GUJARAT TECHNOLOGICAL UNIVERSITY

2nd Semester Civil Engineering - PDDC

Subject Code & Name : X20603 - Structural Analysis-I

Sr. No.	Course content
1.	**Torsion :** Torsion of solid and hollow circular shaft, shear stress and strain due to torsion, angle of twist, torsional moment of resistance, power transmitted by shaft, keys and coupling, combined bending and torsion, closed coiled helical sprigs.
2.	**Thin cylinder :** Analysis of thin cylinder and spherical vessels under pressure
3.	**Fundamentals :** Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's reciprocal theorems. Computation of internal forces in statically determinate structures such as compound truss, portals, gables, grids, beams curved in plan.
4.	**Displacement of determinate beams and plane truss :** Differential equation of elastic curve, relation between moment, slope and deflection, Macaulay's method, moment area method, conjugate beam method applied to beams including varying moment of inertia, Joint displacement of determinate plane truss using unit load method.
5.	**Arches, cables and suspension bridges :** Three hinge arch-segmental and parabolic shapes. Forces and end actions in cables, unstiffened three hinged parabolic and catenary type suspension bridge.
6.	**Strain energy :** Resilience, strain energy in tension, compression, shear, bending, torsion, proof resilience, modulus of resilience, impact loads, and sudden loads.
7.	**Influence lines :** For statically determinate beams, I.L.D for support reaction, shear and moment for U.D.L, several point loads, criteria for maximum effects, influence lines for statically determinate trusses, forces in members for U.D.L and point loads, criteria for maximum effect.
8.	**Direct and bending stresses :** Members subjected to eccentric loads, middle third rule, kernel of section, chimney subjected to wind pressure, retaining walls, dams subjected to hydraulic pressure.
9.	**Columns and struts :** Buckling of columns, different end conditions, effective length, least radius of gyration, product of inertia, principal axes and Mohr's circle of inertia, Euler's and Rankine's formulae, columns with initial curvature, eccentrically loaded columns, columns with lateral loading.

TERM WORK : This will consist of graphical and/or analytical solutions of at least 30 problems based on the above course. Practical examinations shall consists of oral based on term work and above course.

References Books :

1. Junarkar S.B. & Shah H.J.; Mechanics of Structures Vol-I; Charotar publishing house, Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
3. Popov E.P.; Engineering Mechanics of Solids; Prentice Hall of India, New Delhi
4. Ryder G.H.; Strength of Materials; McMillan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Mechanics of Materials; Pearson Education
7. Hibbler R C; Structural Analysis; Pearson Education

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–II • EXAMINATION – WINTER 2013

Subject Code: X20603 **Date: 26-12-2013**

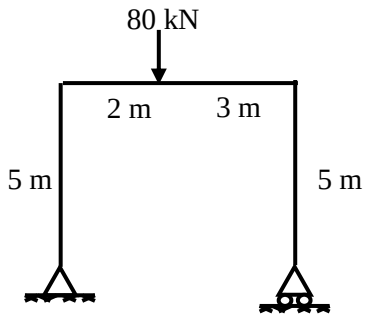
Subject Name: Structural Analysis-I

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

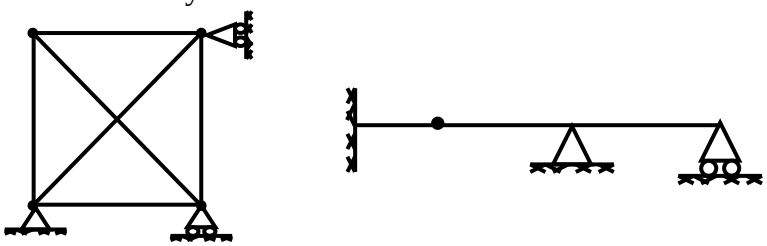
Instructions:

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

.Q.1 **(a)** Analyze the plane frame as shown in Figure below. Draw shear force, bending moment and axial force diagrams. **07**



(b) Find out S.I. and K.I. for the structures as shown in figure below. Also give comment on stability. **04**



(c) Define S.I. and K.I. **03**

Q.2 **(a)** Enlist various assumptions made in Euler's Formula. Also explain effective length of various columns as per their end conditions. **07**

(b) A hollow circular cast iron column of length 4 m has to carry 300 kN axial load. The thickness of the column is 5% of External diameter. The compressive stress is 350 N/mm^2 and Rankine's constant is (1/3600). Both ends of column are fixed. Calculate diameter of the column. **07**

OR

(b) Calculate safe load using Euler's Formula for a 5 m long column having following cross sectional details. **07**
Flange : 250 mm x 20 mm Web: 360 mm x 14 mm
One end fixed and other hinged. Take E = 2 x 10^5 N/mm^2, F.O.S. = 2.5

Q.3 **(a)** Derive equation for longitudinal and hoop stress for thin cylindrical shell subjected to internal pressure 'p'. **07**

(b) A closed cylindrical vessel of length 4 m, diameter 500 mm and thickness 12 mm is subjected to internal pressure of 2.5 N/mm^2. Calculate longitudinal stress, hoop stress, change in length and change in diameter. Take poisson's Ratio = 0.30 and E = 200 GPa. **07**

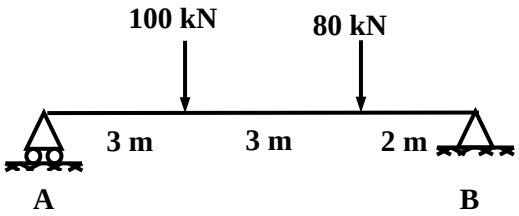
OR

Q.3 **(a)** Derive basic equation of torsion for circular shaft with usual notations. **07**

(b) A hollow shaft of diameter ratio of 0.7 is to transmit 250 kW power at 150 rpm. The maximum torque being 20% greater than the mean and shear stress is not to exceed 100 N/mm^2 and twist in a length of 4 m is not to exceed 2 degrees. Calculate external and internal diameter. Modulus of rigidity = 12 x 10^8 N/mm^2. **07**

