by Dr. Gowrish Rao

Reg. No. | | | | | | | | | | |

MANIPAL UNIVERSITY
DEPARTMENT OF PHYSICS
I SEMESTER MSc (Physics) – 2016-17
End Semester Examination (Credit System)
PHY 601: Mathematical Methods of Physics

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

Answer any FIVE full questions. All questions carry equal marks

1. **(a)** Show that spherical coordinate system is orthogonal.
   (b) State and prove Cauchy integral theorem.

2. **(a)** Find Fourier transform of function $f(t) = e^{-\pi t^2}$
   (b) Obtain isomorphic representation of $C3_v$ group.

3. **(a)** The Laplace equation in spherical coordinates is given by,
$$\nabla^2 V = \frac{1}{r^2}\left[\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right)\right] + \frac{1}{r^2 sin\theta}\left[\frac{\partial}{\partial \theta}\left(sin\theta\frac{\partial V}{\partial \theta}\right)\right] = 0$$
   Show that *angular part* of the equation reduces to Legendre differential equation.
   (b) Show that symmetry of similar indices of a tensor remains invariant under coordinate transformation.

4. **(a)** Show that matrices A and B given below are similar.
$$A = \begin{pmatrix} 2 & 1 \\ -1 & -1 \end{pmatrix} \quad B = \begin{pmatrix} -2 & 5 \\ -1 & 3 \end{pmatrix}$$
   (b) Evaluate following integral using the method of residues.
$$\int_0^{2\pi} d\theta / \left(1 + \frac{\cos\theta}{2}\right)$$

5. **(a)** Obtain Cauchy-Riemann equations for an analytical function $f(z)$.
   (b) Obtain Fourier series expansion for following square wave function.
$$f(t) = \begin{Bmatrix} -1 \ for -T/2 \le t < 0 \\ +1 \ for \ 0 \le t \le T/2 \end{Bmatrix}$$

6. **(a)** Obtain a series solution to Bessel differential equation.
   (b) Show that the following matrix is orthogonal:
$$A = \frac{1}{3}\begin{bmatrix} 2 & -2 & 1 \\ 1 & 2 & 2 \\ 2 & 1 & -2 \end{bmatrix}$$

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Prepared by
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