

DEPARTMENT OF MATHEMATICS
INDIAN INSTITUTE OF TECHNOLOGY DELHI
MINOR TEST 2021-2022 FIRST SEMESTER
MTL 781 (FINITE ELEMENT ANALYSIS AND APPLICATIONS)

Time: 1 hour 15 Minutes

Max. Marks: 30

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- ** Answer to each question should begin on a new page.****
**** Complete and precise answers deserve full credit. ****
**** All parts of a question must be answered at one place. ****
**** All notations are standard. Exhibit clearly all the steps. ****

1. Find solution of the following Dirichlet boundary value problem by Fourier series method.

$$-\nabla^2 u = 2 \quad \text{in } \Omega = \{(x, y) : -a < x < a, -b < y < b\}$$
$$u = 0 \quad \text{on } \Gamma,$$

where Γ is boundary of Ω . (6)

2. Solve by the Galerkin's method, the partial differential equation

$$\nabla^2 u = 10xy \quad \text{in } \Omega,$$

where Ω is a square bounded by $x = 0, x = 1$ and $y = 0, y = 1$. It is given that $u = 2$ on the boundary. Take trial solution (approximate solution) $\tilde{U} = 2 + axy(1-x)(1-y)$. (8)

3. Solve above problem (Q2.) by Reyleigh-Ritz method using the same trial solution $\tilde{U} = 2 + axy(1-x)(1-y)$. (8)

4. Solve the second order differential equation in one dimension

$$\frac{d^2 u}{dx^2} - \alpha^2 u = 0$$

with the following boundary conditions:

$$u(0) = e^0 = 1, \quad u(2) = e^2 = 7.3890$$

with $\alpha = -1$. Assume that the domain is divided into four equal elements with five nodes. (8)