Q.4 **(a)** Calculate slope & Deflection at free end for a cantilever beam of span 5 m subjected to u.d.l. of 10 kN/m over entire span. Use Moment-area method. Take E = 2.3 x 10^4 N/mm^2. C/S of beam = 250 x 300 mm. **07**

(b) Calculate slope at end A and Deflection at mid-span for a beam as shown in figure below. Take EI = 3000 kN-m^2. Use any method. **07**



OR

Q.4 **(a)** Define Strain Energy. Derive that stress due to suddenly applied load is twice than stress due to gradually applied load. **07**

Q.4 **(b)** A load of 3 kN falls through a height of 50 mm on to a collar rigidly attached to the lower end of the vertical bar 3 m long having 30 mm radius. The upper end of the bar is fixed. Find (i) maximum instantaneous stress induced in the bar (ii) elongation in the bar (iii) strain energy stored. Take E = 200 x 10^3 N/mm^2. **07**

Q.5 **(a)** A three hinged parabolic arch is subjected to a point load of 50 kN at 5 m from left end support. The arch has a span of 16 m and central rise of 4 m. Calculate support reactions and maximum positive bending moment in the arch. **07**

(b) A masonry dam 8 m high, 2 m wide at top and 4.5 m wide at bottom retains water up full height on vertical face. Find maximum and minimum stress intensities at the base. The unit weight of water is 10 kN/m^3 and of masonry is 18 kN/m^3. **07**

OR

Q.5 **(a)** A concrete column having cross-sectional dimension 400 mm x 500 mm is loaded by a point load 150 kN acting eccentrically at any of the corner. Find out Maximum and minimum stresses induced in the column. **07**

(b) A u.d.l. of 10 kN/m and 5 m in length passes a simply supported beam of 10 m span from left to right. Draw ILD for shear force and bending moment at a section 4 m from left end support. Also calculate maximum values of shear force and bending moment at section. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–II • EXAMINATION – SUMMER 2013

Subject Code: X20603 **Date: 13-06-2013**

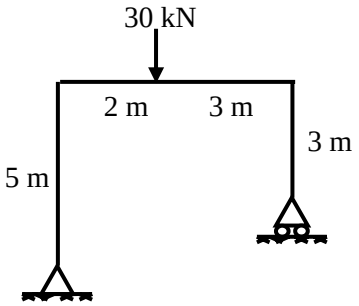
Subject Name: Structural Analysis-I

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

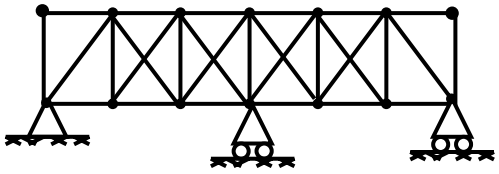
Instructions:

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

Q.1 **(a)** Analyze the plane frame as shown in Figure below. Draw shear force, bending moment and axial force diagrams. **07**



(b) Find out S.I. and K.I. for the structures as shown in figure below. **04**



(c) State Maxwell Reciprocal theorem and Principle of Superposition. **03**

Q.2 **(a)** Calculate maximum slope and deflection for a simply supported beam of span 5m and subjected to a central point load of 10 kN. Use Macaulay's Method. Take E = 2.1 x 10^5 N/mm^2 and I = 100 x 10^6 mm^4. **07**

(b) Calculate Slope and deflection at free end for a cantilever beam of span 'l' and subjected to a udl of 'w' per unit run. Use Moment area method. **07**

OR

(b) Derive relationship between slope, deflection and radius of curvature. **07**

Q.3 **(a)** Derive equation for longitudinal and hoop stress for thin cylindrical shell subjected to internal pressure 'p'. **07**

(b) A closed cylindrical vessel of length 3 m, diameter 600 mm and thickness 10 mm is subjected to internal pressure of 1.4 N/mm^2. Calculate longitudinal stress, hoop stress, change in length and change in diameter. Take poisson's Ratio = 0.20 and E = 205 GPa. **07**

OR

Q.3 **(a)** Define ILD and state significance of ILD in the analysis of structures. Draw **07**

ILD for reactions for a simply supported beam of span 6 m.

(b) A hollow shaft of diameter ratio of 3/5 is to transmit 300 kW power at 120 rpm. The maximum torque being 25% greater than the mean and shear stress is not to exceed 80 N/mm^2 and twist in a length of 5 m is not to exceed 2.5 degrees. Calculate external and internal diameter. Modulus of rigidity = 10×10^8 N/mm^2. **07**

Q.4 (a) A three hinged parabolic arch is subjected to a point load of 12 kN at 4 m from left end support. The arch has a span of 20 m and central rise of 4 m. Calculate support reactions and maximum positive bending moment in the arch. **07**

(b) A masonry dam 6 m high, 2 m wide at top and 4 m wide at bottom retains water up full height on vertical face. Find maximum and minimum stress intensities at the base. The unit weight of water is $10kN/m^3$ and of masonry is 22 kN/m^3. **07**

OR

Q.4 (a) Define: (i) Strain Energy (ii) Proof Resilience (iii) kernel of a section **03**

Q.4 (b) Draw neat sketch of kernel of the following cross sections. **04**

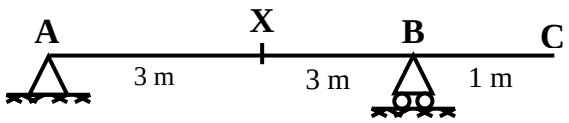
(i) Square section of 400 mm side

(ii) Circular section of 250 mm radius

Q.4 (c) A load of 200 N falls through a height of 35 mm on to a collar rigidly attached to the lower end of the vertical bar 2 m long having 25 mm radius. The upper end of the bar is fixed. Find (i) maximum instantaneous stress induced in the bar (ii) elongation in the bar (iii) strain energy stored in the bar. Take E = 200 N/mm^2. **07**

Q.5 (a) A u.d.l. of 8 kN/m and 4 m in length passes a simply supported beam of 12 m span from left to right. Draw ILD for shear force and bending moment at a section 4 m from left end support. Also calculate maximum values of shear force and bending moment at section. **07**

