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 2011
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. The value of $\frac{d}{du}$(A×B) is
   (a) $B \times \frac{dA}{du} + A \times \frac{dB}{du}$ (b) $A\times \frac{dA}{du} + B \times \frac{dB}{du}$ (c) $B \times \frac{dB}{du} + A \times \frac{dA}{du}$ (d) $A \times \frac{dB}{du} + \frac{dA}{du} \times B$
2. If r_0 and r denotes the position vector then $(r_0 - r)$ is
   (a) Perpendicular to r (b) Parallel to r_0 and r (c) Normal to r (d) none of the above
3. If A = $x^2zi - 2y^3z^2j + xy^2zk$ find ∇.A at the point
   (a) -1 (b) 0 (c) -3 (d) 1
4. A vector field is a conservative field if and only if
   (a) ∇.A=0 (b) ∇ × A=0 (c) ∇ (∇×A) = 0 (d) ∇× (∇.A) = 0
5. If A=∇Φ then the integral around closed path is
   (a) 1 (b) -1 (c) 0 (d) ∞
6. Evaluate $\iint_s$ r.n ds, where S is a closed surface, where V is the volume
   (a) 2V (b) -3V (c) 3V (d) 4V
7. The values of the arbitrary constant in the differential equations
   (a) Cannot be determined (b) Can be determined by initial conditions
   (c) Can be determined by final values (d) none of the above
8. The order and degree in equation $2\frac{d^2y}{dx^2} + (\frac{dy}{dx})^2 = x$ is
   (a) (2, 1) (b) (1, 2) (c) (2, 2) (d) (1, 1)
9. The equation $\frac{dy}{dx} = 12\ ^3$ is a
   (a) non linear (b) Quadratic (c) Third order (d) linear equation

10. The solution of the equation $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 0$ is
    (a) y=$Ae^{x} + Be^{x}$ (b) y=$Ae^{-x} + Be^{-x}$ (c) y=$Ae^{x} + Be^{4x}$ (d) y= $Ae^{x} + Be^{-4x}$

11. The operator D = $\frac{d}{dx}$ satisfies
    (a) Commutative law (b) Associative law (c) Distributive law (d) All the above

12. The period of tan x is
    (a) 2π (b) π (c) 2/π (d) π/2

13. In the case of Legendre polynomials, the Legendre function $P_n(x)$ are orthogonal in the interval
    (a) $1<x<0$ (b) $-1<x<1$ (c) $-1>x>1$ (d) none of the above

14. $\int_{-1}^{1} P_m(x)\, P_n(x)\, dx=0$ if
    (a) m=0 (b) n=0 (c) $m \neq n$ (d) m=n

15. The general solution of $\left(\frac{d^2\Phi}{d\Phi^2}\right) + m^2\Phi=0$ is
    (a) $\Phi = A \sin m\Phi + B \cos m\Phi$ (b) $\Phi = A \cos m\Phi + B \sin m\Phi$
    (c) $\Phi^2 = A^2 \sin m\Phi + B^2 \cos m\Phi$ (d) $\Phi = A^2 \cos m\Phi + B^2 \sin m\Phi$

II.FILL IN THE BLANKS:

16. $\nabla \times (\nabla\Phi)$ is ___________.

17. Green's theorem in the plane can be written as __________.

18. The differential form of equation of a circle can be written as__________.

19. If y=$\frac{d^2x}{dt^2} + b\left(\frac{dx}{dt}\right)$ 3 the order of the differential equation is____________.

20. A recurrence formula for the Gamma function is_________.

III.STATE WHETHER TRUE OR FALSE:

21. The ordinary laws of algebra are valid for dot products in vector algebra.

22. F= $(2xy+z^3)\,\hat{i} + x^2\,\hat{j} + 3xz^2\,\hat{k}$ is a conservative force field.

23. Bernoulli's equation can be reduced to linear form.

24. The particular solution of y″-y'-2y=sin2x is Asin2x.

25. Legendre's associated differential equation can be obtained from Laplace equation.

IV.ANSWER THE FOLLOWING:

26. If A and B are differential functions of scalar u prove $\frac{d}{du}$(A.B) = A.$\frac{dB}{du}$+$\frac{dA}{du}$.B

27. State Stokes theorem.

28. State the Superposition principle.

29. Solve $\frac{d^2y}{dx^2}$ +2 $\frac{dy}{dx}$+y=0.

30. Write the generating function for Legendre polynomials.

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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. A particle moves so that its position vector is given by r = (cosωt)i^ + (sinωt)j^ where ω is a constant. Show that (i) v is perpendicular to r (ii) acceleration a is directed towards the origin and has the magnitude to the distance from the origin.

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

3. Evaluate $\int_c$ F.dr where F=(x-3y)i+(y-2x)j and c is the closed curve in the xy plane, x=2cost,y=3sint from t=0 to t=2π.

4. The differential equation of an electric current containing a resistance R and a capacity C in series with an electromotive force e is R(di/dt)+ i/C=dE/dt, solve the equation if $E=E_0$cospt and i=0 at t=0.

5. Solve $(D^2+16)\ y=2e^{-3x}+\cos 4x$.

6. Evaluate Γ (1/2)

7. Derive the polynomials $p_2(x)$ and $p_1(x)$ from Rodriques formula

SECTION – C

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

8. (a) Find ∇ Φ if (i) Φ=ln r, (ii) Φ=1/r.
(b) Find the directional derivative of $\Phi=4xz^3-3x^2y^2z$ at (2,-1,2) in the direction 2i-3j+6k.

9. (a) Verify Greens theorem in the plane for $\int_c(xy+y^2)dx+x^2dy$. where c is the closed curve of the region bounded by y=x and $y=x^2$.
(b) State and prove Gauss divergence theorem.

10. (a) Solve x $(1- x^2) \frac{dy}{dx} + (2x^2-1) y = ax^3$.

(b) Find the equation of the curve through the origin which satisfies the differential equation $\frac{dy}{dx} = (x-y)^2$.

11. Solve Legendre's differential equation using series solution technique.

12. (a) Derive any two forms of beta function and derive the relation between gamma and beta function.

(b) Evaluate (i) $\int_0^{\propto} e^{-4x^2} dx$ (ii) $\int_0^1 \frac{dx}{\sqrt{-lnx}}$

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