Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2724301 Date: 25/05/2016

Subject Name: Finite Elements Methods for Geotechnical Engineering

Time:10:30 am to 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Enlist various steps of finite element analysis. Explain process of discretization in finite element analysis.	**07**
	(b)	Derive shape function and strain-displacement matrix for 2-noded bar element, using any coordinate system.	**07**
Q.2	**(a)**	Derive the equation [k]{q}={f} using potential energy approach. Where [k]=element stiffness matrix, {q}=displacement vector and {f}=nodal force vector.	**07**
	(b)	Compute axial displacement of a steel tapered rod of 1.0 m length, 100 mm^2 area at fixed end and 50 mm^2 area at free end with liner variation of c/s area. The rod is subjected to axial tensile force of 10 kN. Discretize the rod in to 2-noded 2-element. Take E=200 GPa.	**07**
		OR	
	(b)	A bar is subjected to uniformly distributed load of 5 kN/m along the length as shown in fig.1. Find nodal displacements & element stresses considering 2-nodded 2-elements. Take A=200 mm^2 and E=200 GPa.	**07**
Q.3	**(a)**	Define following with suitable example: (i) Plane stress problem (ii) Plane strain problem (iii) Axi-symmetric element	**07**
	(b)	Derive strain displacement matrix for axi-symmetric element shown in fig.2. Take E=200GPa, μ= 0.3.	**07**
		OR	
Q.3	**(a)**	Discuss the use of Pascle's triangle and tetrahedron in deciding the displacement function of the element.	**07**
	(b)	Evaluate the following integral using appropriate Gaussian quadrature. $\int_{-1}^{1}\int_{-1}^{1}\left(s^2+t^3\right)dsdt$	**07**
Q.4	**(a)**	Evaluate the element stiffness matrix for the element shown in fig. 3. The coordinates are shown in units of mm. Assume plane stress conditions. Take E=200GPa, μ= 0.3, and thickness t = 10 mm.	**07**
	(b)	Determine the nodal displacements and element stresses for the element shown in fig. 3 using the element stiffness matrix evaluated in Q.4(a).	**07**
		OR	
Q.4	**(a)**	Derive shape function of 4-noded quadrilateral element, using natural coordinate system.	**07**
	(b)	What is Jacobian matrix? Give a procedure to find out Jacobian matrix.	**07**

Q.5 **(a)** Determine (i) the fluid head distribution along the length of the coarse gravelly medium of length 40 cm (ii) the velocity in the upper part, and (iii) the volumetric flow rate in the upper part. The fluid head at the top is 20 cm and that at the bottom is 2.0 cm. Let the permeability coefficient be Kxx = 1.2 cm/s. The cross-sectional area of A = 10 cm^2. Descretize the continuum in to 2-noded 2-element. **07**

(b) For the element shown in fig. 4, find out Jacobian for the Gaussian point (0.5773, 0.5773). **07**

OR

Q.5 **(a)** Determine the nodal forces for a linearly varying pressure on the edge of the CST element shown in fig. 5. Assume element thickness = t. **07**

(b) Enlist the software packages based on FEM used for geotechnical engineering problems. What is pre-processor in context of FEA modeling? Explain the steps involved in preprocessor for FEA modeling. **07**

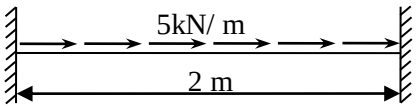

Fig. 1 [Q-2(b) OR]

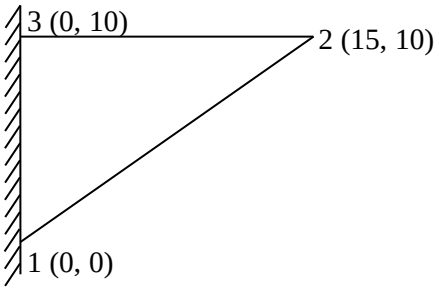

Fig. 3 [Q-4(a)(b)]

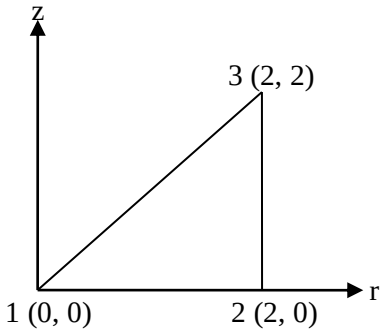

Fig. 2 [Q-3(b)]

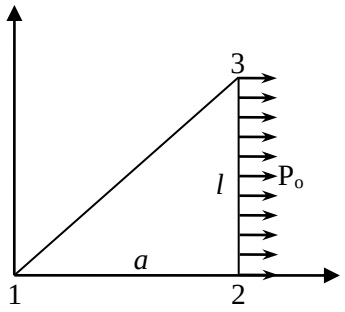

Fig. 5 [Q-5(a) OR]

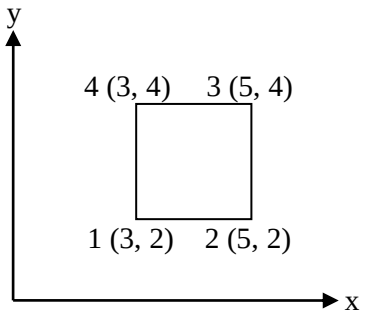

Fig. 4 [Q-5(b)]

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