(b) Draw ILD for for V_A , V_B , V_X and M_X for an overhanging beam as shown in figure below. **07**



OR

Q.5 (a) A concrete column having cross-sectional dimension 500 mm x 300 mm is loaded by a point load 120 kN acting eccentrically at 30 mm distance from center along one of the diagonals. Find out Maximum and minimum stresses. **07**

(b) Calculate the load carrying capacity using Euler's and Rankine's Formula for a rectangular column having 300 mm x 400 mm size and 4 m length. The ends of the column are fixed. Take E = 1.6×10^5 N/mm^2 , Rankine's Constant = 1/1600, fc = 250 N/mm^2 **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER – II • EXAMINATION – WINTER 2012

Subject code: X 20603 **Date: 22/01/2013**

Subject Name: Structural Analysis -I

Time: 10.30 am - 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)** Explain resilience, proof resilience and modulas of resilience. **07**

(b) Find position of maximum deflaction and maximum deflaction for beam shown in fig. 1, using Macaulay's method. $E = 2 \times 10^5$ MPa and $I = 4.3 \times 10^8$ mm^4. **07**

Q.2 **(a)** Find the deflaction under point load for a beam shown in fig. 2. $E = 2 \times 10^5$ MPa and $I = 1 \times 10^8$ mm^4. Use Conjugate beam method. **07**

(b) A hollow CI column 200 mm outside diameter and 150 mm inside diameter, 8 m long has both ends fixed. It is subjected to axial compressive load. Factor of safety = 6, Constant a = 1/1600, f_c = 560 MPa. Determine safe Rankine load. **07**

OR

(b) A hollow CI column is 4 m long with both ends fixed. Determine minimum diameter of column if it has carry a safe load of 250kN with factor of safety of 5. Take internal diameter as 0.8 times external diameter. Take f_c = 550 MPa and constant a = 1/1600. **07**

Q.3 **(a)** Prove that maximum shear stress at any point in the thin cylinder, subjected to internal fluid pressure is given by
(p x d / 8t) **07**

(b) A hollow shaft of internal diameter 10 cm, is subjected to pure torque and attains a maximum shear stress q on the outer surface of the shaft. If the strain energy stored in the hollow shaft is given by $(\tau^2/3C) \times V$, determine the external diameter of the shaft. **07**

OR

Q.3 **(a)** Show that in thin cylindrical shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress. **07**

(b) Determine the diameter of a solid shaft which will transmit 90 kW at 160 rpm. Also determine the length of the shaft if the twist must not exceed 1^0 over entire length. The maximum shear stress is limited to 60 MPa. Take modulas of rigidity = 8×10^4 MPa. **07**

Q.4 **(a)** Draw neat sketches of kernel of the following cross sections **07**

(i) Rectangular cross section 200 mm x 300 mm

(ii) Hollow circular cylinder with ext. dia. = 300 mm and thickness 50 mm

(iii) Square 400 cm^2 area.

(b) Find the permissible span for a steel cable suspended between supports at the same level, if the central dip is $1/10^{th}$ of the span and the permissible stress is 120 MPa. Specific weight of steel is 78 **07**

kN/m^3. Assume cable to hang in a parabolic curve.

OR

Q.4	**(a)**	A short column of rectangular cross section 80 mm by 60 mm carries a load of 40 kN at a point 20 mm from longer side and 35 mm from shorter side. Determine maximum compressive and tensile stresses in the section.	**07**
Q.4	**(b)**	A three hinged parabolic arch hinged at crown and springings has a horizontal span of 12 m and central rise of 2.50 m. it carries a UDL of 30 kN/m horizontal run over the left hand half of the span. Calculate the reactions at the end hinges. Also calculate the value of normal thrust, shear force and bending moment at 1.5 m from left hand hinge.	**07**
Q.5	**(a)**	Draw SFD, BMD and AFD for the portal frame shown in fig. 3.	**07**
	(b)	A train of loads shown in fig. 4 crosses a simply supported beam of span 18 m from left to right. Calculate maximum SF and BM at section 8 m from left to right.	**07**

OR

Q.5	**(a)**	Draw SFD, BMD and AFD for the portal frame shown in fig. 5.	**07**
	(b)	Explain Influence line diagram. Differentiate between ILD of bending moment and normal bending moment diagram.	**07**

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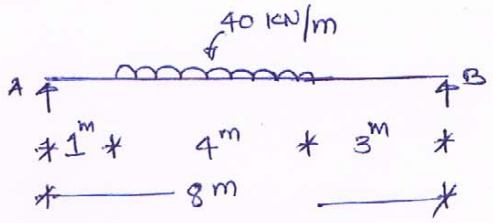

Fig. 1 (Q.1 (b))

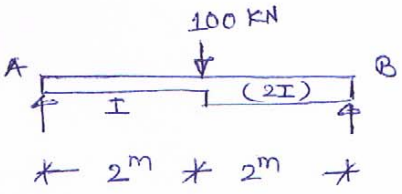

Fig. 2 (Q.2 (a))

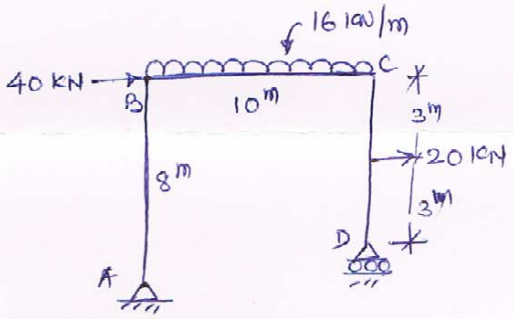

Fig. 3 (Q.5 (a))

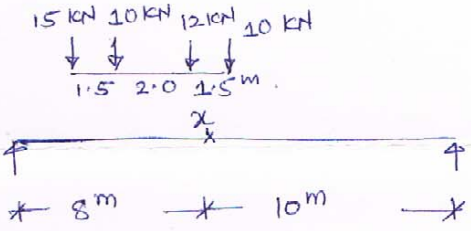

Fig. 4 (Q.5 (b))

