Ref. No. ***Ex/PG/CE/T/115A/2024***

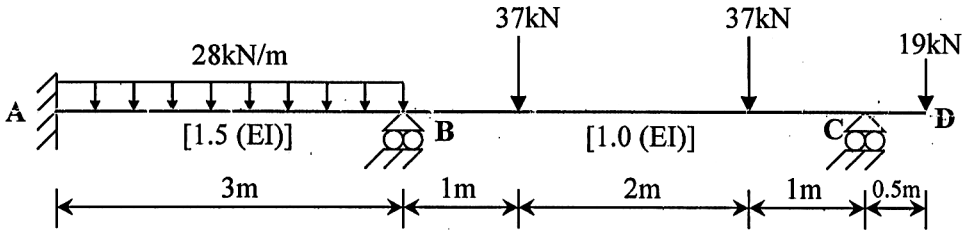
M. E. CIVIL ENGINEERING 1ST YEAR 1ST SEMESTER ... EXAMINATION, ***2024***

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) Write the advantages of Stiffness method over Flexibility method in the matrix method of structural analysis? b) What are the uses of 'shape function' in finite element analysis? c) Write the situations when sub-parametric and super-parametric finite element formulations are preferred than the isoparametric finite element formulations. d) Integrate the following function ***with 3-point Gauss integration rule*** and compare the results with exact solution and write comment on possible variation: $I = \int_{-1}^{+1} (2{,}5\xi^4 + 3\xi^3 - 0.3\xi^2 + 4\xi)\,d\xi$ Sampling Point No. | Coordinate | Weight factor 1 | $-\sqrt{(0.6)}$ | 5/9 2 | 0 | 8/9 3 | $+\sqrt{(0.6)}$ | 5/9	[2+2+ 4+2= 10]
2.	Analyse the continuous beam ABCD as shown in Fig.1 by '**Stiffness Method**' assuming that support **A** *settles down* by **3.0mm** and support and **B** *settles down* by **5.0mm**. Also calculate the support reactions. Given, E = 210×10^6 kN/m^2, I = 300×10^{-6} m^4. Determine the member end actions and draw bending moment and shear force diagrams.  **Fig. 1**	[25]
3.	a) Derive the shape functions for a **two-noded** one dimensional element of length 'L' in Cartesian coordinate system. b) Using these shape functions, derive the stiffness matrix of an one dimensional two-noded element of length 'L' if it is used in 'uniaxial problem' Assume relevant data.	[6+6+ 13 = 25]

[Turn Over

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M. E. CIVIL ENGINEERING 1ST YEAR 1ST SEMESTER ... EXAMINATION, *2024*

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
3. (contd.)	c) A bar of length 'L', cross-sectional area 'A' is suspended from the top and subjected to an axial load 'P' at the free end at bottom. Determine the end deformation, strain and stress developed in the bar considering the **external load** (P at the free end) and its **self-weight**. Discretize the bar **using two numbers two-noded one dimensional elements**. Assume any other data, if required.	
4.	a) Explain '**area coordinate system**' and derive the shape functions of **6-noded triangular element** in '**area coordinate system**'. b) Derive the shape functions for a **three-noded triangular element** having the coordinates of the vertices as **(2,2), (9,2)** and **(9,11)**. All values are in cm. c) Using these shape functions, form the **strain-displacement matrix** for the above element having two degrees of freedom (u,v) per node in '**plane-strain condition**'. Assume any other relevant data, if required. d) Write the **constitutive relationship matrix** for '**plane-strain condition**' using **E = 2.1x10^5 N/mm^2** and **ν = 0.2**..	[6+10 +5+4 = 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 **(5.0,4.0), (8.5,4.0),(12.0,4.0), (11.0,6.0) (10.0,8.0), (7.5,9.0), (5.0,10.0)** and **(5.0,7.0)** [All values are in cm] corresponding to a sampling point having natural coordinates **$\xi = -1/\sqrt{3}$, $\eta = +1/\sqrt{3}$** to be used in **plane stress condition.**	[10+15 = 25]

Ref No. –Ex/PG/CE/T/115A/2024

M.C.E. 1ST YEAR 1ST SEMESTER EXAM 2024

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

SUBJECT: Computer Methods and Finite Element Analysis

Full Marks 100

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~ (40 marks for each part II)

Use a separate Answer-Script for each part

No. of Question	PART – II	No.
	ANSWER QUESTION 1 and ANY TWO FROM THE REST	
1.a.	What is the difference between FEM and BEM?	
b.	Write some engineering applications of BEM?	4+2+4
c.	What is the collocation method in numerical analysis? Explain.	
2.	Obtain approximate solution of the following problem using Rayleigh-Ritz method. Use quadratic trial solution. $d^2u/dx^2 = 3x^3+1, \quad 0<x<1$ Given boundary conditions, u(0)=0, u(1)=0. Find u(0.5) and compare with exact solution.	15
3.	What is Weighted Residual Method? Obtain approximate solution of the following equation using Galerkin Method. Hence find y(0.2). $d^2y/dx^2 + (3x)(dy/dx)-6y = 0; \quad 0<x<1; y(0)=1; y'(1)=0.1;$	15
4.	Write the solution matrix for 1-dim steady state heat conduction problem. The inside of a 1.0m thick wall is maintained at a constant temperature 400° C, while the outside is insulated. There is a uniform heat source inside generating 450W/m^3. The thermal conductivity K=28.0W/m-°C. Find the temperature distribution at 1/4th points in the wall.	2+13 =15