Form A : Paper-setting Blank

Ref. No. *Ex/PG/CE /T/115A/6/2017*

.........***M. C. E. 1ST YEAR 1ST SEMESTER***...... EXAMINATION, ***2017***

SUBJECT ... ***COMPUTER METHODS AND FINITE ELEMENT ANALYSIS***...

Full Marks 100
(65 marks for this part)

Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks

Answer Q.1 and any TWO questions from the rest

1. a) Write the main differences between 'flexibility method' and 'stiffness method'.
b) What is 'shape function' in finite element analysis?
c) Write short notes on 'Jacobian Matrix and its use' in finite element analysis of two-dimensional problem. Mention the changes in the elements of it, if it is used in: isoparametric, sub-parametric and super-parametric finite element formulation.
d) Explain 'area coordinate system' and derive the shape functions of 6-noded triangular element in 'area coordinate system'. [2+2 5+6 = 15]

2. Analyse the continuous beam ABC as shown in Fig.1 by '**Stiffness Method**' assuming that support **A** *rotates* by **0.01 radian** in *clockwise direction* and support **C** *settles down* by **2.0mm**. Also calculate the support reactions. Given, E = 210x10^6 kN/m^2, I = 300x10^{-6} m^4. [25]

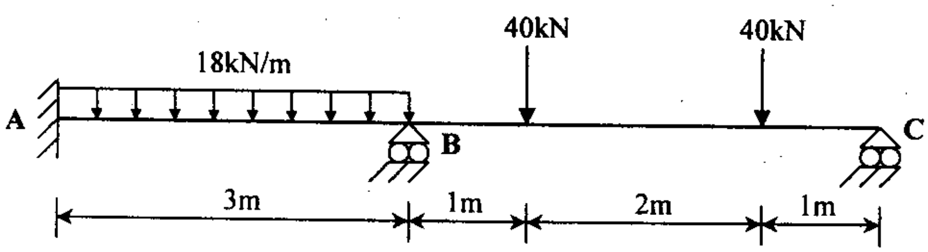

Fig.1

3. a) Derive the shape functions for a three-noded one dimensional element in **Natural coordinate system**.
b) Using these shape functions, derive the stiffness matrix of an one dimensional element of length 'L' if it is used in 'uniaxial problem' considering ***isoparametric finite element formulation with 2-point Gauss integration rule***. Assume relevant data. [5+12 +8 = 25]

Sampling Point No.	Coordinate	Weight factor
1	$-1/\sqrt{3}$	1.0
2	$+1/\sqrt{3}$	1.0

........*M. C. E. 1ST YEAR 1ST SEMESTER*...... EXAMINATION, *2017*

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Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions	**PART II**	Mar
	(*Contd. from page 1*)	
3. (contd.)	c) An one-dimensional bar is suspended from a support at top. It length is 'L', cross-sectional area is 'A', modulus of elasticity of the material is 'E'. Calculate the nodal displacement, strain and stress developed in it by 'finite element analysis' using above one dimensional elements, if the bar is subjected to the an axial load of magnitude 'W' at the free end.	
4.	a) Derive the shape functions for a **three-noded triangular element** having the coordinates of the vertices as (4,3), (9,3) and (9,9). All values are in mm. b) Using these shape functions, form the **strain-displacement matrix** for the above element having two degrees of freedom (u,v) per node in '**plane-stress condition**'. c) Using the above data, derive the **stiffness matrix** of this element if it is used in '**plane-stress condition**'. Consider $E = 2.1\text{x}10^5$ N/mm^2 and $\nu = 0.3$. Assume any other relevant data, if required.	[10- +10 25
5.	a) Using the properties of the shape functions, derive the shape functions for a **two-noded one dimensional element** in '**natural coordinate system**'. b) Using the above-mentioned shape functions, derive the shape functions for **four-noded rectangular element** in '**natural coordinate system**'. c) Using the shape functions of above-mentioned 4-noded element, calculate the elements of the '***Jacobian matrix***' and '***Strain-displacement matrix***' of a **4-noded 'quadrilateral element'** having the nodal coordinates (2,2), (9,2), (7,8), and (2,5) [All values are in mm] corresponding to a sampling point having natural coordinates $\xi = -\sqrt{(0.6)}$, $\eta = +\sqrt{(0.6)}$ to be used in plane stress condition.	[6+ 13 25
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M.C.E. 1ST YEAR 1ST SEMESTER EXAM 2017

(1st-/ ~~2nd Semester / Repeat / Supplementary / Annual / Bianual~~)

SUBJECT: Computer Methods and Finite Element Analysis

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

Full Marks 100

(35 marks for PART – II)

Use a separate Answer-Script for each part

No. of Question	PART – II	No.
1. a.	What is weighted Residual Method?	
b.	Explain and compare between Least Square Method, Collocation Method and Gallerkin Method.	
c.	What are the advantages of BEM over FEM?	15
2.	Solve the following Eigen Value problem using Rayleigh-Ritz method. Find **two** eigen values and corresponding eigen vectors. $d^2u/dx^2 + \lambda u(x) = 0, \quad 0<x<1$ Given boundary conditions, u(0)=0, u(1)=0 **Or,**	20
2. a)	Derive the governing differential equation for 1-dim steady state heat conduction problem.	
b)	The inside of a 1.25m thick wall is maintained at a constant temperature 400° C, while the outside is insulated. There is a uniform heat source inside generating 500W/m^3. The thermal conductivity K=30.0W/m-°C. Find the temperature distribution at 1/5th points in the wall.	5+15 =20