

S. No.: 102

BATCH: 2017 &amp; 2018

Reg. No.: 

END OF SEMESTER EXAMINATIONS, APRIL / MAY - 2019

MATHEMATICAL PHYSICS - I

SUBJECT CODE: 17P3PH02

MAJOR : M.Sc (Physics)

TIME : 3 HOURS

SEMESTER : I

MAX. MARKS: 70

**SECTION - A ( 10 X 1 = 10 )****Answer the following questions:**

1. Define gradient of a scalar function.
2. State any two uses of Fourier series.
3. Define singularity of an analytic function.
4. Write the generating function of Legendre's polynomial.
5. Define curve fitting.

**Choose the correct answer:**

6. If  $\vec{F}$  represents the force  $\vec{F}$  acting on the particle, then the line integral  $\int \vec{F} \cdot d\vec{r}$  represents
  - a) Work done    b) Energy    c) Torque    d) Couple per unit mass
7. The Laplace transform of  $1, 1.e L(1)$  is
  - a) S    b)  $\frac{1}{s}$     c)  $\frac{1}{s^2}$     d)  $s^2$
8. The residue of  $f(z) = \frac{z}{z-1}$  at  $z = 1$  is
  - a) 0    b) 1    c) -1    d)  $\infty$
9. The value of  $J_{-1}(x) + J_1(x)$  is
  - a) 0    b) 1    c)  $\infty$     d) -1
10. If  $f(x)$  is continuous in the interval  $(a, b)$  and if  $f(a)$  and  $f(b)$  are of opposite signs, then the equation  $f(x) = 0$  will have atleast one real root between
  - a) at zero    b) 0 and b    c) 0 and a    d) a and b

**SECTION - B ( 5 X 4 = 20 )****Answer ALL the questions:**

11. a) State and prove Gauss-divergence theorem.  
(OR)  
b) State and prove expansion theorem.
12. a) Find the Laplace transform of  $\cos^2 t$ .  
(OR)  
b) Find the Fourier series representing  $f(x) = x$  in the range  $0 < x < 2\pi$ .
13. a) Deduce Cauchy-Riemann differential equations.  
(OR)  
b) Evaluate  $\int_C \frac{dz}{z^2 - 1}$  when C is the circle  $x^2 + y^2 = 4$ .
14. a) Deduce Rodrigue's formula for Legendre's Polynomial.  
(OR)  
b) Show that  $\int_{-1}^{+1} p_n(x) dx = 0, n \neq 0$  and  $\int_{-1}^{+1} p_n(x) dx = 2, n = 0$ .

...2...

15. a) By the method of least squares, find the best fitting straight line to the data given below:

x	5	10	15	20	25
y	15	19	23	26	30

(OR)

- b) Derive Newton-Raphson iterative formula.

**SECTION - C ( 5 X 8 = 40 )**

**Answer ALL the questions:**

16. a) Describe Schmitt's orthogonalization method of obtaining ortho-normal vectors.

(OR)

- b) i) Describe inner product of vector space. Mention its properties. (4)

ii) Prove that  $(X, Y) = (Y, X)$ . (4)

17. a) Solve the following equation by Laplace transform  $y''' - 2y'' + 5y' = 0$ ;  $y = 0$ ,

$$y' = 1 \text{ at } t = 0 \quad y' = 1 \text{ at } t = \pi/8$$

(OR)

- b) i) State and prove linearity property of Laplace transform. (3)

ii) Find the Laplace transform of  $t \sin at$ . (5)

18. a) Obtain the Taylor's series expansion of a analytic function  $f(z)$ .

(OR)

- b) State and prove Cauchy's residue theorem. Apply the same to evaluate the wkgoal

$$\int_0^{2\pi} \frac{d\theta}{5 - 3\cos\theta}$$

19. a) Solve Bessel's differential equation and hence deduce Bessel's function  $J_n(x)$ .

(OR)

- b) State and prove orthogonal property of Legendre's Polynomial.

20. a) i) Derive Simpson's one-third rule. (4)

ii) Evaluate  $\int_0^{\pi} \sin x \, dx$  by dividing the range into ten equal parts by Simpson's rule. (4)

(OR)

- b) Apply the fourth order Runge-Kutta method to find  $y(0.2)$ . Given that

$$y' = x + y, \quad y(0) = 1$$

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