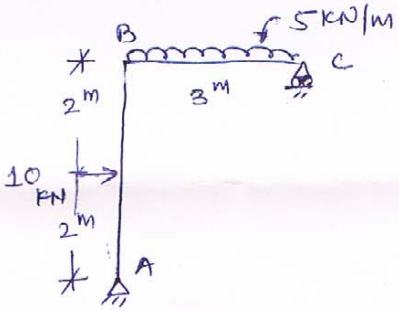

Fig. 5 (OR Q.5 (a))

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GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-II Examination May 2012

Subject code: X20603

Subject Name: Structural Analysis - I

Date: 25/05/2012 **Time: 10.30 am – 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)**	Define Influence Line Diagram and give it's uses.	**03**
	(b)	Find out SI and KI of the structures shown in the fig.1 and fig.2.	**04**
	(c)	Calculate the deflection at C in terms of EI for the beam as shown in figure-1 by Macaulay's method..	**07**
Q.2	**(a)**	Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E = 205 GPa. Also determine the crippling load by Rankine's formula using constants as 335 MPa and 1/7500.	**07**
	(b)	A three hinged arch of 40m span and 8m rise carries a UDL of 20kN per horizontal meter run over the left hand half of the span and three point loads of 80kN each at 25,30 and 35m from the left hand hinge. Calculate the horizontal thrust.	**07**
		OR	
	(b)	A light cable, 18 m long is supported at two ends at the same level. The supports are 16 m apart. The cable supports three loads of 8, 10 and 12 N dividing the 16 m distance in four equal parts. Find the shape of the string and the tension in various portions	**07**
Q.3	**(a)**	Draw the S.F and B.M diagram for the beam loaded as shown in the figure3.	**07**
	(b)	For torsion of a circular shaft, derive the equation $T/I_P = \tau/R = C\theta/L$ with usual notations	**07**
		OR	
Q.3	**(a)**	Draw the S.F and B.M diagram for the portal loaded as shown in the figure2.	**05**
	(b)	A hollow circular shaft transmits 800 kW at 150 RPM. Its maximum torque is 25% more than the average torque. The ratio of internal to external radius is 0.8. If the maximum shear stress and angle of twist in 3 m length are not to exceed 80 MPa and 3^o then find the required sectional dimension of the shaft. Take modulus of rigidity: C = 85 GPa.	**09**
Q.4	**(a)**	Write the equation for instantaneous stress for impact loading. Using the same show that the stress induced due to sudden loading is twice that of the stress due to gradual loading.	**07**
	(b)	A cylindrical pressure vessel 180 cm in dia. And 360 cm in length is made up of 1.25 cm thick plates. It is subjected to an internal pressure of 8 N/cm^2. Calculate the longitudinal and circumferential stresses developed in the vessel.	**07**

OR

Q.4 **(a)** A spherical shell of 1.8 m diameter is made up of 1.5 cm thick plates. Calculate the increase in volume of the shell when it is subjected to an internal pressure of 150 N/cm^2. Take E = 2x10^5 N/mm^2 and μ = 0.3. **07**

(b) A steel bar 3 m long and 2500 mm^2 in area hangs vertically, which is securely fixed on its lower end. If a weight of 15 kN falls on the collar from a height of 10 mm, determine the stress developed in the bar. What will be the strain energy stored in the bar? Take E as 200 GPa. **07**

Q.5 **(a)** Find out the value of stresses at every corner for a rectangular column of size 300X500 subjected to an axial load of 1000kN at an eccentricity of 50mm along X-X axis and 60mm along Y-Y axis. **07**

(b) Draw ILD for R_A, R_B, Shear at C and BM at D for beam shown in **figure(4)** **07**

OR

Q.5 **(a)** A masonry dam 4m high. 1 m wide at its top and 3m wide at its bottom retains water on its vertical face. Determine maximum and minimum stresses at the base when the reservoir is full and when the reservoir is empty. Take weight of water and masonry as 10 kN/m^3 and 24 kN/m^3 respectively. **07**

(b) Obtain the differential equation given below for the deflection curve of a beam stating clearly assumptions made in deriving it. $\frac{d^2y}{dx^2} = \pm \frac{M}{EI}$ **07**

Explain how a particular sign (+ve or –ve) can be chosen in the above equation.

