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MANIPAL UNIVERSITY, MANIPAL

FIRST SEMESTER M.Sc. (Physics)
END SEMESTER EXAMINATION-2015-16
Mathematical Methods of Physics (PHY – 601)
(CREDIT SYSTEM)

Time: 3 Hrs. **Max. Marks: 50**

NOTE: (a) Answer any FIVE full questions. (b) All questions carry equal marks.

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1. **(a)** Represent the vector $\vec{A} = z\hat{\imath} - 2x\hat{\jmath} + y\hat{k}$ in cylindrical coordinate system

(b) Obtain Cauchy-Riemann condition for an analytic function $f(z) = u(r,\theta) + iv(r,\theta)$ in polar coordinates

2. **(a)** Find the Fourier transform of $f(x) = Ae^{-\alpha x^2}$, where A and α are constants

(b) State and prove Cauchy integral theorem

3. **(a)** Show that quantum mechanical equation for a harmonic oscillator reduces to Hermite differential equation

(b) Find the Laplace transform of $f(x) = x^n$, where n is a positive integer

4. **(a)** Solve the following system of linear equations using *Cramer's rule*

$$2x + 4y + 3z = 4$$
$$x - 2y - 2z = 0$$
$$3y - 3x + 2z = -7$$

(b) Evaluate the following integral using *residue theorem*

$$\int_0^{2\pi} \frac{d\theta}{5 + 4cos\theta}$$

5. **(a)** Obtain the multiplication table of $C3_v$ group and find the order of each element

(b) Find the recurrence relation for Legendre differential equation and obtain first three Legendre polynomials

6. **(a)** If a metric is given by

$$ds^2 = 5(dx^1)^2 + 3(dx^2)^2 + 4(dx^3)^2 - 6dx^1dx^2 + 4dx^2dx^3$$

Find the components of metric tensor and its reciprocal

(b) Obtain Fourier series for $f(x) = x^2$ in the interval $0 \leq x \leq 2$

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