STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05 & thereafter)

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

B.Sc. DEGREE EXAMINATION NOVEMBER 2007
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. $\vec{A}\times\left(\vec{B}\times\vec{C}\right)+\vec{B}\times\left(\vec{C}\times\vec{A}\right)+\vec{C}\times\left(\vec{A}\times\vec{B}\right)$ is equal to
   a) zero b) $\left(\vec{A}\bullet\vec{B}\times\vec{C}\right)$ c) $\vec{B}\left(\vec{A}\bullet\vec{C}\right)$ d) $\vec{A}\left(\vec{B}\bullet\vec{C}\right)$

2. The value of the integral $\iint_S \left(\vec{r}.\vec{n}\right)ds$ is given by [S is a closed surface enclosing a volume V]
   a) S b) 2S c) V d) 3V

3. If $\vec{A}=\left(2\vec{i}-\vec{j}\right)$ and $\vec{B}=3\vec{i}+\vec{K}$, then $\vec{A}\bullet\vec{B}$ is
   a) $-8\vec{i}$ b) $10\vec{j}$ c) 6 d) - 10

4. A particle moves so that its position vector $\vec{r}$ is given by $\vec{r}=\vec{i}\cos\omega t+\vec{j}\sin\omega t$ where ω is a constant. If $\vec{v}$ is the velocity of the particle, then $\vec{r}.\vec{v}$ is equal to
   a) ω b) 0 c) r d) v

5. If $\vec{A}=xz\vec{i}-y^2\vec{j}+2x^2y\vec{k}$, then $\nabla.\vec{A}$ is
   a) x – y b) 2x – y c) x – 2y d) 2x – z

6. The angle which the vector $\vec{A}=3\vec{j}-6\vec{j}+2\vec{k}$ makes with the +ve x – axis is
   a) 64.6° b) 149° c) 73.4° d) 120°

7. $\underset{z\to 0}{Lt}\left(\frac{1-CosZ}{z^2}\right)$ is given by
   a) ½ b) 5/3 c) 1/3 d) 1/7

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8. $\frac{d}{d2}(\bar{z})$ is

a) $\bar{z}$ b) $z\bar{z}$ c) $z/\bar{z}$ d) Does not Exist

9. The particular solution of the equation $(D^2 - 3D + 2)\, y = e^x$ is

a) xe^x b) $-xe^{-x}$ c) $-xe^x$ d) xe^{-x}

10. $y = c_1e^{-x} + c_2e^{2x}$ is the primitive of the equation

a) $(D^2 + D + 2)y = 0$ b) $(D^2 - D + 2)y = 0$

c) $(D^2 - D - 2)y = 0$ d) $(D^2 + D - 2)y = 0$

11. If an electrical circuit contains a resistance (R), condenser of capacity 'C' is series and an emf E; the charge 'q' on the condenser is given by

a) $\frac{dq}{dt} + \frac{q}{c} = \frac{E}{R}$ b) $R\frac{dq}{dt} + \frac{q}{c} = E$ c) $R\frac{dq}{dt} + qC = E$ d) $\frac{dq}{dt} + \frac{R}{qc} = E$

12. The diffrential equation representing vertical oscillations of a loaded spring is given by $\left(\frac{d^2x}{dt^2}\right) + 96x = 0$. Its period of oscillation is

a) 0.64 sec b) 1.2 sec c) 0.05sec d) 4 sec

13. The value of Pn(1) is

a) 1 b) - 1 c) 0 d) n

14. The value of $\sqrt{3/2}$ is

a) 1.45 b) 3.14 c) 0.886 d) 1.571

15. The value of the integral $\int_{-1}^{+1} P_0(x)dx$ is

a) 1 b) 2 c) - 1 d) -2

II FILL IN THE BLANKS:

16. Given $A = \hat{i} + 2\vec{j} + 3\vec{k}$ and $\vec{B} = 3\hat{i} + 2\vec{j} + \vec{k}$, the unit vector perpendicular to both $\vec{A}$ and $\vec{B}$ is _____.

