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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M.Tech. - Civil Engineering (MCAD)

Semester End Examination; April / July - 2021

Continuum Mechanics - Classical and FE Approach

Time: 3 hrs *Max. Marks: 100*

Course Outcome

The Students will be able to:

CO1: Understand the concept of stresses and analyze the various mathematical operations involved I analyzing stresses in 2D and 3D problems in Cartesian and polar coordinates.

CO2: Apply the concept of stain at a point and to get acquaint with the various mathematical operations involved in analysis strains in 2D and 3D problems in Cartesian and polar coordinates .

CO3: Develop general stress strain relations and understand its application in various cases.

CO4: Apply the basic principles of theory of plasticity to understanding the plastic behaviour of materials and theories of failure.

Note: ***I)*** *Answer any* ***FIVE*** *full questions, selecting* ***ONE*** *full question from each unit.*
II) *Any* ***THREE*** *units will have internal choice and remaining* ***TWO*** *unit questions are compulsory.*
III) *Each unit carries 20 marks.* ***IV)*** *Missing data, if any, may suitably be assumed.*

Q. No.	Questions	Marks	BLs	COs	POs
	UNIT - I	**20**			
1 a.	Derive Strain-stress relations and stress-strain relations for a three dimensional state of stress. Also derive relationship between bulk modulus and young's modulus.	12	L3	CO1	PO1
b.	For what values of *a* and *b* will be the following stress distribution represents an equilibrium state. If the body forces are constant. $\sigma_x = 20x^2 y$ $\sigma_y = ay^3$ $\tau_{xy} = bxy^2$	08	L3	CO1	PO1
	OR				
1 c.	Derive the equation of equilibrium for two dimensional problems in polar coordinates.	10	L3	CO1	PO2
d.	Find the magnitude and direction of principal stresses with the following data: $i)\ \sigma_x = 30\ MPa,\quad \tau_{xy} = 60\ MPa$ $ii)\ \sigma_x = 60\ MPa,\quad \sigma_y = 30\ MPa\quad \tau_{xy} = 50\ MPa$	10	L1	CO1	PO2
	UNIT - II	**20**			
2 a.	Consider the displacement field, u = 0.05 y^2, v = 0.04 yz and w = 0.04+0.06 x^2z. What are the rectangular strain components at the point P (2, −2, −1). Use only linear terms.	10	L2	CO2	PO2
b.	Show that $\tau_{xy} = \tau_{yx}$, $\tau_{yz} = \tau_{zy}$ and $\tau_{xz} = \tau_{zx}$ as complementary shear stresses	10	L1	CO2	PO2
	OR				

2 c.	The strain component at a point is given by, $\in_x = 0.02, \quad \in_y = 0.02 \quad \in_z = 0.01$ $\gamma_{xy} = 0.03 \quad \gamma_{yz} = 0.04 \quad \gamma_{xy} = 0.04$ Determine the normal and shearing strains on the Octahedral plane.	8	L1	CO2	PO2
d.	Derive the expression for the normal and tangential components of strain at a given point along desired directions where the strain components $\in_x, \in_y$ and γ_{xy} are known.	12	L2	CO3	PO2
	UNIT - III	**20**			
3 a.	Derive the compatibility equation for plane strain problem in Cartesian coordinate system.	12	L2	CO2	PO1
b.	Explain plane stress and plane strain with examples.	08	L2	CO2	PO1
	OR				
c.	Using stress function in the form of a polynomial of fourth degree. Plot a stress on rectangular plate of size 2C×L.	10	L3	CO3	PO2
d.	Show that $\sigma_x = -\dfrac{Pxy}{I}, \quad \sigma_y = 0$ and $\tau_{xy} = -\dfrac{P}{2I}(C^2 - y^2)$ are the expression for the stresses components is solving a problem for a narrow cantilever of span "*L*" with rectangular cross section under an end load *P*.	10	L3	CO3	PO2
	UNIT - IV	**20**			
4.	For a plate having a small circular hole in the middle and subjected to uniform tensile stress in the horizontal direction. Find the corresponding stress components. Also find the stress concentration at the edge of the hole.	20	L4	CO4	PO3
	UNIT - V	**20**			
5.	Find the shape function at point *P* as shown in Fig. 5. Also find the stiffness matrix for the triangular element. Assume plane stress condition constant thickness *t* equal to 1 unit and poison ratio = 0.3.	20	L4	CO4	PO3

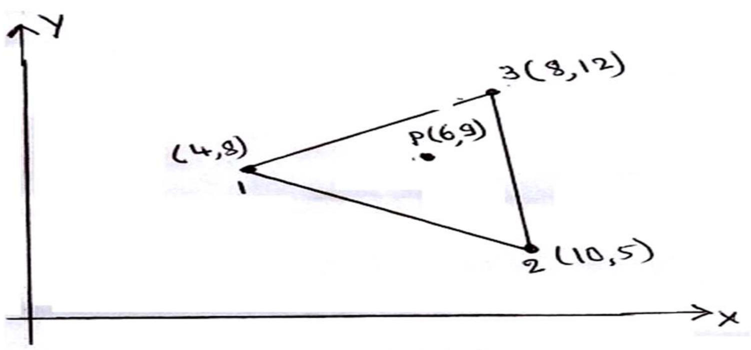

Fig. 5

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