

Roll No.

(07/22-II)

11676

M. Sc. (2 Year) EXAMINATION

(For Batch 2017 & Onwards)

(Fourth Semester)

MATHEMATICS

MTHCE-2407

Boundary Value Problems

Time : Three Hours

Maximum Marks : 70

Note : Attempt *Five* questions in all, selecting the compulsory question and *one* question from each Unit. All questions carry equal marks.

Compulsory Question

1. (a) Define shifting property of Dirac delta function.
- (b) Define Newtonian Potential.

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(c) Define Fourier transform and its shifting property. (1)

(d) Define Reynolds number.

(e) Define Hilbert transform. (1)

(f) Solve the integral equation :

$$\sin s = \frac{1}{\pi} \int_{-\infty}^{+\infty} \left[\frac{g(t)}{t-s} \right] dt$$

(g) Give the properties of the single layer potential : 7×2=14

$$u = \int_S \left(\frac{\sigma}{r} \right) dS \quad (1)$$

Unit I

2. (a) Reduce the Bessel equation : 7

$$s^2 \frac{d^2 y}{ds^2} + s \frac{dy}{ds} + (\lambda s^2 - 1)y = 0$$

with end conditions $y(0) = 0, y(1) = 0$ to a Fredholm integral equation.

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(b) Solve the Boundary Value Problem : 7

$$\frac{d^2y}{dx^2} = F(x), y(0) = 0, y(l) = 0$$

using Green's function.

3. (a) Find the Modified Green's function for the system :

$$y'' - \lambda y = 0, y(0) = y(1), y'(0) = y'(1) \quad 7 \text{ (4)}$$

(b) Define Modified Green's function and its properties. Discuss the procedure to find it. 7 (3)

Unit II

4. Define exterior Dirichlet problem and find the solution of the problem. 14 (12)

5. (a) State and prove Poisson integral formula. 7

(b) Discuss Green's function for Laplace equation in a free space. 7

Unit III

6. (a) Define Laplace transform and its five properties. 7

(b) Solve : 7

$$y(t) = t + 2 \int_0^t \cos(t-x)y(x) dx$$

7. (a) Obtain the first form of the Hilbert transform pair. 7

(b) Obtain electrostatic potential due to a thin circular disc. 7

Unit IV

8. (a) Discuss Steady Stokes Flow in an unbounded medium. 7

(b) Discuss in detail boundary effects on Stokes flow. 7

9. (a) Discuss Steady Oseen Flow. 7

(b) Discuss the basic perturbation method. 7