.....*M.E. Civil Engineering 1st Year 2nd Semester*..... EXAMINATION, *2018*

SUBJECT .....*Advanced Computer Methods and Finite Element Analysis*.....

Full Marks 100
(50 marks for each part)

Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	Answer any TWO questions	
1.	a) Write a note on 'material nonlinear' and 'geometric nonlinear' behaviour of structure. b) Explain the types of 'strain hardening characteristics' of a material beyond yield point and relate 'hardening parameter', 'initial modulus of elasticity' and 'tangential modulus of elasticity'. c) What do you mean by 'yield criterion'? State two yield criteria commonly used for finite element analysis of ductile material. Write the expressions for generalized three dimensional problem d) Write a short note on 'flow vector and its use in nonlinear finite element analysis'. Derive the elements of flow vector for plane stress problem using Tresca's yield criterion. e) Write the difference between 'initial stiffness algorithm' and 'tangential stiffness algorithm' of nonlinear finite element analysis. f) Write the significance of 'residual force' in nonlinear finite element analysis?	3+6+7 +4+2+ 3 = 25
2.	a) Write the nonlinear stiffness matrix of one-dimensional two-noded bar element. b) Use the above-mentioned element for the solution of this problem: An one dimensional bar of rectangular cross-section is fixed at upper end and free at lower end. The size of its rectangular cross-section is 15mm x 20mm and its length is 900mm. It is subjected to a vertically downward concentrated force of 10kN. Calculate the end deflection, strain and stress developed in it. The material behaviour is shown in Fig.1. Apply the load in three steps (i.e. 40%, 30% and 30% of total). Perform maximum three iterations in each step.	2+23 = 25
3.	a) Derive elasto-plastic constitutive relationship matrix $[D_{ep}]$ for plane stress problem. Write the expression to calculate the plastic strain increment in the elasto-plastic nonlinear finite element analysis. b) For a plane stress problem, the stresses at a point are: $\sigma_x = 100N/mm^2$, $\sigma_y = 225N/mm^2$ and $\tau_{xy} = 90N/mm^2$. Check whether the material at that point is yielded or not according to Von-Mises yield criterion if uniaxial yield stress of the material is $250N/mm^2$. If it is yielded then find flow vector and elasto-plastic constitutive relationship matrix $[D_{ep}]$ considering $H' = 280N/mm^2$. Given $E = 2x10^5 N/mm^2$ and $\nu = 0.3$. c) Write the steps for elasto-plastic nonlinear finite element analysis of two dimensional problem.	10+8+7 = 25

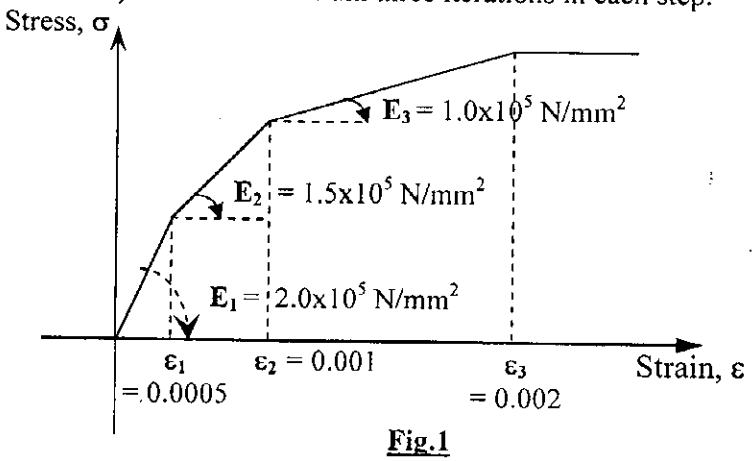

Fig.1

Ref. No. : Ex/PG/CE/T/1210A/2018

Name of the Examinations: M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER - 2018

Subject : ADVANCED COMPUTER METHODS AND FINITE ELEMENT ANALYSIS

Time : Three (3) hours Full Marks : 100

Part II

Instructions : Use Separate Answer scripts for each Group

Answer *all* questions.

1. Develop the relationship between the stress tensor in the current configuration and the stress tensor in the reference configuration. (5)
2. Write short notes on (a) Deformation Gradients (b) Deformation tensor (iii) Lagrangian finite strain tensor (iv) Eulerian finite strain tensor (4 x 2)
3. (a) Obtain the Green – Lagrangian strain tensor for a Timoshenko beam undergoing finite deformation. (4)
   (b) Describe the process of consistent linearization (3)
4. Assuming elastic material model, develop the finite element stiffness matrices (geometric and material) for an arbitrarily oriented Timoshenko beam element undergoing finite deformation. (30)