K21P 0539

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (C.B.S.S. – Reg./Suppl. (Including Mercy Chance)/Imp.) Examination, October 2020
(2014 Admission Onwards)
PHYSICS
PHY1C01 : Mathematical Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions, either (**a**) or (**b**). **Each** question carries **12** marks :

1. a) Using Gauss Jordan method, find the inverse of the matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 1 \\ 1 & 1 & 4 \end{bmatrix}$.

OR

b) What do you mean by a normal matrix ? Prove that eigen vectors corresponding to different eigen values of a normal matrix are orthonormal. What about the converse of this result ?

2. a) State and prove Cauchy's integral formula. Also obtain an expression for the derivative of a complex function f(z) from the above formula of f(z).

OR

b) What do you mean by associated Laguerre polynomials ? Obtain the generating function for the associated Laguerre polynomials. Also obtain a Rodrigues representation of the associated Laguerre polynomial. **(2×12=24)**

SECTION – B

Answer **any four**, (**1** mark for Part '**a**', **3** marks for Part '**b**', **5** marks for Part '**c**') :

3. a) Define curl of a vector field.

b) If $\vec{u}$ and $\vec{v}$ are irrotational vectors, prove that $\vec{u} \times \vec{v}$ is solenoidal.

c) Explain the physical interpretation of divergence.

P.T.O.

4. a) Define a tensor of rank two.

   b) Obtain the Christoffel symbol of the first kind $[i, j, k] = g_{mk}\Gamma^{m}_{ij}$ as derivative of the metric tensor.

   c) Find the eigen values and eigen vector corresponding to the largest eigen value of $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 2 \end{bmatrix}$.

5. a) What do you mean by an exact differential equation ?

   b) Compare linear and non-linear differential equations with examples.

   c) Obtain the indicial equation of $y'' + w^2y = 0$.

6. a) Check whether $f(z) = z^2$ is analytic or not.

   b) What are the different types of singularities of a complex functions ? Give examples in each case.

   c) Derive Cauchy-Riemann conditions in polar form for an analytic function.

7. a) Define Gamma function.

   b) Explain double factorial notation.

   c) Evaluate $\int_0^1 \left(1-x^n\right)^{-\frac{1}{2}} dx$ in terms of gamma function.

8. a) Write the Rodrigues' formula for Legendre polynomials.

   b) Prove that $H_{2n}(0) = (-1)^n \frac{(2n)!}{n!}$.

   c) Write down the Laguerre ordinary differential equation. Derive Rodrigues' formula for Laguerre polynomials. **(4×9=36)**
