**Code No.PC5101ME**

**METHODIST COLLEGE OF ENGINEERING & TECHNOLOGY (An Autonomous Institution)**

**M.E I-Semester (Regular & Supplementary) Examination, March -2023**

**Subject: FINITE ELEMENTS TECHNIQUES**

**Time: 3 hours Max.Marks:60**

**Note: Missing data, if any, maybe suitably assumed.**

**PART-A**

**Answer All the questions.**

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| **Q.No** | **Questions** | **Marks** | **CO** | **BTL** |
| **1. a** | **Enlist** the equilibrium equations on three dimensional cartesian co-ordinates for elasticity problem | **2** | **1** | **2** |
| **b** | **Illustrate** by sketch the hermite shape functions of a beam element | **2** | **2** | **2** |
| **c** | **Summarize** the conditions to be satisfied for application of axi-symmetric elements | **2** | **3** | **2** |
| **d** | **Rephrase** the physical significance of a capacitance matrix in heat transfer analysis | **2** | **4** | **2** |
| **e** | **Reproduce** the consistent mass matrix for a beam element with 2 dof/node | **2** | **5** | **1** |

**PART-B**

**Answer Any Five questions**.

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| **Q.No.** |  | **Questions** | **Marks** | **CO** | **BTL** |
| **2.** | **a** | (i) **State** the equilibrium equations on three dimensional Cartesian co-ordinates for elasticity problem  (ii) **Distinguish** between error and residual. | **5** | **1** | **2** |
| **b** | (i) **Write** the K Matrix for Frame, Beam and Quadratic bar element  (ii) **Illustrate** 2D Truss and 2D beam element and show the dof. | **5** | **1** | **2** |
| **3.** | **a** | **Find** nodal displacements and element stress in the truss shown in Fig.1  E= 80 GPa ; A1 = 600 mm2; L1 = 500 mm; A2 = 600 mm2 ; L2 = 600 mm; A3 = 600 mm2; L3 = 500 mm;    Fig.1 | **10** | **2** | **3** |
| **4.** | **a** | **Formulate** element equations for the axi-symmetric element shown in Fig.2 E= 100 GPa; *v =*0.3; α = 5×10-6 per 0C ; ∆T = 60 OC; *p* = 8 N/mm2 acting perpendicular to the side *jk.*  Nodal coordinates in mm  *ri* = 5; rj = 1; rk = 3;  *zi* = 5; zj = 6; zk = 2;    Fig.2 | **7** | **3** | **3** |
| **b** | **Distinguish** between sub-parametric, iso-parametric and super-parametric elements | **3** | 3 | **2** |
| **5.** | **a** | **Calculate** the nodal temperatures of the composite wall shown in Fig.3 There is a uniformly distributed heat source Q = 50 W/m3 present in the composite layered wall. Thermal conductivities: k1 = 60 W/m OC; k2 = 0.5 W/m OC; Heat flux q” on the surface = 100W/m2; Right face is maintained at 25 OC;    Fig.3 | **10** | **4** | **3** |
| **6.** | **a** | **Determine** the natural frequencies of a simply supported beam shown in Fig.4 Use 2 beam elements with consistent mass matrix. ρ = 5000 kg/m3; E= 100 GPa ; I = 2000 mm4; A = 250 mm2    Fig.4 | **10** | **4** | **3** |
| **7.** | **a** | **Recall** and reproduce the process of finite element method to solve a fluid flow problem in detail, with suitable illustrations | **5** | **5** | **2** |
| **b** | The stream function corresponding to a fluid flow is given by Ψ(x,y) = 4x3 – 5y2. **Check** whether the flow is rotational or irrotational. | **5** | **5** | **3** |
| **8.** | **a** | Determine the nodal displacement and element stress by finite element formulation for the following figure.  C:\Users\Swamy\Downloads\WhatsApp Image 2023-03-20 at 9.34.33 AM.jpeg  Use: P=300KN, Aa= 0.5m2, Ab= 1m2, E=200GPa | **10** | **3** | **2** |
|  |  |  |  |  |
| **9.** | **a** | **Distinguish** between essential and natural boundary conditions. **Recall** the essential and natural boundary conditions of a cantilever beam for FE analysis | **5** | **4** | **2** |
| **b** | **Determine** the deflection and slope at 2 m from the left end of the shaft mounted in bearings. A load of 1 kN and a moment of 2 kN m act on the shaft. Model the bearings as fixed supports. | **5** | **2** | **3** |

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