

Register Number
Name of the Candidate:

M.Sc. DEGREE EXAMINATION, May 2015

(PHYSICS)

(FIRST YEAR)

110: MATHEMATICAL PHYSICS AND NUMERICAL METHODS

Time: Three hours

Maximum: 100 marks

SECTION-A

(5×4=20)

Answer any FIVE questions

1. Explain the concept of gradient, divergence and curl.
2. Prove the Cayley Hamilton theorem.
3. Distinguish symmetric and antisymmetric tensors.
4. Explain the addition of tensors with example.
5. Give the relation between beta and gamma function.
6. What are the Dirichlet conditions.
7. State and prove convolution theorem.
8. What are the logical operators and explain them with examples.

SECTION-B

(5×16=80)

Answer any FIVE questions

9. a) Deduce an expression for the gradient of a scalar in orthogonal curvilinear co-ordinates.
b) Explain the method of finding the inverse of a matrix with an example.
10. a) Compare Gauss divergence, Stokes and Green's theorems.
b) From the set of vectors $(1, 0, 1)$; $(0, 0, 1)$ and $(1, 1, 0)$ construct a set of orthonormal vectors using Schmidt method.
11. a) A covariant tensor has components $xy, 2y-x^2, xz$ in rectangular co-ordinates. Find its covariant components in spherical co-ordinates.
b) Explain the quotient law of tensors.
12. Derive the one dimensional heat flow equation and obtain its solution.
13. Solve the Legendre differential equation.
14. Find the Fourier transform of the slit function $f(x)$ defined as

$$f(x) = \begin{cases} \frac{1}{\epsilon}, & |x| \leq \epsilon \\ 0, & |x| > \epsilon \end{cases}$$

Determine the limit of this transform as $\epsilon \rightarrow 0$ and discuss the result.

15. a) Explain the importance of Laplace transforms with an example.

b) Find the inverse Laplace transform of

$$\frac{1}{(s+1)(s^2+1)}$$

16. a) Use i) Trapezoidal rule and ii) Simpson's one third rule to evaluate the approximate value of $\int_0^1 \frac{dx}{1+x}$ correct to 3 decimals taking $h=0.25$.

b) Use Runge Kutta method to find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ take $h=0.2$.