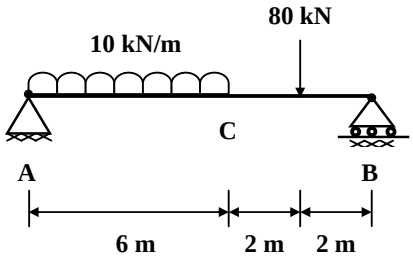

Fig. 1

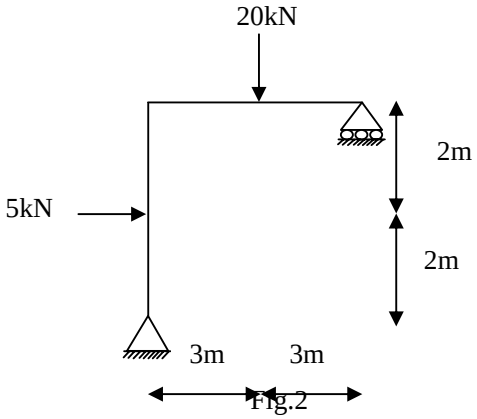

Fig.2

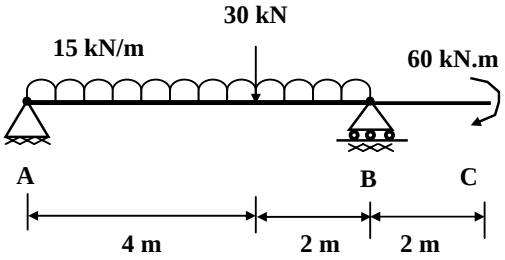

Fig. 3

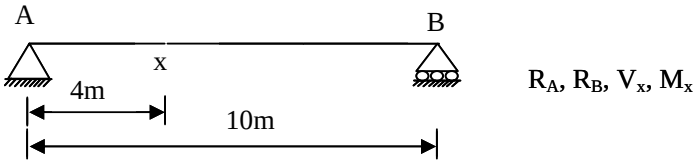

Fig.4

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-II Examination-Dec-2011

Subject code: X20603 **Date: 28/12/2011**

Subject Name: Structural Analysis-I

Time: 10.30 am -1.00 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)**	Analyse the frame in **Fig.-1**, and draw axial force, shear force and bending moment diagram.	**07**
	(b)	Find Statically Inderminacy of the structure as shown in **Fig.-2**.	**07**
Q.2	**(a)**	What diameter of shaft will be required to transmit 80kW at 80 r.p.m., if the maximum torque is 30per cent greater than the mean and the limit of torsional stress is to be 56MPa? If the modulus of rigidity is 84GPa, what is the maximum angle of twist in 3m length.	**07**
	(b)	A hollow shaft of diameter ration 3/5 is required to transmit 800kW at 110 r.p.m., the maximum torque being 20% greater than the mean. The shear stress is not exceeding 63MPa and the twist in a length of 3m is not to exceed 1.4degrees. Calculate the minimum external diameter satisfying these conditions.	**07**
		OR	
	(b)	A steel cylinder 90cm long, 15cm internal diameter is made from plates of 5mm thick. It is subjected to an internal pressure of 7MPa. The increase in volume due to internal pressure is 16cm^3. Estimate the value of Poisson's ration and modulus of rigidity. Assume E=210GPa.	**07**
Q.3	**(a)**	A cantilever beam having span '*L*' is loaded with '*w*' per unit length. Derive equation for maximum slope and maximum deflection in term of '*w*' and '*L*'	**07**
	(b)	A simply supported beam loaded as shown in **Fig.-3.** Find the slope at *B* and deflection at *C*. Take E=210GPa, I=9600cm^4. Use Macaulay's method.	**07**
		OR	
Q.3	**(a)**	Determine the maximum possible span for a cable supported at its two ends (on level supports), if the central sag is limited to 10 percent of the span, and if the permissible tensile stress is 150MPa. Assume the unit weight of the steel as 78.5kN/m^3. Take parabolic profile of cable having span / rise ratio is 10.	**07**

(b) A three hinged parabolic arch of 18metre span and 3m central rise carries a point load of 6kN at 3m horizontally from the left hand hinge. Calculate the maximum positive and negative bending moment. Also draw the bending moment diagram. **07**

Q.4 **(a)** A steel specimen 1.5cm^2 in cross section stretches 0.005cm over a 5cm gauge length under an axial load of 30kN. Calculate strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50kN, calculate the elongation at elastic limit and the proof resilience. **07**

(b) A bar 1.2cm internal diameter and 2cm external diameter gets stretched by 0.3cm under a steady load of 8kN. What stress would be produced in the bar by weight of 800N which falls 8 cm before commencing the stretching of the rod which is initially unstressed? E=200GPa. **07**

OR

Q.4 **(a)** Consider a simply supported beam *AB* of span 25m as shown in **Fig.-4**. Two point loads of 50kN each, 5m apart, followed at 2.5m by a uniform load of 5kN/m, 5 m long, cross from left to right. Using influence lines , determine the maximum values of support reactions at *A* and *B*. **07**

(b) Consider the simply supported beam with overhangs, *ABCD* , loaded as shown in **Fig.-5** Using influence lines, determine (i) the reaction at *C* (ii) the bending moment at *E* (iii) the shear force at *E*. **07**

Q.5 **(a)** Find the maximum and minimum stress intensities induced on the base of masonry wall 4 metre high, 2 m wide and 1.2 m this subjected to a horizontal wind pressure of 1200N/m^2 acting on 2 metre side. The density of masonry may be taken as 22400N/m^3. **07**

(b) A beam of rectangular section of 50mm to 100mm carries a uniformly distributed load of 20kN/m over a span of 2 m and an axial compressive force of 5kN. Calculate (i) maximum fibre stress, (ii) fibre stress at a point 0.5 m from the left end of the beam and 30mm below the neutral axis. **07**

OR

Q.5 **(a)** A built up beam as shown in **Fig-6** is simply supported at ends. Computer is length given that when it is subjected to a load of 40kN per meter length, it deflects by 1cm. Find out the safe load if this beam is used in a column with both ends fixed. Assume a factor of safety 4. Use Euler's formula E=210GPa **07**

(b) A concrete pier 1.5mx1.5m in section and 6m long carries a compressive load '*P*', lying at a point on the top which is 50cm from each of the two adjacent faces. What is the maximum value of '*P*', if no tensile stress is produced in the bas? Take weight of concrete pier as 2x10^4 N/m^3. **07**

