2553/MP1 **OCTOBER 2011**

MATHEMATICAL PHYSICS

(For those who joined in July 2003 and after)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

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

(ii) Show that $\iint_S \vec{r} \cdot \hat{n} ds = 3V$, where V is the volume enclosed by S and $\vec{r}$ is the position vector.

Or

(b) (i) State and prove Cayley-Hamilton theorem.

(ii) Find the inverse of the matrix $A = \begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 2 \\ 3 & 1 & 2 \end{bmatrix}$.

2. (a) (i) Obtain the Fourier series of $f(x) = x$ in the interval $-\pi \le x \le \pi$.

(ii) Show that $p\beta\{p,(q+1)\} = q\beta\{(p+1),q\}$.

Or

(b) (i) Distinguish between Dirac delta function from Kronecker delta function.

(ii) Show that $\lim_{n\to\infty} \int_{-\infty}^{+\infty} \phi_n(x) f(x) dx = f(0)$ where $\phi_n(x)$ (n =1, 2, 3) as a delta sequence.

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

(ii) Evaluate $I = \int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$.

Or

(b) (i) State and prove the convolution theorem for Fourier Transform.

(ii) Find the Fourier sine and cosine transforms for the functions $f(x) = 2x$ $0 < x < 4$.

4. (a) (i) Write Sturm-Liouville's equation and deduce Legendre, Bessel and Hermite differential equations from it.

(ii) Construct a polynomial solution of Bessel differential equation.

Or

(b) Show that $P_n(x)$ is the coefficient of z^n in the expansion of $(1-2xz+z^2)^{-\frac{1}{2}}$ in ascending powers of z.

5. (a) (i) Derive Green's function for Poisson's equation.

(ii) Derive the Green's function for one dimensional problem.

Or

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

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2554/MP2 **OCTOBER 2011**

Paper II — CLASSICAL MECHANICS AND STATISTICAL MECHANICS

(For those who joined in July 2003 and after)

Time : Three hours Maximum : 100 marks

Answer ALL questions

1. (a) Using D' Alembati's principle obtain lagrange's equations of motion for a conservative system.

Or

(b) (i) What is a cyclic co- ordinate? (2)

(ii) Show that the generalised momentum conjugate to a cyclic co-ordinate is conserved. (8)

(iii) Discuss the advantages of variational principle. (10)

2. (a) (i) Using Laplace-Runge- lenz vector derive the orbit equation for the kepler problem. (8)

(ii) Explain Inverse square law of force in kepler's problem. (12)

Or

(b) Discuss

(i) Lagrange's equations of motion and first integral. (12)

(ii) Equivalent one- dimensional problem. (8)

3. (a) (i) Calculate angular velocity of precession and spin where mutation is absent

(ii) What are normal co-ordinates?

Or

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

4. (a) Derive Equations of Motion and infinitesimal canonical transformation in the poisson Bracket formulation.

Or

(b) Discuss the symplectic approach to canonical transformation.

5. (a) (i) State and prove the principle of equipantitian of energy.

(ii) Discuss the quantized linear oscillation.

Or

(b) Explain the specific heat capacity of a diatomic gas. Also explain Fermi-Dirac statistics.