

Government General Degree College, Chapra

Internal Assessment- 1st Semester, 2022-23

Sub.- Physics

Paper: MATHEMATICAL PHYSICS-I

Total Marks: 15

Time: 40 minutes

Answer any three questions only:

1. If $\vec{F} = x^2\hat{i} + y^2\hat{j}$, then find the line integral $\int_C \vec{F} \cdot d\vec{r}$ in the $x - y$ plane along a line $y = x^2$ from $P(0,0)$ to $Q(1,1)$. 5
2. (a) Find the eigenvalues of the matrix $\begin{pmatrix} 3 & i \\ -i & 3 \end{pmatrix}$. 2
(b) Prove that the modulus of each characteristic root of a unitary matrix is unity. 3
3. (a) Solve the differential equation $(x + 1)\frac{dy}{dx} - y = e^x (x + 1)^2$. 3
(b) Find the Taylor series expansion of $\ln x$ about $x = 2$. 2
4. Solve the equation –
 $y'' + 6y' + 8y = 0$, subject to the condition $y = 1, y' = 0$ at $x = 0$,
where, $y' = \frac{dy}{dx}$ and $y'' = \frac{d^2y}{dx^2}$. 5
5. (a) Find a unit vector normal to $\vec{A} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} + 3\hat{k}$. 2
(b) Using Stoke's law, prove that $\vec{\nabla} \times \vec{\nabla} \phi = 0$. 3
6. (a) The position vectors of three points A, B and C are $\vec{r}_1 = \hat{i} + 2\hat{j} + \hat{k}, \vec{r}_2 = 3\hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{r}_3 = 2\hat{i} + 2\hat{j} - 3\hat{k}$. Find the area of the triangle. 3
(b) $\vec{\omega}$ is a constant vector and \vec{r} is the position vector of a point. If $\vec{v} = \vec{\omega} \times \vec{r}$, then prove that $\vec{\nabla} \cdot \vec{v} = 0$. 2