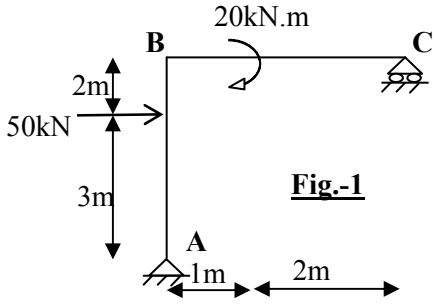

Fig.-1

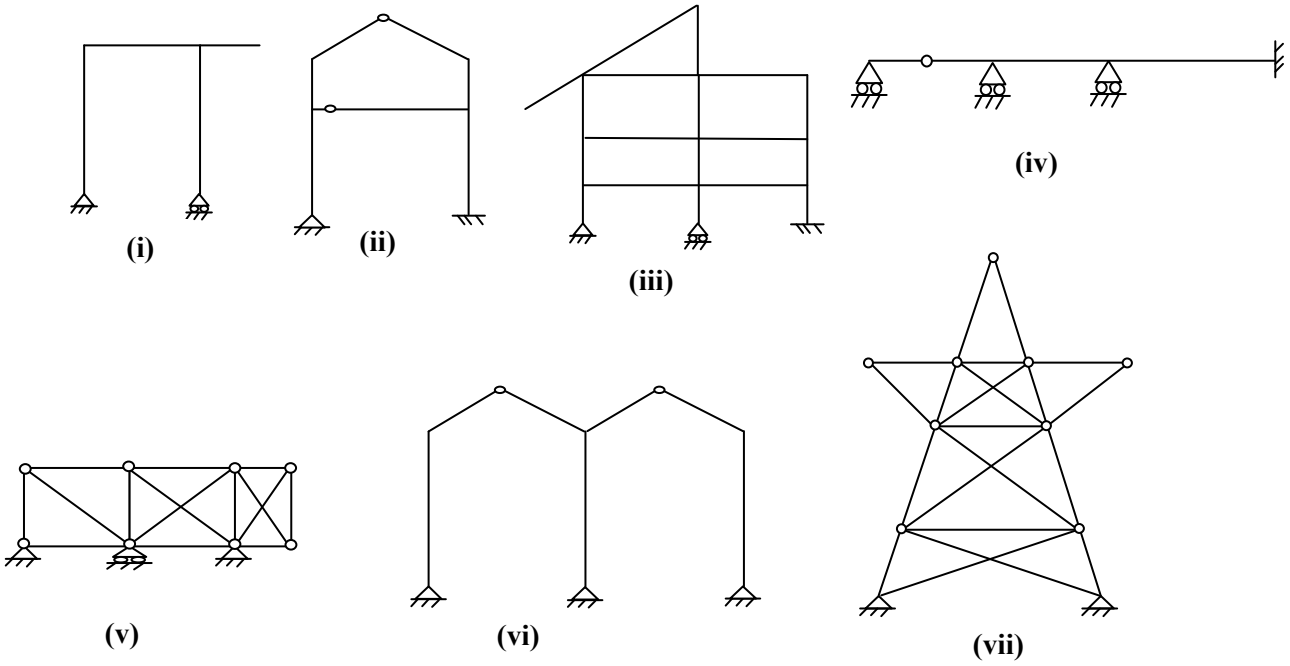

Fig.-2

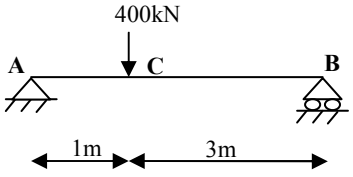

Fig.-3

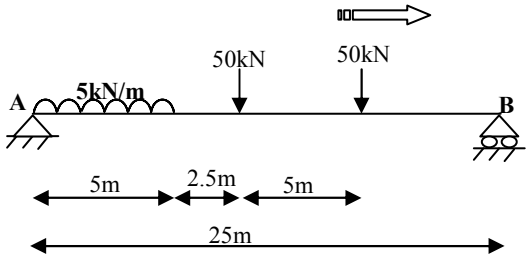

Fig.-4

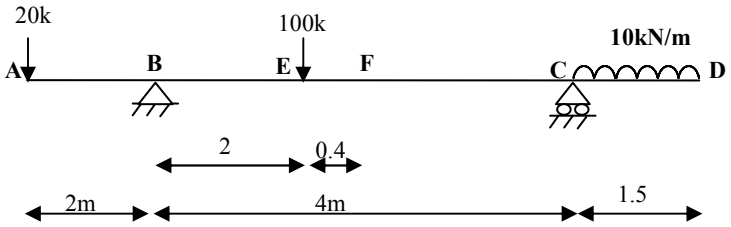

Fig.-5

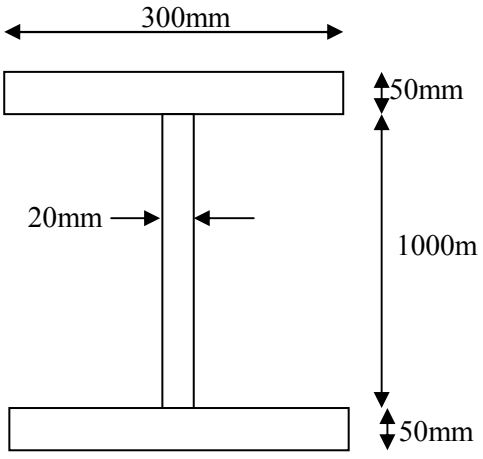

Fig.-6

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Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC 2ND Semester Examination – July- 2011

Subject code: X 20603

Subject Name: Structural Analysis-I

Date:16/07/2011 **Time: 10:30 am – 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) Derive generalized formula for torsion of circular shaft (with usual notation) **06**

$$\frac{T}{I_P} = \frac{\tau}{r} = \frac{C\theta}{L}$$

(b) A solid shaft is to transmit 300kW power at 100 r.p.m. If the shear stress is not to exceed 80MPa, find the diameter of shaft. What percentage of material saving will take place when it is replaced by a hollow shaft with diameter ratio 0.6. **08**

Q.2(a) Derive the relationship to determine longitudinal stress and hoop stress in closed cylindrical vessel under an internal pressure. **07**

(b) A closed cylindrical vessel of length 3m, diameter 750mm and thickness 12.5mm is subjected to internal pressure 1.5MPa. Calculate, **07**

(i) Longitudinal stress (ii) Hoop stress (iii) Change in diameter

(iv) Change in length (v) Maximum shear stress

Take Poisson's ratio 0.25 and modulus of elasticity 210GPa.

OR

(b) Find the forces in truss shown in Fig.1 using strain energy concept. Assume all the members have same cross sectional area and are made from same material. **07**

Q.3(a) A simply supported beam of span 14m carries two point loads 120kN and 80 kN at 3m and 9.5m from left support. If the moment of inertia of section is 16 x 10^8 mm^4 and modulus of elasticity of material is 2.1 x 10^5 MPa, calculate deflection under point load 120kN. Use moment curvature relationship. **07**

(b) A simply supported concrete beam of cross section 200 x 400mm and span 4m, carries two point loads 10kN and 20 kN at 1m and 2m from left support. If the modulus of elasticity of concrete is 2 x 10^4 MPa, calculate **07**

(i) Slope at both ends

(ii) Location and magnitude of maximum deflection.

