NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. 8th Semester (Major) Examination, Spring-2019

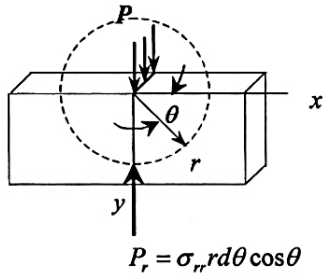
Theory of Elasticity (MEC ~ 803)

[Total No. of Questions: 5] [Total No. of Printed Pages: 1]

Max. Marks: 60 **Max. Time Allowed: 3 hour**

Note:

- *Attempt any four (4) questions.*
- *Assume any missing data suitably.*

Q.1 (a)	What are the assumptions made in theory of elasticity? Explain how stress is a tensor quantity.	**2+3**	**CO1**
(b)	Explain the Airy's stress function. Derive bi-harmonic equation in Cartesian coordinates for 2D stress states.	**2+3**	**CO2**
(c)	Explain the significance of compatibility equation, derive the same for a strain field.	**2+3**	**CO2**
Q.2 (a)	Derive the solution of two dimensional problems by the use of polynomials.	**8**	**CO2**
(b)	Find graphically the principal strains and their directions for rosette measurements $\varepsilon_{\varphi} = 2 \times 10^{-3}$ $\varepsilon_{\alpha+\varphi} = 1.35 \times 10^{-3}$ $\varepsilon_{\alpha+\beta+\varphi} = 0.95 \times 10^{-3}$ inch per inch where $\alpha = \beta = \varphi = 45^{o}$	**7**	**CO1**
Q.3 (a)	Explain how the following principle are used to solve the problems of theory of elasticity in practice: i. Generalized Hooke's Law ii. Saint Venant Principle iii. Fourier Series Solution	**2+3 +3**	**CO1 CO2**
(b)	A large plate is subjected to a line of uniform distribution of load acting on the edge as indicated. Determine the Airy's stresses in polar coordinates.  $P_r = \sigma_{rr} r d\theta \cos\theta$ *Boundary Conditions* $\sigma_\theta = \tau_{r\theta} = 0$ $@\ \theta = 0, \pi$	**7**	**CO4**
Q.4 (a)	Derive Winkler-Bach formula for curved beams.	**7**	
(b)	Investigate what problem of plane stress is satisfied by the stress function $$\varphi = \frac{3F}{4d}\left[xy - \frac{xy^3}{3d^2}\right] + \frac{p}{2}y^2$$ applied to the region included in y = 0, y = d, $x = 0$ on the side x positive.	**8**	**CO3**
Q.5 (a)	Show that the following stress function satisfies the boundary condition in a beam of rectangular cross-section of width $2h$ and depth d under a total shear force W. $$\phi = -\left[\frac{W}{2hd^3} xy^2(3d - 2y)\right]$$	**8**	**CO3**
(b)	Derive expressions for radial and tangential stresses for a plate with a circular hole and subjected to uniform tensile stress S in x-direction.	**7**	**CO4**