Ref : Ex./PG/CT/T/113A/7/2017

Master of Construction Engg. 1st Semester Exam. – 2017

Sub: Theory of Elasticity, Plasticity and Elastic Stability

Time : Three Hours | Part – I | Full Marks : 100

Answer any TWO questions

1. (a) Write down the general expression for short-column formula. Simplify the expression to obtain solutions for the constants '**C**' and '**n**'.
   (b) For a particular metal, **E** = 7.24×10^4 N/mm^2, σ_p= 117.45 N/mm^2 and σ_y=351.634N/mm^2. Find the values of the constants '**C**' and '**n**'. From these write down the general equation for short-column formula for this metal.
   (c) A column made of the above metal is 381mm long and is subjected to an axial load of 22686 N. It has a solid square cross-section of side 'a'. Assuming that the column is fixed at both ends, determine the side 'a' of the cross-section if the given load P is to be the buckling load of the column. Find also the corresponding critical stress. 5+7+13

2. (a) Explain the reduced modulus theory giving neat sketch.

   (b) Explain thetangent modulus theory. Deduce the expression for double modulus of I-section with negligible web thickness. 5+20

3. (a) Define shape factor and load factor Deduce an expression for load factor in terms of shape factor and safety factor for a simply-supported beam of rectangular cross- section.

(b) Determine the expressions for plastic hinge lengths of a fixed-ended rectangular beam with a concentrated load W at a distance 'a' from the left support and 'b' from the right support. The total length of the beam is 'l'. 5+10+10

4.(a) Explain yield criteria and flow rule. Write down the expression for stress deviations in tensor notation.

(b) What are stress invariants? Write down the expressions for all the three stress invariants of the stress deviations explaining meaning of all the terms.

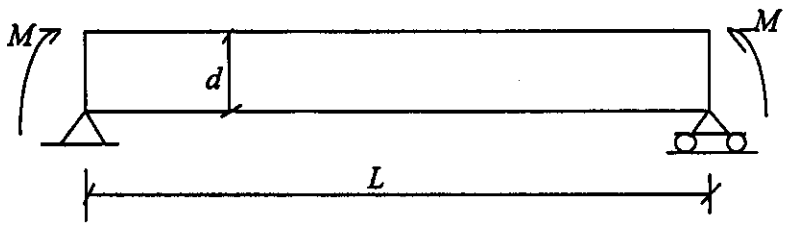
(c) State and explain Von Mises yield criterion giving neat sketch. State the condition of yield criterion by this theory for simple tension and simple shear. 5 + 7 + 13

SUBJECT ...*Theory of Elasticity, Plasticity & Elastic Stability*
(Name in full)

Full Marks 100
(50 marks for part I)

Time: ~~Two hours~~/Three hours/~~Four hours/Six hours~~

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks
	Answer any two questions.	
1.a)	A stress tensor is defined as $\sigma = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 2 & 2 \\ 3 & 2 & 4 \end{bmatrix}$, find the principal stresses and show that the principal planes are mutually orthogonal.	8
b)	Starting from strain displacement relationship, establish the Saint-Venant compatibility equation.	9
c)	Prove that to preserve angular momentum, the stress tensor must be a symmetric tensor.	8
2.	What is constitutive equation? Show that the number of independent coefficients for isotropic material is only two.	25
3.a)	Starting from equilibrium and compatibility equations derive the biharmonic equation without body forces for plane strain problem.	11
b)	Determine the stress field and displacement field for the beam shown in Fig.1  *Fig.1*	14