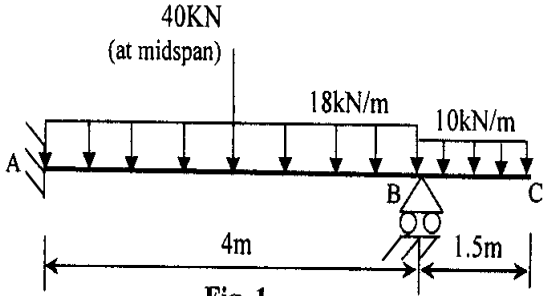
... *M. E. CIVIL ENGINEERING 1ST YEAR 1ST SEMESTER* ... EXAMINATION, *2018*

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

Full Marks 100
(60 marks for this part)

Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	Answer Q.1 and any TWO questions from the rest	
1.	a) What is the use of 'shape function' in finite element analysis? b) Write short notes on 'the benefit of using Gauss Quadrature technique in isoparametric finite element formulation' with reference to a two dimensional problem. c) Explain 'area coordinate system' and derive the shape functions of 3-noded triangular element in 'area coordinate system'.	[3+3 +4 = 10]
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 **B** *settles down* by **1.5mm**. Also calculate the support reactions. Given, E = 200×10^6 kN/m^2, I = 250×10^{-6} m^4.  **Fig. 1**	[25]
3.	a) Derive the shape functions for a **three-noded one dimensional element** of length 'L' in **Cartesian 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' Assume relevant data. c) An one-dimensional bar is suspended from a support at top. It length is 'L', cross-sectional area is 'A', density is 'ρ' and 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 element, if the bar is subjected to its self weight. Compare the result with analytical solution and comment.	[5+10 +10 = 25]

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No. of Questions	**PART I**	Mar
	(Contd. from page 1)	
4.	a) Derive the shape functions for a **four-noded rectangular element** having the coordinates of the vertices as (0,0), (7,0), (7,4) and (0,4). 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 = 2.1×10^5 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 an **eight-noded rectangular element** in '**natural coordinate system**'. b) Using the shape functions of above-mentioned 8-noded element, calculate the elements of the '***Jacobian matrix***' and '***Strain-displacement matrix***' of an **8-noded 'quadrilateral element'** having the nodal coordinates (3.0,3.0), (6.5,2.0),(10.0,3.0), (9.0,5.0) (8.0,7.0), (5.5,6.5), (3.0,6.0) and (3.0,4.5) [All values are in mm] corresponding to a sampling point having natural coordinates $\xi = -1/\sqrt{3}$, $\eta = +1/\sqrt{3}$ to be used in plane stress condition.	[10+ = 25
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Ref No. –Ex/PG/CE/T/115A/2018

M.C.E. 1ST YEAR 1ST SEMESTER EXAM 2018

(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

(40 marks for PART – II)

Use a separate Answer-Script for each part

No. of Question	PART – II	No.
	ANSWER ANY TWO	
1.a)	Solve the following Boundary Value problem using Rayleigh-Ritz method. Use a quadratic trial solution. $-d^2u/dx^2 - u + x^2 = 0, \quad 0<x<1$ Given boundary conditions, u(0)=0, du(1)/dx=0	16+4
b)	Write short note on Collocation Method.	
2. a)	What is Boundary Element Method?	
b)	Solve the following Boundary Value problem using Galerkin Method. Use a quadratic trial solution. $-d^2u/dx^2 = 3x + x^2, \quad 0<x<1$ Given boundary conditions, u(0)=0, u(1)=0	4+16
3.a)	Write the form of General ONE Dimensional Boundary Value Problem. Give examples of its practical application.	
b)	The inside of a 1.5m thick wall is maintained at a constant temperature 300° 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 1/6th points in the wall.	4+16