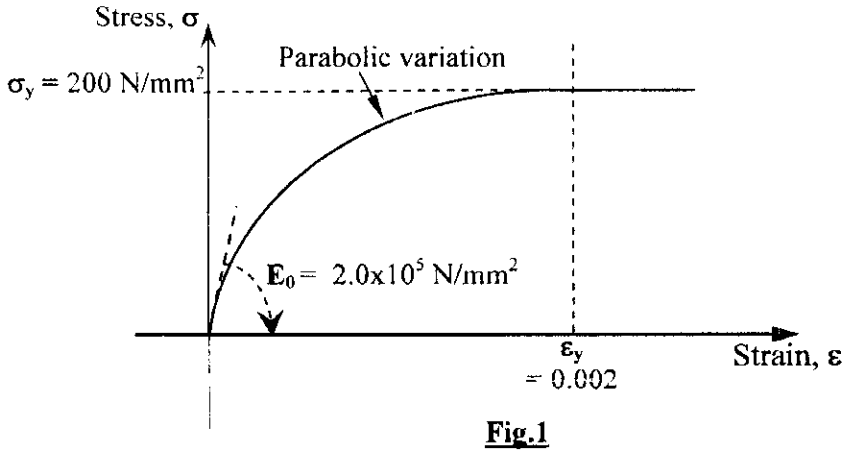
.....*M.C.E. 1st Year 2nd Semester*..... EXAMINATION, *2017*

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) What is the difference between 'material nonlinearity' and 'geometric nonlinearity'? b) Write short note on 'strain hardening characteristics' of a material beyond yield point. c) Explain the terms: 'hardening parameter', 'initial modulus of elasticity' and 'tangential modulus of elasticity'. Derive the relationship among them. d) What do you mean by 'yield criterion'? State two yield criteria commonly used for finite element analysis of ductile material. e) What is 'flow vector'? Where is it used in nonlinear finite element analysis? f) Write the difference between 'initial stiffness algorithm' and 'tangential stiffness algorithm' of nonlinear finite element analysis. g) What is 'residual force' in nonlinear finite element analysis?	3+4+5 +6+2+ 3+2 = 25
2.	a) Derive the nonlinear stiffness matrix of one-dimensional two-noded bar element. b) Use **two** numbers of above-mentioned element for the solution of this problem: An one dimensional bar of circular cross-section is fixed at upper end and free at lower end. The diameter of its circular cross-section is 15mm and its length is 1000mm. It is subjected to a vertically downward concentrated force of 20kN. Calculate the end deflection, strain and stress developed in it. The material behaviour is shown in Fig.1. Apply the load in two steps (i.e. 60% and 40% of total). Perform maximum three iterations in each step.	2+23 = 25
		
	Fig.1	
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: σ_x = 150N/mm^2, σ_y = 250N/mm^2 and τ_{xy} = 75N/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' = 300N/mm^2. Given E = 2x10^5 N/mm^2 and ν = 0.3. c) Write the steps for elasto-plastic nonlinear finite element analysis of two dimensional problem.	10+8+7 = 25

Ref. No.:: Ex/PG/CE/T/1210A/2017

Name of the Examinations: M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER 2017

Subject: Advanced Computer Methods and Finite Element Analysis Time: Three Hours Full Marks: 100

Group / Part II

Instructions: Use Separate Answer scripts for each Group

Question 1(a): Obtain the expression for first Piola-Kirchhoff stress tensor in terms of Cauchy's stress tensor. (6)

(b) Show that the complete distortion in a volume element for a 3-D continuum is a summation of corresponding strains and rotations. (4)

(c) The Lagrangian description of motion for a line element is given as follows:

$x_1 = X_1 + X_3(e^t - 1)$

$x_2 = X_2 + X_3(e^t - e^{-t})$

and $x_3 = X_3\, e^t$

where x_i and X_i 's are spatial and material coordinates, respectively and 'e' is a constant.

Find the components of material deformation gradient **F**, Spatial deformation gradient **H**, Lagrangian Strain tensor **L**, Eulerian strain tensor **E** and Cauchy-Green deformation tensor **G**.

(15)

Question 2: Obtain the expression for Strain-Displacement matrix in the reference configuration for a Timoshenko beam element evaluated at beam midpoint. Hence obtain the Material and Geometric Stiffness matrices for the element. (25)