Name :
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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

07 THRISSUR CLUSTER

FIRST SEMESTER M.TECH. DEGREE EXAMINATION MARCH 2021

Civil Engineering Department

Structural Engineering

07 CE 6301 THEORY OF ELASTICTY

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

Answer all six questions. Part 'a' of each question is compulsory.
Answer either part 'b' or part 'c' of each question.

Q.no.	Module 1	Marks
1a	Write all the Differential equations of equilibrium in rectangular Cartesian coordinate system.	**4**

Answer b or c

b	When the stress tensor at a point with respect to axes x,y,z is given by $[\sigma]=\begin{bmatrix}4 & 2 & 3\\ 2 & 8 & 0\\ 3 & 0 & 10\end{bmatrix}$ N/mm^2. Find the stress components by transformation of the axes by 45^0 about the z axis.	**5**
c	A body is subjected to a three dimensional state of stress represented by $[\sigma]=\begin{bmatrix}40 & 10 & 30\\ 10 & 50 & 20\\ 30 & 20 & 60\end{bmatrix}$ MPa. Determine the normal stress and the shearing stress on an octahedral plane.	**5**

Q.no.	Module 2	Marks
2a	Derive the strain-displacement relations.	**4**

Answer b or c

b The stress tensor at a point is given by **5**

$$[\sigma]=\begin{bmatrix} 200 & 100 & -150 \\ 100 & -300 & 120 \\ -150 & 120 & 100 \end{bmatrix} \text{ kN/m}^2.$$

If the modulus of elasticity E = 2 x 10^5 N/mm^2 and the Poisson's ratio is 0.3,determine the strain tensor at this point.

c At a point in an elastic body subjected to loading, the strain components with respect to a system of Cartesian coordinates are given by, **5**

$$\begin{bmatrix} 14 & 10 & 13 \\ 10 & 8 & 12 \\ 13 & 12 & 10 \end{bmatrix}$$

Determine the normal and shear components on an inclined plane ,whose normal is equally inclined to the three coordinate axes X,Y and Z.

Q.no.	Module 3	Marks
3a	.Explain Generalised Hooke's law.	**4**
	Answer b or c	
b	Derive Beltrami-Mitchell compatibility equations.	**5**
c	Derive the Lame-Navier Equation.	**5**

Q.no.	Module 4	Marks
4a	Explain plane strain problem with examples.	**4**
	Answer b or c	
b	Derive the Lame's Equation for thick cylinders subjected to internal and external pressure.	**5**
c	Derive the compatibility equation with body forces in terms of stress function for plane stress case.	**5**

Q.no.	Module 5	Marks
5a	Explain membrane analogy.	**5**
	Answer b or c	
b	Show that for the same twist ,the elliptical section has a greater shearing stress than the inscribed circular section. Which section take greater torque for the same allowable shearing stress.	**7**

c	Explain St.Venant's principle.	**7**

Q.no.	**Module 6**	**Marks**
6a	State and prove the theorem of stationary potential energy.	**5**
	Answer b or c	
b	A cantilever beam of span L is subjected to a concentrated load W at a distance 'L/3' from the free end.Using Castigliano's theorem ,Determine the deflection under the load.Assume uniform flexural rigidity.	**7**
c	Explain the principle of Virtual work.	**7**