17. A force $\vec{F} = (5\hat{i} + 2\vec{j})$ acts at the point (2,1). The moment of this force about the origin is _____.

18. The function which is a solution of Laplace equation is called _____.

19. The general solution of the equation y'' + 9y = 0 is _____.

20. The relation between Gamma and Beta functions is given by _____.

III STATE WHETHER TRUE OR FALSE:

21. The value of $\nabla \times \vec{r}$ is zero.

22. The work done in moving an object along a vector $\vec{r} = 3\vec{i} + 2\vec{j} - 5\vec{k}$ by the force $\vec{F} = 2\vec{i} - \vec{j} - \vec{k}$ is 6 Joules.

23. An example of Exact Differential equation is $\left(4x^3 + 6xy + y^2\right)\left(dx/dy\right) = -\left[3x^2 + 2xy + 2\right]$.

24. $\Phi = \left(1/r\right)$ is a solution of Laplace equation.

25. Gamma function is generally represented by an Improper integral.

IV ANSWER THE FOLLOWING:

26. State Green's theorem in the plane.

27. Prove that the area of a parallelogram with sides $\vec{A}$ and $\vec{B}$ is $\left|\vec{A} \times \vec{B}\right|$.

28. State L' Hospital's rule.

29. Prove that $\Gamma\left(1/2\right) = \sqrt{\Pi}$.

30. Show that $\beta(m,n) = \beta(n,m)$.

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TIME : **2 ½ HOURS** MAX. MARKS : **70**

SECTION – B

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

1. Show that $\vec{A} = (2xy + z^3)\vec{i} + x^2\vec{j} + 3xz^2\vec{k}$ is a conservative force field. Find the scalar potential.

2. Find the work done in moving a particle once around a circle 'C' in the X – Y plane, if the circle has centre at the origin and radius 3 units and if the force – field is given by $\vec{F} = (2x - y + z)\vec{i} + (x + y - z^2)\vec{j} + (3x - 2y + 4z)\vec{k}$.

3. If $\vec{v} = \vec{w} \times \vec{r}$, prove that $\vec{\omega} = \frac{1}{2} curl\vec{v}$ where $\vec{\omega}$ is a constant vector.

4. Derive Cauchy's integral formula.

5. Find the particular solution of the differential equation $(x + xy^2)dx + (y + x^2 y)dy = 0$, given that y = 2 when x = 1.

6. If the population of a country doubles in 50 years, in how many years will it treble, under the assumption that the rate of increase is directly proportional to the Number of inhabitants?

7. Plot the graph of Gamma function $\Gamma n \ \ [0 \le n < 4]$.

SECTION – C

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

8. If $\phi(x, y, z) = x^2 yz$ and $\vec{A} = 3x^2 y\vec{i} + yz^2\vec{j} - xz\vec{k}$, find $\left(\frac{\partial^2}{\partial y \partial z}\right)(\phi\vec{A})$ at the point $(1,-2,-1)$.

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9. a) State and prove stokes' fheorem.

   b) A particle moves along a curve whose parametric equations are $x = 3e^{-2t}$, $y = 4 \text{ Sin } 3t$, $z = 5 \text{ Cos } 3t$ where 't' is the time. Find the magnitudes of the velocity and acceleration at $t = 0$.

10. a) Solve $\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 25y = 20Cos2x$.

    b) A body of mass 4 kgms falls from rest (at $t = 0$) in a medium for which the resistance (in kg) is numerically equal to square of the velocity v^2. Find (i) the velocity and distance travelled at any time $t > 0$ and (ii) the limiting velocity.

11. a) Deduce Rodrigues' formula for Pn(x).

    b) Give the graphical representation for $P_1(x)$ and $P_2(x)$.

12. a) Show that $\beta(m,n) = \int_0^\infty \frac{ym^{-1}}{(1+y)^{m+n}} dy$.

    b) Evaluate using Gamma Beta function: $\int_0^\infty e^{-x2} dx$.