

2022

APPLIED MATHEMATICS WITH OCEANOLOGY AND  
COMPUTER PROGRAMMING

[P.G.]

(M.Sc. Second Semester End Examination-2022)

PAPER-MTM 205

GENERAL THEORY OF CONTINUUM MECHANICS

*Full Marks: 50*

*Time: 02 Hrs*

*The figures in the right hand margin indicate marks  
Candidates are required to give their answers in their own words as  
far as practicable*

*Illustrate the answers wherever necessary*

1. Answer any four questions: **4 × 2 = 8**
- i) Explain the body forces and surface forces.
  - ii) What are Lamé constants? Write those in terms of elastic constants.
  - iii) What do you mean by elasticity? Interpret the Hook's law.
  - iv) Describe the concept of stream function.
  - v) Find the time rate of change of small strain
  - vi) Show that Lagrangian linear strain tensors are identical with Eulerian linear strain tensors when the deformation is small.
  - vii) The components of the stress quadratic at a certain point of a continuous medium are given by

(2)

$$(E_{ij}) = \begin{pmatrix} 200 & 400 & 300 \\ 400 & 0 & 0 \\ 300 & 0 & -100 \end{pmatrix}$$

2. Answer any four questions:  $4 \times 4 = 16$

(a) Prove that, stress at any point is characterized by nine scalar quantities  $T_{ij}$ . 4

(b) Establish the normal and shearing strain 4

(c) At a point the strain tensor is given  $E_{ij} = \begin{bmatrix} a & b & 0 \\ b & -a & 0 \\ 0 & 0 & 0 \end{bmatrix}$ .

Determine the principal strains and principal directions of strain. 4

(d) Establish the Beltrami-Michell compatibility equation for stresses. 4

(e) If the velocity field is  $\vec{V} = (Ax^2yt)\hat{j} + (By^2zt)\hat{i} + (ct^2z)\hat{k}$ , Where  $A, B, C$  are constants then find acceleration and vorticity components 4

(f) A horizontal straight pipe gradually reduces in diameter from 24 inch to 12 inch. If the pressure at the larger end is 50 lbs/inch<sup>2</sup> and velocity of the water is 8 ft/sec, then find the pressure difference between the two ends. 4

(g) Find the complex potential due to sources of strength  $m_1, m_2, m_3, \dots, m_n$  4

(3)

3. Answer any two questions:  $8 \times 2 = 16$

i) What is strain quadric? Explain the geometric interpretation of infinitesimal strain tensors. 2+6

ii) State and prove the Cauchy's first equation of motion. When the continuum is in static equilibrium? Deduce the equation of equilibrium. 8

iii) For various kind of fluid motion describe the Bernoulli's equation or pressure equation. 8

iv) Prove that, if incompressible fluid is contained within a fixed boundary, the sum of its kinetic energy and potential energy remain unchanged with the passage of time. 8

[Internal Assessment-10]