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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – January 2025** |
| **Date:** 06/01/2025 **Time:** 09:30am – 12:30pm |

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| **School:** SOE | **Program:** B. Tech. (Mechanical Engineering) (Mechatronics) | |
| **Course Code:** MEC3091 | **Course Name:** Finite Element Analysis | |
| **Semester**: V | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** |
| **Marks** | **24** | **24** | **26** | **26** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*
3. *Use of Design Data Handbook permitted.*

**Part A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** | | | | |
| **1** | How is FEA method essential to solve a problem in Engineering and Mathematical Application? | **2 Marks** | **L1** | **CO1** |
| **2** | List the FEA steps to solve Engineering or Mathematical problems. | **2 Marks** | **L1** | **CO1** |
| **3** | Write the element equation or formulation of characteristics matrix and vector. | **2 Marks** | **L1** | **CO2** |
| **4** | Write the strain equation in the form of solution displacement vector. | **2 Marks** | **L1** | **CO2** |
| **5** | How is the material behavior defined in FEA method? | **2 Marks** | **L1** | **CO4** |
| **6** | Write the application involved in utilizing the FEA methods. | **2 Marks** | **L1** | **CO3** |
| **7** | List the advantages of using FEA method to solve Engineering problems. | **2 Marks** | **L1** | **CO3** |
| **8** | List the disadvantages of using the FEA method to solve the Engineering problems. | **2 Marks** | **L1** | **CO4** |
| **9** | Write a brief note on sources of error in FEA. | **2 Marks** | **L1** | **CO4** |
| **10** | Write a brief note on Modelling error and Discretization error in FEA. | **2 Marks** | **L1** | **CO3** |

**Part B**

|  |  |  |  |  |  |
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| **Answer ALL Questions. Each question carries 20 marks. 4QX20M=80M** | | | | | |
| **11** | **11a** | Write a brief note on boundary conditions in FEA. | **10 Marks** | **L2** | **CO 1** |
| **11b** | Mention the disadvantages of FEA. | **10 Marks** | **L2** | **CO 1** |
| **Or** | | | | | |
| **12** | **12a** | Briefly mention the applications of FEA. | **10 Marks** | **L2** | **CO 1** |
| **12b** | What are the various methods of formulation of elemental properties? | **10 Marks** | **L2** | **CO 1** |
|  |  |  |  |  |  |
| **13** | **13a** | For the given figure below the interior point P at (3,2) divides the three areas namely A1, A2 and A3, written in the form of . Determine A1/A, A2/A and A3/A | **10 Marks** | **L3** | **CO3** |
| **13b** | The differential equation of physical phenomenon is given by  The trial function Y=a1(x-x4). The boundary conditions are y(0)=0 and y(1)=0. Calculate the value of parameter a1 by any three weighted residual methods. | **10 Marks** | **L3** | **CO3** |
| **Or** | | | | | |
| **14** | **14a** | Find the Matrix of Quadratic form for the following x2−2y2+3z2−4yz+6xz. | **10 Marks** | **L3** | **CO3** |
| **14b** | A long rod is subjected to loading giving rise to an increase in temperature by 30 degrees Celsius. The total strain at a point is measured to be 1.3x10-5, E=100 GPa and thermal diffusivity =12x10-7 degree Celsius. Find the stress induced in the rod.  Given,  Find, I – A\*dT, where I represents Identity matrix. | **10 Marks** | **L3** | **CO3** |
|  |  |  |  |  |  |
| **15** | **15** | A steel bar of 400 mm is subjected to an axial load of 3 kN, as shown in the figure. Find the elongation of the bar. Neglect self-weight and consider three elements for the problem. | **20 Marks** | **L3** | **CO4** |
| **Or** | | | | | |
| **16** | **16a** | Consider a bar as shown in the figure below. An axial load of 700 kN is applied at point P0.      Calculate:   1. The nodal point displacement. 2. The stress. 3. The reaction force. 4. The displacement at each section if the total displacement is 10 mm. | **20 Marks** | **L3** | **CO4** |
|  |  |  |  |  |  |
| **17** | **17** | An axial load of 6×105 N is acting at a temperature of 20°C, as shown. The temperature is then raised to 70°C.    Find:   1. The assembled stiffness matrix K and force vector F. 2. The displacement under load. 3. The stress. 4. The reaction force for each material, denoted as R1​,R2​,R3 | **20Marks** | **L3** | **CO4** |
| **Or** | | | | | |
| **18** | **18a** | Evaluate and verify | **10Marks** | **L3** | **CO4** |
| **18b** | **F**or the isoparametric quadrilateral element, determine the local coordinates at the node p, given the coordinates of four nodes as shown in the diagram. The element has parameters ξ=2 and η=2**.** | **10Marks** | **L3** | **CO4** |