Use Macaulay's method.

OR

Q3(a) Find the vertical deflection of joint D of truss shown in Fig.2 due to point load 10kN at joint D. All the members have cross-sectional area 200mm^2 and modulus of elasticity 210 GPa. **07**

(b) Draw bending moment diagram for the frame shown in Fig.3 using strain energy concept. Assume all the members have same moment of inertia and modulus of elasticity. **07**

Q.4 (a) A three hinged parabolic arch of span l and rise h carries a uniformly distributed load over its entire span. Show that the arch is not subjected to any bending moment at any section. **07**

(c) A hammer of 100N falls from a height of 1.25m on a cube of dimension 50x50x50mm before coming to the rest. Calculate the instantaneous deformation and stress produced in cube. Also determine the fall velocity of hammer. The modulus of elasticity of material is 200 GPa. **07**

OR

Q.4 (a) Use first principal to derive influence lines diagram for a simply beam has span l (i) Reaction at one of the supports (ii) Shear force at any section (iii) Bending moment at any section. **07**

(b) Draw influence diagram for member U_1L_1, U_1L_2, L_1L_2, and U_1U_2 for the truss shown in Fig 4. **07**

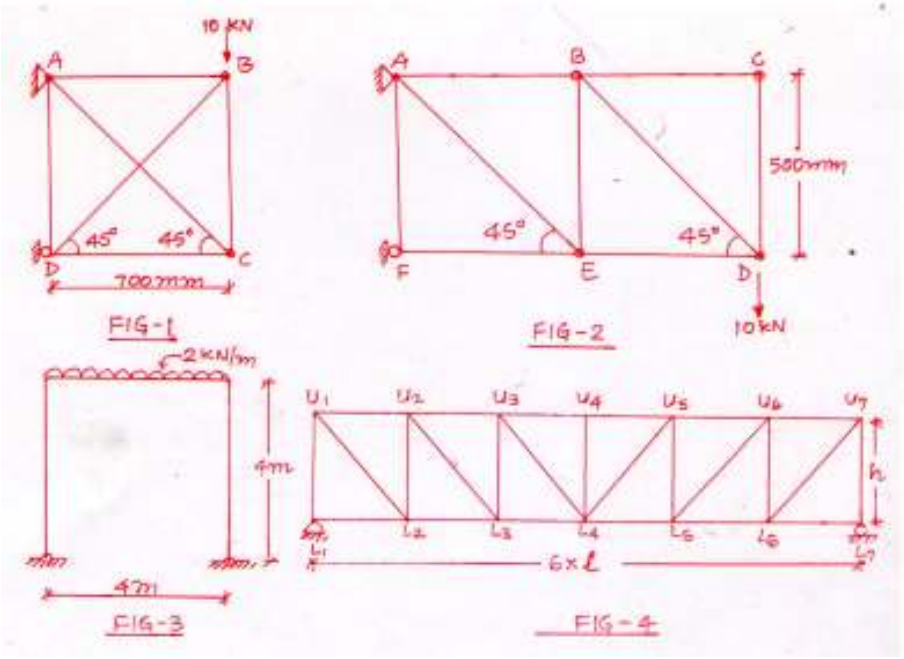
Q.5 (a) What do you understand by the kernel of the section? Determine kernel region for (i) rectangular section (ii) Circular section **07**

(b) A concrete column having cross-sectional dimension 300x400mm is loaded by a point load 120kN acting eccentrically at 50mm distance from center along one of the diagonals. Find out the stress at all four corners. **07**

OR

Q.5 (a) What do you understand by effective length of column? Write the significance of slenderness ratio. In which circumstances Euler's formula cannot be used? **05**

(b) A 3m long hollow cylindrical cast iron column of external diameter 150mm and internal diameter 120mm is hinged at one end whereas its other end is fixed. Find the strength of column as per (i)Euler's formula and (ii) Rankine's formula **09**
Also determine at what length of column, the strength by both formulae will be same.
Take modulus of elasticity E = 8 x 10^4 MPA, Crushing stress f_c = 550 MPa and Rankin's Constant α = 1/1600



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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- II Remedial Examination Nov / Dec. 2010

Subject code: X 20603 **Subject Name: Structural Analysis I**

Date: 01 / 12 / 2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

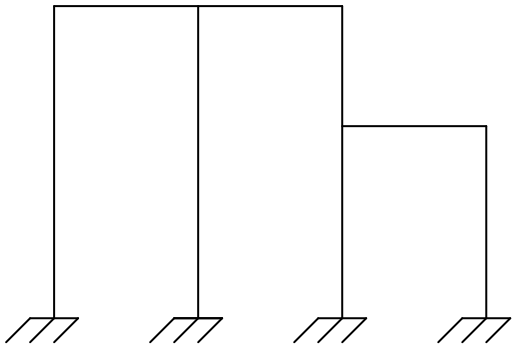
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define : (i) Core of a section (ii) Proof resilience (iii) Thin cylinder (iv) Strut (v) Modulus of resilience **05**

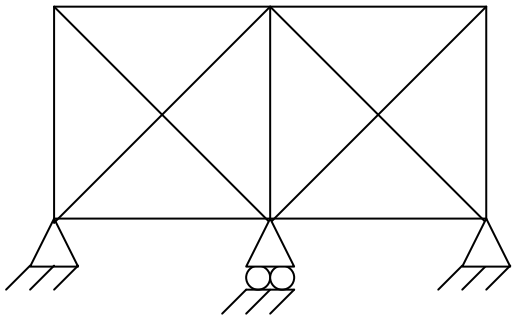
(b) Write assumptions made by Euler for deriving critical load for long columns **03**

