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E-5332

M.A. / M.Sc. (IIIrd Semester) Examination, 2021

MATHEMATICS

(Partial Differential Equations and Mechanics - I)

Time Allowed : Three Hours

Maximum Marks : 70

Note : Attempt questions from all four sections as directed. Distribution of marks is given with each section.

SECTION - A

Note : Attempt all questions of this section. Each question carries one mark. **10×1=10**

Q. 1. Fill in the blanks type questions :

(i) If $\cup(x) = L^{-1} f(x) = \int G(x,\xi) f(\xi) d\xi$, then Kernel of this integral operator is called _____ for the differential operator.

(ii) In fundamental solution t in Heat-Equation ϕ is _____ at the point (0, 0).

(iii) The complete integral (Nonlinear first order PDE), being a relation between x, y and z represents equation of a _____.

(iv) The attraction of a uniform soild sphere at an external point is the same as that of mass M, equal to the mass of the sphere, _____ at the centre of sphere.

(v) To find the distribution of given potential formula for surface density of _____ matter.

Multiple choice questions.

Choose the correct alternative :

(vi) In two dimensional wave equations, the Laplacian operator is :

(a) ∇

(b) ∇^3

(c) $(\nabla^3)^2$

(d) ∇^2

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(vii) Eliminate a and b from z = a (x + y) + b is :

(a) $\frac{\partial^2 z}{\partial x^2} = 0$

(b) $\frac{\partial^2 z}{\partial y^2} = 0$

(c) $\frac{\partial z}{\partial t} = \frac{\partial z}{\partial x}$

(d) $\frac{\partial z}{\partial x} = \frac{\partial z}{\partial y}$

(viii) The potential of a circle of uniform surface density ρ and radius *a* at a point on its circumference is :

(a) 4 $y\rho a$

(b) 2 $y\rho a$

(c) 3 $y\rho a$

(d) $\frac{1}{2} y\rho a$

(ix) In Gauss theorem, the whole mass of particle is :

(a) $\int Nds = \frac{4}{3}\pi yM$

(b) $\int Ndx = 4\pi yM$

(c) $\int Ndx = -4\pi yM$

(d) $\int Ndx = -\frac{4}{3}\pi yM$

(x) The function ϕ is said to be harmonic if ϕ satisfying :

(a) Laplace equation

(b) Hopf-Lax formula

(c) Riemann's formula

(d) Lagrange equation

SECTION - B

Note : Attempt any five questions. Each question carries 2 marks. **5×2=10**

Q. 2. Very short answer type questions (25-30 words) :

(i) What is Euler-Lagrange equation ?

(ii) Explain : Energy method.

(iii) What is Hopf-Lax formula ?

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(iv) Write the formula of potential of spherical shell.

(v) What is Poisson equation ?

(vi) What is Non-homogeneous equation ?

(vii) What is Hamilton's ODE ?

SECTION - C

Note : Attempt any five questions. Each question carries 4 marks. **5×4=20**

Q. 3. Short answer type questions (250 words) :

(i) Show that green functions are regularity property.

(ii) Explain : HEAT BALL in mean-value formula.

(iii) Find the complete integral of $q = 3p^2$.

(iv) Show that the attraction of uniform rod AB on the unit mass at P, in the direction parallel to AB, varies at $\frac{1}{PA} - \frac{1}{PB}$.

(v) Explain : Distribution for a given potential.

(vi) Show that the general solution of wave equation $c^2 \frac{\partial^2 \phi}{\partial x^2} = \frac{\partial^2 \phi}{\partial t^2}$ is $\phi = f(x + ct) + g(x - ct)$.

(vii) Explain initial value problem on Heat equation.

SECTION - D

Note : Attempt any three questions. Each question carries 10 marks. **3×10=30**

Q. 4. Essay type questions (more than 500 words) :

(i) Determine the Green's function for the Helmholtz equation for half-space $z \geq 0$.

(ii) State and prove : Gauss theorem.

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(iii) To find the attraction of thin uniform rod at an external point.

(iv) Find the temperature in a sphere of radius *a* when its surface is maintained at zero temperature and initial temperature is f(r, θ).

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