**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.**
**(For candidates admitted during the academic year 2008-09 & thereafter)**

**SUBJECT CODE : PH/MC/MP34**

**B.Sc. DEGREE EXAMINATION NOVEMBER 2010**
**BRANCH III - PHYSICS**
**THIRD SEMESTER**

**REG. No._____**

**COURSE : MAJOR – CORE**
**PAPER : MATHEMATICAL PHYSICS**
**TIME : 30 MINS.** **MAX. MARKS : 30**

**SECTION – A**

**TO BE ANSWERED IN THE QUESTION PAPER ITSELF**
**ANSWER ALL QUESTIONS:** **( 30 x 1 = 30 )**

**I CHOOSE THE CORRECT ANSWER:**

1. div curl **A** is equal to,
   a) 1 b) 0 c)$\nabla^2\mathbf{A}$ d) none of the above

2. A Vector is solenoidal if ,
   a) $\nabla\mathbf{V} = 0$ b) $\nabla.\mathbf{V} = 0$ c) $\nabla\mathbf{x}\mathbf{V} = 0$ d) $\nabla^2\mathbf{V} = 0$

3. If $R = \text{Sin}t\,\mathbf{i} + \text{Cos}t\,\mathbf{j} + t\,\mathbf{k}$ then $|dR/dt|$ is,
   a) $\sqrt{2}$ b) 1 c) 0 d) $1/\sqrt{2}$

4. For irrotational motion of incompressible liquid,
   a) $\nabla\mathbf{x}\,\mathbf{V} = O$ and $\nabla.\,\mathbf{V} = 0$
   b) $\nabla\mathbf{x}\,\mathbf{V} \neq O$ and $\nabla.\,\mathbf{V} = 0$
   c) $\nabla\mathbf{x}\,\mathbf{V} = O$ and $\nabla.\,\mathbf{V} \neq 0$
   d) $\nabla\mathbf{x}\,\mathbf{V} \neq O$ and $\nabla.\,\mathbf{V} \neq 0$

5. If $\mathbf{F} = \nabla\varphi$ then,
   a) $\nabla\mathbf{x}\,\mathbf{F} = 0$ b) $\nabla.\mathbf{F} = 0$ c) $\nabla\varphi\ \mathbf{x}\ \mathbf{F} = 0$ d) $\nabla\varphi\,.\mathbf{F} = 0$

6. Laplaces equation is ,
   a) $\nabla.\,\nabla\varphi = 0$ b) $\nabla\mathbf{x}\nabla\varphi = 0$ c) $\nabla.\,\nabla\mathbf{x}\varphi = 0$ d) ) $\nabla\mathbf{x}\nabla\mathbf{x}\varphi = 0$

7. If $\mathbf{A} = \mathbf{i} - 2\mathbf{j} + 3\,\mathbf{k}$ and $\mathbf{B} = 3\mathbf{i} + 2\mathbf{k}$ , then , $\mathbf{A}\ .\ \mathbf{B}$ is equal to,
   a) 2 b) 10 c) 3 d) 0

8. The angle between the two vectors $-2\mathbf{i} + 3\,\mathbf{j} + \mathbf{k}$ and $\mathbf{i} + 2\mathbf{j} - 4\mathbf{k}$ is,
   a) 0° b) 90° c) 180° d) 45°

..2..

9. Radium decays to Radon. If $N_O$ be the number of radium atom at t =0, $N_1$ be the number of radon atoms at a time t, $\lambda_1$ and $\lambda_2$ their decay constants the relation between $N_O$ and $N_1$ is ,
a) $N_1 = N_O\ e^{-\lambda_1 t}$ b) $N_1 = N_O\ e^{\lambda_1 t}$
c) $N_1 = N_O\ e^{-\lambda_2 t}$ d) $N_1 = N_O\ e^{\lambda_2 t}$

10. Solution of $(D^2 - 5D + 4\ Y) = 0$ is,
a) $Y = A e^{-x} + B e^{4x}$ b) $Y = A e^{x} + B e^{4x}$
c) $Y = A e^{x} + B e^{x}$ d) none of the above.