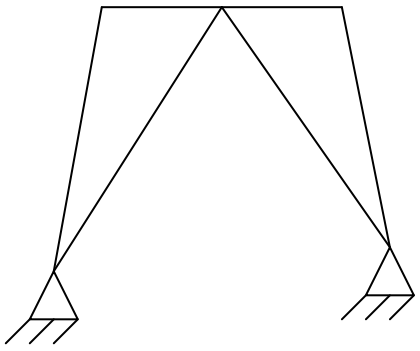
(c) Find S.I. and K.I. for the system shown in Figure below. **06**

(A)



(B)





(C)

Q.2 **(a)** A copper tube of outside diameter 38 mm and inside diameter 35.5 mm, is closely wound with steel wire of 0.75 mm diameter. Estimate the tension at which the wire must have been wound, if an internal gauge pressure of 20 kg/cm^2 produce a tensile circumferential stress of 70 kg $/cm^2$ in the copper tube. Take E for steel = 1.6 E for copper **07**

(b) A beam AB of 4 m span is simply supported at the ends and loaded with a point load of 10 kN at 1 m and an u.d.l. of 5 kN/m of 2 m length at 2 m from left end. Determine (i) deflection at the point where udl starts, (ii) maximum deflection and (iii) slope at left end. Take E = 2 X 10^5 N/mm^2 and I = 1000 cm^4 Use Macaulay's method. **07**

OR

(b) A beam ACB, simply supported at the ends, has moment of inertia 4I for the length AC and I for length CB, and is loaded with a point load W at C. Determine (i) slope at end A, (ii) deflection at mid-span, (iii) maximum deflection. AC = 8 m, CB = 2m, W = 10 kN, I = 4000 cm^4 and E = 2 X 10^5 N/mm^2. **07**

Q.3 **(a)** Four wheel loads of 6, 4, 8 and 5 kN cross a girder of 20 m span, from left to right followed by and u.d.l. of 4 kN/m and 4 m long with the 6 kN load leading. The spacing between the loads in the same order are 3m, 2m and 2m. The head of the u.d.l. is at 2m from the last 5 kN load. Using influence lines, calculate the S.F. and B.M. at a section 8m from the left support when the 4 kN is at centre of the span. **07**

(b) A suspension bridge cable hangs between two points A and B separated horizontally by 120m and with A 20 m above B. The lowest point in the cable is 4 m below B. the cable supports a stiffening girder which is hinged vertically below A, B and lowest point in the cable. Find the position and magnitude of the largest bending moment which a point load of 10 kN can induce in the girder together with the position of load. **07**

OR

Q.3 **(a)** A beam ABC is supported at A, B and C, and has hinge at D distance 3 m form A. AB = 7 m and BC = 10m. Draw the influence lines for reactions at A, B and C. If an u.d.l of intensity 2 kN/m and length 3 m, travels from left to right, calculate quantities for which I.L. are drawn. **07**

(b) A symmetrical three hinged circular arch has a span of 16 m and a rise to the central hinge of 4 m. It carries a vertical load of 16 kN at 4 m from the left hand end. Find (a) the magnitude of the thrust at the springings, (b) the reactions at the supports, (c) bending moment at 6 m from the left hand hinge and (d) maximum positive and negative moment. **07**

Q.4 **(a)** A vertical tie fixed rigidly at the top consists of a steel rod 2 m long and 20 mm diameter encased throughout in a brass tube 20 mm internal diameter and 30 mm external diameter. The rod and casing are fixed together at both ends. The compound rod is suddenly loaded in tension by a weight of 15 kN falling through a height of 3 mm before being arrested by the tie. Determine the maximum stress in steel and brass. Take E = 2 X 10^5 N/mm^2 for steel and E =1 X 10^5 N/mm^2 for brass. **07**

(b) 450 kW power has to be transmitted at 100 R.P.M. Find (i) the necessary diameter of solid circular shaft, (ii) the necessary diameter of circular section, the inside diameter being ¾ of the external diameter. Allowable shear stress = 75 N/mm^2 and the density of material = 77 kN/m^3. **07**

OR

Q.4 **(a)** Two bars A and B are each 20 cm long and are of the same material. Bar A is 2 cm in diameter for a length of 5 cm and 4 cm in diameter for the remaining 15 cm length. Bar B is 2 cm in diameter for the length of 15 cm and 4 cm in diameter for the remaining 5 cm length. An axial blow given to A produces a maximum instantaneous stress of 1200 kg/cm^2. Calculate the maximum instantaneous stress produced by the same blow on B. If each bar is stressed up to the elastic limit, calculate the ratio of energy stored by A and B at proof stress. Also, calculate the ratio of strain energy per unit volume of each bar at the same stress. **07**

(b) A hollow steel shaft 4 m long is to transmit 150 kW power at 150 R.P.M. The total angle of twist in this length is not to exceed 2.5^0C and the allowable shear stress is N/mm^2. Determine the inside and outside diameters, if $N = 0.082 \times 10^6$ N/mm^2. **07**

Q.5 **(a)** Compare the crippling loads given by Euler's and Rankine's formula for a tubular steel strut 2.3 m long having outer and inner diameters 38 mm and 33 mm respectively, loaded through pin joints at each end. Take the yield stress as 335 N/mm^2, the Rankine's constant = 1/7500 and $E = 0.205 \times 10^6$ N/mm^2. For what length of strut of this cross section does the Euler formula cease to apply? **07**

(b) A short hollow cylindrical cast iron column having outside diameter 30 cm and inside diameter 20 cm was cast in a factory. On inspection it was found that the bore is eccentric in such a way that the thickness varies from 3 cm at one end to 7 cm at the other. Calculate extreme intensities of stress induced in the section, if column carries a load of 800 kN along the axis of the bore. **07**

OR

Q.5 **(a)** Derive the equation of crippling load for the column having one end fixed and other hinged with usual notations by Euler's theory. Also, explain why Rankine's theory is better than Euler's theory for short columns? **07**

(b) A masonry retaining wall trapezoidal in section with one face vertical is 1m wide at top and 3 m at the base and 8 m high. The material retained on the vertical face exerts a lateral pressure varying form zero at top to 25 kN/m^2 at the base. If the unit weight of masonry is 21 kN/m^2, calculate the maximum and minimum stress intensities induced in the base. **07**

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