MSC PHYSICS

1588/MP1

MAY 2008

Paper I — MATHEMATICAL PHYSICS

Time : Three hours — Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

$(5 \times 20 = 100)$

1. (a) (i) State and prove Stoke's theorem.

(ii) Verify Stoke's theorem for the vector F = (z,x,y) taken over the half of the sphere $x^2 + y^2 + z^2 = a^2$ lying above the xy plane.

Or

(b) (i) Define subgroups, classes, cosets and invariant subgroups of a group.

(ii) Define conjugate classes of a group. Show that all the elements of a class have the same order and the same character.

2. (a) (i) Explain convergence and divergence of a series.

(ii) Explain Cauchy's integral test.

(iii) Check whether the following series in convergent or not. $f(x) = \sum_{n=1}^{\infty} \frac{n^2}{3^n}$

Or

(b) (i) Deduce the value of $\Gamma\left(\frac{1}{2}\right)$.

(ii) Find the relation between Beta and Gamma functions.

(iii) Show that $\beta(m,n)=\beta(n,m)$.

3. (a) (i) State and prove Cauchy's Residue theorem.

(ii) Apply the above theorem to evaluate $\int_0^{2\pi} e^{\cos\theta}\cos(n\theta-\sin\theta)d\theta$.

Or

(b) (i) Find the Fourier sine Transform of e^{-x}.

(ii) Find the Fourier cosine Transforrm of $x^n.e^{-ax}$.

4. (a) (i) Starting from the definition of $J_n(x)$ prove that $J_{n-1}(x)+J_{n+1}(x)=\frac{2n}{x}J_n(x)$.

(ii) Obtain the series solution of the Hermite differential equation. $y''-2xy'+2ny=0$ when n=2.

Or

(b) (i) Obtain differential form of Hermite polynomials and then find $H_3(x)$.

(ii) Prove the following recurrence relations for Hermite polynomials.

$$H_n'(x)=2xH_n(x)-H_{n+1}(x)$$
$$H_{2n+1}'(x)=2(2n+1)H_{2n}(x)$$

5. (a) Derive the wave equation for a perfectly flexible stretched string and then construct Fourier series solution for it.

Or

(b) (i) Construct the Green's function for the nonhomogeneous problem $\frac{d^2u}{dx^2}=f(x)$ with boundary condition $u(0)=u(L)=0$.

(ii) Expand the Green's function in a series of eigen functions of the homogeneous equation.

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1589/MP2 **MAY 2008**

Paper II — CLASSICAL MECHANICS AND STATISTICAL MECHANICS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

1. (a) (i) What are degrees of freedom generalised co-ordinates, generalised velocity and generalised momentum? Explain.

(ii) State D'Alembert's principle. Deduce Lagrange equation of motion from D'Alembert's principle for non-conservative system.

Or

(b) (i) Explain Hamilton's principle. Derive Lagrange equations form Hamilton's principle.

(ii) Write in detail the conservation theorems and symmetry properties.

2. (a) (i) State and prove virial theorem.

(ii) Explain inverse square law and motion in time in the Kepler's problem.

Or

(b) (i) Explain in detail matrix transformation.

(ii) What are Euler's angles? Explain their role in rigid body dynamics.

3. (a) (i) Discuss the cyclic co-ordinates and conservation theorems.

(ii) Explain Routh's procedure.

Or

(b) (i) State and prove the principle of least action.

(ii) Obtain the Hamiltonian for a charged particle in an electromagnetic field.

4. (a) (i) Derive the canonical transformation equations.

(ii) Apply Hamilton Jacobi equation to solve harmonic oscillator problem.

Or

(b) Explain action angle variables. Solve the Kepler-problem in action angle variable.

5. (a) (i) Explain the types of statistics.

(ii) Derive the Sackur-tetrode equation for a mono atomic ideal gas.

Or

(b) Explain :

(i) Para magnetism and

(ii) Random walk in detail.

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