11. A simple harmonic motion is given by,
$d^2y/dt^2 = (-3g/2a)\ Y$.The time period of oscillation is given by,
a) $2\pi\sqrt{2a/3g}$ b)$2\pi\sqrt{3g/2a}$ c) $2\pi(2a/3g)$ d) $2\pi(3g/2a)$

12. The value of $\Gamma 1/2$ is,
a) $\Pi$ b) $\Pi/2$ c) $\sqrt{\Pi}$ d) $\sqrt{\Pi}/2$

13. The criterion for Mdx + Ndy to be exact is,
a) $\partial M/\partial Y = \partial N/\partial X$ b) $\partial M/\partial X = \partial N/\partial Y$
c) d M/dY = d N / dX d) d M/dX = d N / dY

14. The order and degree of the differential equation
$d^2y/dx^2 + (dy/dx)^3 = x$ is,
a) 2 & 1 b) 3 & 2 c) 2& 3 d) 1 & 2

15. If $\mathbf{A} = 2\mathbf{i} + a\mathbf{j} + \mathbf{k}$ and $\mathbf{B} = 4\mathbf{i} - 2\mathbf{j} - 2\mathbf{k}$ are perpendicular vectors, The value of a is,
a) 3 b) 0 c) 5 d) -3

**II FILL IN THE BLANKS**.

16. The value of $\mathbf{A} . (\mathbf{A} \times \mathbf{C})$ is equal to ----------.

17. A vector field is conservative if and only if there exists a scalar point Function $\varphi$ such that, ----------.

18. The gradient of a scalar is a ----------.

19. If $\mathbf{A} = 3\mathbf{i} - \mathbf{j}$ and $\mathbf{B} = 3\mathbf{j} + \mathbf{k}$ then $\mathbf{A} . \mathbf{B}$ is equal to, ----------.

20. The value of $\Gamma n$ is, ----------.

**III STATE WHETHER TRUE OR FALSE**.

21. If $\mathbf{A} \times \mathbf{B} = 0$ and if **A** and **B** are not zero, then **A** is perpendicular to **B**

22. A vector is uniquely specified by giving its divergence and curl with in a region and its normal component over the boundary

23. $0(\mathbf{A}) = \mathbf{0}$

24. The value of $\Gamma$-n = 0.

25. $\beta(m, n) = -\beta(n, m)$

**IV ANSWER THE FOLLOWING**.

26. Define curl of a vector field.

27. State Greens theorem.

28. Can we add a velocity vector to a displacement vector? Why?

29. Define order and degree of a differential equation.

30. What is the relation between beta and gamma functions?

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**COURSE : MAJOR – CORE**
**PAPER : MATHEMATICAL PHYSICS**
**TIME : 2 ½ HOURS** **MAX. MARKS : 70**

**SECTION – B**

**ANSWER ANY FIVE QUESTIONS:** **( 5 x 5 = 25 )**

1. Find the work done by a force $\mathbf{F} = -4\mathbf{j} + 2\mathbf{k}$ acting on a particle if the particle is displaced from a point A (2 , 2, 2) to a point B(4, 4, 4) along a straight segment AB. Comment on your results.

2. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at (2 , -1 , 2)

3. State and prove Gauss divergence theorem .

4. Prove that curl grad $\varphi = 0$.

5. An e.m.f of 10 volts is applied to a circuit having a resistance of 10 ohms and inductance of 0**.** 5 henry. Find the time required by the current to attain 63.2% of its final value.

6. Show that $\int_0^\infty ( x^8 ( 1 - x^6 ) dx / ( 1+ x )^{24} = 0$

7. Solve : $dy / dx + y \cos x = \sin 2x / 2$

**SECTION – C**

**ANSWER ANY THREE QUESTIONS:** **( 15 x 3 = 45 )**

8. a) Find the total work done in moving a particle in a force field given by $\mathbf{F} = 3xy\,\mathbf{i} - 5z\mathbf{j} + 10x\,\mathbf{k}$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$.

   b) If $\varphi ( x, y, z) = 3x^2 y - y^3 z$ find the value of grad$\varphi$ at the point (1, -2, -1)

**..2..**

9. a) State and prove Stokes theorem.

b) Evaluate : $\int\int \mathbf{F} \cdot \mathbf{n}\, ds$ where $\mathbf{F} = 4xz\,\mathbf{i} - y^2\,\mathbf{j} + yz\,\mathbf{k}$ and S is the surface of the cube bounded by $x = 0,\ x = 1,\ y = 0,\ y = 1$ and $z = 0, z = 1$.

10. a) A hot body cools in air at a rate proportional to the difference between the temperature of the body and that of the surrounding air. If the air is maintained at 20° C and the body cools from 100° C to 75°C in 10 minutes. When will its temperature be 25° C ? What will be its temperature in 30 minutes since it started cooling from 100°C?

b) Calculate the time required for 10% of a sample of thorium to disintegrate. assume the half life of thorium to be $1.4 \times 10^{10}$ years.

11.a ) A circuit is made up of a source of constant e.m.f, a self inductance, a key, a capacitor, and an ohmic resistance in series. Assuming the capacitor is uncharged before closing the key investigate theoretically how its charge varies with time after closing the key.

b) Solve : $(D^2 + 5D + 6)\, Y = e^x$

12. Obtain the series solution of Legendres differential equation.

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