- Q.5 (a)** A suspension cable is suspended between two points at the same level with 80m between them. It carries UDL of 15 kN load per horizontal meter. Determine the central dip which may be allowed if the maximum tension in the cable is not to exceed 1000 kN . **07**
- (b) Two point loads 100 kN and 50 kN spaced at 2m distance crosses a girder having span of 10m, the smaller load is leading from left to right. Calculate values of maximum S.F. and maximum B.M. for this girder. **07**

