Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April/May – 2017**

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| **Code :** | **14CE3006** | **Duration :** | **3hrs** |
| **Sub. Name :** | **FINITE ELEMENT METHODS IN ENGINEERING** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Identify the basic philosophy of finite element method and briefly explain the finite element procedure. | CO1 | 5 |
| b. | Develop the shape function of four noded bar element using Lagrangean interpolation functions. Nodes are equally spaced. | CO1 | 5 |
| c. | Explain two methods of weighted residuals with example. | CO1 | 5 |
| d. | The loading and other parameters of a two bar truss are shown. Determine (a) element stiffness matrix for each element (b) global stiffness matrix (c) nodal displacements (d) reaction forces (e) stress induced in the elements. E=200GPa.  Capture.PNG | CO1 | 5 |
| (OR) | | | | |
| 2. | a. | Explain the convergence criteria for monotonic convergence of a displacement model. | CO1 | 5 |
| b. | Distinguish between Strong formulation and weak formulation in the context of finite element model. | CO1 | 2 |
| c. | Develop the force displacement relations for a two dimensional truss element inclined at an angle “θ” with horizontal. | CO1 | 5 |
| d. | Determine the displacement and rotation under the force and moment located at the centre of beam shown below.. The beam is discritized into 2 elements. E=210GPa;  Capture.PNG | CO1 | 8 |
| 3. | a. | Prove that a 3 noded plane stress / strain triangular element is a Constant Strain Triangle element using area coordinates as shape functions. | CO1 | 8 |
|  | b. | Develop the shape functions for QST in area coordinates. | CO1 | 4 |
|  | c. | Explain static condensation techniques. | CO1 | 4 |
|  | d. | Explain the Principle of virtual work for formulation of finite element  model. | CO1 | 4 |
| (OR) | | | | |
| 4. | a. | Develop the shape function and stiffness matrix for a 8 noded 2D rectangular elements. | CO1 | 5 |
|  | b. | Evaluate the nodal load vector due to self-weight of a four noded rectangular element with two degrees of freedom (translational) at each node. Use Gauss quadrature method of numerical integration. | CO1 | 5 |
|  | c. | Distinguish between Sub, Iso and Superparametric element and explain the importance of Jacobian determinant. | CO1 | 5 |
|  | d. | Evaluate the shape function N1, N2 and N3 at the interior P(3.85,4.8) for the triangular element shown, | CO1 | 5 |
| 5. | a. | Evaluate the following integral using appropriate Gauss Quadrature. | CO1 | 5 |
|  | b. | Develop shape functions and hence the stiffness matrix for 10 noded tetrahedran element. | CO1 | 10 |
|  | c. | Detremine the stiffness matrix for the axisymmetric element shown. Take E = 2.1 x 105 N/mm² and ϒ = 0.3 | CO1 | 5 |
| (OR) | | | | |
| 6. | a. | Develop the shape functions for the 9 noded Langarangean rectangular element. | CO1 | 5 |
|  | b. | Develop the shape functions and stiffness matric for an isoparametric quadrilateral element. | CO1 | 5 |
|  | c. | Develop the shape functions and hence deduce the stiffness matrix  for 20 noded hexahedral (ZIB 20) element . | CO1 | 10 |
| 7. | a. | Discuss the development of triangular plate bending elements. | CO1 | 5 |
|  | b. | Differentiate C0, C1 and C2 plate bending elements. | CO1 | 5 |
|  | c. | Explain the finite strip method. | CO1 | 5 |
|  | d. | Prove that a 12 dof rectangular plate bending element is a non-conforming element. | CO1 | 5 |
| (OR) | | | | |
| 8. | a. | Discuss in detail the 4 different approaches used to generate shell elements. | CO1 | 5 |
|  | b. | Develop the stiffness matrix for 4 noded bilinear degenerated quadratic shell element. | CO1 | 10 |
|  | c. | Explain dynamic condensation technique. | CO1 | 5 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Explain the various sources of errors in FEA. | CO2 | 5 |
|  | b. | Develop the lumped mass and consistent mass matrices for a bar element. | CO2 | 5 |
|  | c. | Explain “h”, “p”, “r” and “hp” methods of adaptive mesh refinement techniques. | CO2 | 5 |
|  | d. | Write a brief note on mesh generation techniques. | CO2 | 5 |

ALL THE BEST