Mid-West University

Examinations Management Office

End Semester Examinations 2081

Master level/ M.Sc.(Physics)/ 1st Semester — Full Marks: 37.5

Time: 3 hours — Pass Marks: 18.75

Subject: Mathematical Physics I (PHY 511)

Candidates are required to give their answer in their own words as far as Practicable. The figures in the margin indicate full marks.

Attempt all the questions:

1. Describe Cartesian tensors in three spaces and derive their transformation law, prove that the Kronecker delta is a second-rank tensor and the Levi-Civita antisymmetric symbol is a third-rank tensor according to this transformation. Derive Frenet Formulas. (10)
2. Explain Green's function. Solve the differential equation of vibrating string subjected with a force proportional to $-\delta(x - x')e^{-i\Omega t}$ for $x \neq x'$. Also, convert the partial differential equation into an integral equation using Green's function. (10)

   OR

   Define groups, finite groups, infinite groups, subgroups, and classes. Describe some operators in groups. Derive the condition for a round drum head perturbed by four masses at the vertices of a concentric square, degeneracy is broken down and the corresponding representation is reducible.
3. Solve the differential equation related to temperature distribution in the semi-infinite region $x > 0$ when initially $T = 0$ and the plane $x = 0$ is maintained at $T = T_0$. Here the diffusion equation is $\nabla^2 T - \frac{1}{k}\frac{\partial T}{\partial t} = 0$ Where $k = \frac{K}{C_p}$. (5)

   OR

   Solve the equation of vibration of round head describing small oscillation $\nabla^2 u - \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2} = 0$ using the separation of variables.

4. Define the Fourier series and convert it into complex form. Find the Fourier transform of

   $$f(t) = \begin{cases} 0 & for \quad t < 0 \\ e^{-t/T} \sin w_0 t & for\ t > 0 \end{cases} \qquad (5)$$

5. Explain linear vector space and linear operators. Define similarity transformation and show that any algebraic matrix equation remains unchanged under a similarity transformation. (5)
6. Prove that eigenvalues of the Hermitian matrix are real. (2.5)

   OR

   Write the short notes on:

   Riemann-Christoffel Tensor.

The End