2015

M.Sc. Part–II Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—VII

Full Marks : 100

Time : 4 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Group-A

[Marks : 25]

Answer *Q. No. 1* and any *two* from the rest.

1. What do you mean by Lorentz Gauge? 1

2. Find the potential and field due to an electric dipole. Deduce the expression for the mutual potential energy of two dipoles in a plane. 6+6

(Turn Over)

3. (a) Prove the following Maxwell's equation.

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

[notations have their usual meanings]

(b) Find the expressions of the electric and magnetic field in terms electromagnetic potentials. 6+6

4. (a) Show that $\vec{E}$, $\vec{H}$ and $\vec{K}$ constitute a right hand orthogonal set for plane electromagnetic wave.

(b) Prove that a plane electromagnetic wave can not propagate in a conducting medium without attenuation. 6+6

Group-B

(*Fuzzy sets and its applications in O.R.*)

[Marks : 25]

Answer *Q. No. 5* and any *three* from Q. No. 6 to Q. No. 10.

5. Give an example of a trapezoidal fuzzy number. 1

6. (a) Using the addition rule of fuzzy numbers show that 6 + 9 = 15 for real numbers. Also, show that for interval numbers distributive law does not hold in general. 4+2

(b) Simplify the following :

3(2, 4, 6, 7) + 4[8, 10] + (1, 3, 5) + 5 2

7. (a) Using Werner's approach, derive the equivalent crisp LPP for the following fuzzy LPP :

Maximize Z = Cx

Subject to $(Ax)_i \underset{\sim}{\leq} b_i$, i = 1, 2, —, m

$x \geq 0$,

Where p_i in the tolerance for the i-th fuzzy resource for each i = 1, 2, —, m. 6

(b) Prove that the law of excluded middle do not hold for fuzzy sets. 2

8. (a) Define triangular and trapezoidal fuzzy numbers. 2

(b) Define addition of two fuzzy numbers. Is it possible to add a crisp number with a fuzzy number ? Explain. 1+1 generating lines making an angle 'α' with the undisturbed stream lines. Prove that the resultant fluid pressure per unit length on the curved surface is $2a\pi - \frac{5}{3}\rho a v^2 \sin^2\alpha$, where π is the fluid pressure at a great distance from the cylinder. 8

(c) State and prove Blasius theorem for a two dimensional irrotational motion of an incompressible homogeneous liquid. 8

(d) If the fluid fills the region of space on the positive side of x-axis, which is a rigid boundary and if these be a source +m at the point (0, a) and an equal sink at (0, b) and if the pressure on the negative side of the boundary be the same as the pressure of the fluid at infinity. Show that the resultant pressure on the boundary is

$$\frac{\pi\rho m^2(a-b)^2}{ab(a+b)}$$

Where ρ is the density of the fluid. 8

(e) Describe the steady motion of a viscuss fluid of uniform density between parallel planes. Where one plate is at rest and the other is in motion. 8

Group-D

(Magnetohydrodynamics)

[Marks : 20]

Answer any two questions : 2×10

1. (a) For a conducting fluid in a magnetic field, show that the magnetic body froce per unit volume, i.e. $\mu(\nabla \times H)\times H$ is equivalent to a tension μH^2 per unit area along the lines of force, together with a hydrostatic presure $\frac{1}{2}\mu H^2$.

(b) A viscous, in compressible conducting fluid of uniform density is confined between a channel made by an infinitely long conducting horizontal plate y = 0 (lower) and a horizontal infinite long non-conducting plate y = h (upper). Assume that there is no pressure gradient and a uniform magnetic field H_0 acts perpendicular to the plates. The lower plate is at rest and the upper plate moves with uniform velocity U. Find the velocity of the fluid and the magnetic field.

(c) (i) Define magnetic Reynolds number and explain its significance.

(ii) Explain Lorentz force and its importance.

5+5

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