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(FOR THE CANDIDATES ADMITTED
DURING THE ACADEMIC YEAR 2024ONLY)

24UPS2A2

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS :MAY-2025

B.Sc.-PHYSICS **MAXIMUM MARKS: 75**
SEMESTER: II **TIME : 3 HOURS**

PART - III
ANCILLARY MATHEMATICS FOR PHYSICS - II
SECTION – A

ANSWER THE FOLLOWING QUESTIONS: **(10 X 1 =10 MARKS)**
MULTIPLE CHOICE QUESTIONS. [K1]

1. The value of cos (ix) = -------.
   a) i cos hx b) cos hx c) $\frac{1}{\cos hx}$ d) none

2. The formula for $L^{-1}\{1\}$ = -------.
   a) s b) $\frac{1}{s}$ c) $-\frac{1}{s}$ d) none

3. $\nabla X \vec{F} = 0, \vec{F}$ *is* --------.
   a) irrotational b) solenoidal c) conservative d) none

4. $\nabla X \nabla \phi$ = ---------.
   a) zero b) one c) infinity d) none

5. A scalar function ϕ satisfying the condition $\nabla^2 \phi = 0$ is called the ------ function.
   a) scalar b) vector c) harmonic d) none

ANSWER THE FOLLOWING IN ONE OR TWO SENTENCES. [K2]

6. Write the formula for L $\{\cos hat\}$.
7. Formula for $L^{-1}\{e^{-at}\}$.
8. Define Solenoidal.
9. Define surface integral.
10. State Stoke's theorem.

SECTION –B **(5 X 5 = 25 MARKS)**

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. **K3**

11. a) If tan y = tan α tan h β, tan z = cot α tan h β, prove that tan (y + z) = sin h 2β cosec 2α.

(OR)

b) Find the Laplace transform of L {sin ^{2} 3t}.

12. a) Find the Laplace inverse of $\left\{\frac{10}{(s+2)^6}\right\}$.

(OR)

b) Find $L^{-1}\left\{\frac{1}{s(s^2+a^2)}\right\}$.

(CONTD…………2)

13. a) If $\phi(x,y,z) = x^2y + y^2x + z^2$ find $\nabla\phi$ at the point (1, 1, 1).

(OR)

b) Find the directional derivative of xyz – xy^2z^3 at the point (1, 2, -1) in the direction of the vector $\hat{i} - \hat{j} - 3\hat{k}$.

14. a) If $\overline{F} = (3x^2 + 6y)\vec{i} - 14yz\,\vec{j} + 20xz^2\,\vec{k}$ evaluate $\int \overrightarrow{F}.\overrightarrow{dr}$ from (0, 0, 0) to (1, 1, 1) along the following path x = t, y = t^2, z = t^3.

(OR)

b) If $\overline{F} = 3xy\vec{i} - y^2\,\vec{j}$, evaluate $\int_C \overrightarrow{F}.\overrightarrow{dr}$ where C is the curve on the xy plane y = $2x^2$ from (0, 0) to (1, 2).

15. a) Using divergence theorem, evaluate $\int_S \overrightarrow{F}.\vec{n}\,dS$ where $\overrightarrow{F} = 4xz\vec{i} - y^2\,\vec{j} + yz\,\vec{k}$ and S is the Surface of the cube bounded by the planes x = 0, x = 2, y = 0, y = 2, z = 0, z = 2.

(OR)

b) Evaluate $\int_S \left[ax\vec{i} + by\vec{j} + cz\vec{k}\right].\vec{n}\,dS$ where of the is the surface of the sphere $x^2 + y^2 + z^2 = 1$.

SECTION –C (5X8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

16. a) If tan (α + iβ) = i, α and β being real, prove that α is indeterminate and β is infinite.[K4]

(OR)

b) Find the Laplace transform of L{sin ^{3} 2t}.

17. a) Find $L^{-1}\left\{\dfrac{s^2 + 9s + 2}{(s-1)^2\,(s+2)}\right\}$. [K5]

(OR)

b) Find $L^{-1}\left\{\dfrac{7s^3 - 2s^2 - 3s + 6}{s^3\,(s-2)}\right\}$.

18. a) Show that $\overrightarrow{F} = (y^2 - z^2 + 3yz - 2x)\,\hat{i} + (3xz + 2xy)\,\hat{j} + (3xy - 2xz + 2z)\,\hat{k}$ *is* irrotational and solenoidal. [K4]

(OR)

b) If $\vec{v} = \vec{w}\,x\,\vec{r}$ prove that $\vec{w} = \frac{1}{2}\,curl\,\vec{v}$ when $\vec{w}$ is a constant vector and $\vec{r}$ is the position vector of a point.

19. a) Show that $\overrightarrow{F} = (2xy + z^3)\vec{i} + x^2\,\vec{j} + 3xz^2\,\vec{k}$ is a conservative vector field and find a function ϕ such that $\overrightarrow{F} = \nabla\phi$. Also find the work done in moving an object in this field from (1, -2, 1) to (3, 1, 4). [K5]

(OR)

b) Evaluate $\iint_S \overrightarrow{F}.\vec{n}\,ds$ where $\overrightarrow{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ and S is the part of the surface of the sphere $x^2 + y^2 + z^2 = 1$ which lies in the first octant.

20. a) Verify Stoke's theorem for $\overrightarrow{F} = x^2\,\vec{i} + xy\,\vec{j}$ taken round the square in the xy plane whose sides are x = 0, x = a, y = 0, y = a. [K4]

(OR)

b) Verify Green's theorem in the plane for $\oint_C (xy + y^2)\,dx + x^2\,dy$ where C is the chord curve of the region bounded by y = x and y = x^2.

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