STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2011-2012 and thereafter)

SUBJECT CODE : 11PH/MC/MP34

B.Sc. DEGREE EXAMINATION NOVEMBER 2014
BRANCH III - PHYSICS
THIRD SEMESTER

REG. No.________________

COURSE : MAJOR - CORE
PAPER : MATHEMATICAL PHYSICS
TIME : 30 MINUTES **MAX. MARKS : 30**

SECTION – A
TO BE ANSWERED IN THE QUESTION PAPER ITSELF
ANSWER ALL QUESTIONS: **(30x1=30)**
Choose the correct answer:

1. **a**.**b** = __________
   a) |**a**| |**b**| cosθ b) |**a**| |**b**| sin θ c) |**a**| |**b**| cosh θ d) |**a**| |**b**| sinhθ

2. The relation between angular velocity **ω**, linear velocity **v** and the position vector **r** is given by ____________.
   a) **ω = vr** b) **v = r/ ω** c) **v = ω.r** d) **v = w x r**

3. If F is a solenoidal vector function, which of the following condition should be satisfied?
   a) div **F** = 0 b) curl **F** = 0 c) $\int \mathbf{F}.\mathbf{dr} = 0$ d) ∇.(∇x**F**) = 0

4. The gradient of a scalar field is always a _________________.
   a) Vector b) scalar c) numeric d) sometimes vector and sometimes scalar

5. If $\int_A^B \mathbf{F}.\mathbf{dr}$ is independent of the point joining A and B, then **F** is called ___________ field.
   a) Non- conservative b) Non-lamellar c) Conservative d) Curl

6. $L\frac{d^2q}{dt^2} - R\frac{dq}{dt} + \frac{q}{c} = E\sin \omega t$ is a differential equation of ____.
   a) degree 1 and order 1 b) degree 1 and order 2
   c) degree 2 and order 1 d) degree 2 and order 2

7. If m_1 and m_2 are the roots of a differential equation, then the complementary function is __________________
   a) $y = (A+Bx)e^{m_1 x}$ b) $y = (A+Bx)e^{m_2 x}$
   c) $y = A\, e^{m_1 x} + e^{m_2 x}$ d) $y = e^{m_1 x}(A\cos m_2x+B\sin m_2x)$

8. The Legendre equation has singular points _____________.
   a) 0, ∞ b) -∞, ∞ c) -1, 1 d) 1, 0

9. The value of $\frac{2}{3}P_2(x) + \frac{1}{3}P_0(x)$ is ___________.
   a) x b) x^3 c) $2/3 + x^2$ d) x^2

10. Γ (n+1) = __________.
    a) n! b) (n+1)! c) (n-1)! d) 0

11. The value of $\Gamma 1/2$ is __________.
    a) π b) $\sqrt{\pi}$ c) ∞ d) 1

12. $\beta(8,9) - \beta(9,8)$ = __________________.
    a) 17 b) -1 c) 0 d) 1

13. For a current flowing through an inductance L, the voltage drop across the inductance is __________.
    a) $L^2 \frac{dI}{dt}$ b) $L^2 (\frac{dI}{dt})^2$ c) $L \frac{dI}{dt}$ d) $L(d^2I/dt^2)$

14. If x is the displacement of the particle, then its acceleration is _____________.
    a) 0 b) $\frac{dx}{dt}$ c) d^2x/dt^2 d) d^2t/dx^2

15. If **r** is the position vector, curl **r** is __________.
    a) 1 b) 3 c) r d) 0

State whether the following statements are true or false:

16. The vector product of two vectors is commutative.

17. The work done by a force is a scalar product of two vectors.

18. The physical significance of curl is rotation.

19. $\frac{dy}{dx} + Py = Q$ is called a homogeneous differential equation.

20. $\beta(m,n) = \frac{1}{n}\int_0^\infty e^{-\frac{1}{n}}dy$.

Fill in the blanks;

21. If the dot product of two vectors is zero, then the vectors are ________to each other.

22. In the charge free region, the Laplace's equation is ________________.

23. A differential equation involving derivatives with respect to a single independent variable is called _______________.

24. The value of $P_0(x)$ = __________.

25. The gamma function is defined as _____________.

Answer briefly:

26. Write the expression for **a**x (**b** x **c**).

27. Define divergence of a vector function.

28. Write the equation of continuity in vector form in electromagnetism.

29. Write the Legendre's equation.

30. Find the auxiliary equation of $d^2y/dx^2 - 6(dy/dx) + 9y = 0$

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

SECTION – B

Answer any Five Questions: **5x5=25**

1. A force F = 3i+2j-4k is applied at the point (1,-1,2).Find the moment of the force about the point (2,-1,3).
2. If $A = 2xz^2\mathbf{i} - yz\mathbf{j} + 3xz^3\mathbf{k}$, find $\nabla x(\nabla x\mathbf{A})$ at the point (1,1,1).
3. Evaluate $\int \mathbf{F} . \mathbf{dr}$ where $\mathbf{F} = xy\mathbf{i} + (x^2+y^2)\mathbf{j}$ and C is the arc of the curve $y = x^2 - 4$ from (2,0) to (4,12) in the x-y plane.
4. State Gauss Divergence theorem. Apply the theorem to deduce Gauss law in differential form.
5. Show that for L-R d.c circuit, the current I flowing in the circuit is given by, $I = E/R\ (1 - e^{\frac{-Rt}{L}})$.
6. Evaluate $\int_0^\infty \sqrt[4]{x} e^{-\sqrt{x}}\ dx$.
7. Derive the relation between beta and gamma function.

SECTION – C

Answer any Three Questions: **3x15=45**

8. a) Find the angle between the surfaces $x^2+y^2+z^2 = 9$ and $x^2+y^2-z = 3$ at the point (2,-1, 2).
   b) If $\frac{d\mathbf{a}}{dt} = \mathbf{u} \times \mathbf{a}$ and $\frac{d\mathbf{b}}{dt} = \mathbf{u} \times \mathbf{b}$, **then** prove that $\frac{d(\mathbf{a}\times\mathbf{b})}{dt} = \mathbf{u} \times (\mathbf{a}\times\mathbf{b})$.
9. State and prove Stoke's theorem.
10. a) Write the Bernoulli's equation and solve $\frac{dy}{dx} + xy = x^3y^3$.
    b) Derive the equation of motion for the free oscillations of a spring.
11. a) Solve the differential equation $d^2x/dt^2 + \frac{g}{t}x = \frac{g}{l}L$
    Where g,l,L are constants subject to the conditions x = a, $\frac{dx}{dt} = 0$ at t = 0.
    b) Solve: $d^2y/dx^2 - 8(dy/dx) + 15y = 0$.
12. Find Rodrigue's formula for Legendre polynomial.

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