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

SUBJECT CODE : 11PH/MC/ME24

B.Sc. DEGREE EXAMINATION APRIL 2015
BRANCH III – PHYSICS
SECOND SEMESTER

REG. NO._____

COURSE : MAJOR – CORE
PAPER : MECHANICS
TIME : 30 MINS. **Max. Marks : 30**

SECTION – A
TO BE ANSWERED IN THE QUESTION PAPER ITSELF
ANSWER ALL THE QUESTIONS: **(30 × 1 = 30)**

I CHOOSE THE RIGHT ANSWER:

1. If an oblique collision occurs between two equal smooth perfectly elastic spheres, in which one of the sphere was initially at rest, their paths after impact would be
   a) Parallel to each other b) perpendicular to each other
   c) Opposite to each other d) go together

2. If two equally perfect elastic spheres impinge directly , then they interchange their
   a) Acceleration b) Masses c) Velocities d) momentum

3. For a particle revolving in a circular path, the acceleration of the particle is
   a) along the tangent b) along the circumference of the circle
   c) zero d) along the radius

4. A linear harmonic oscillator has a total energy of 100J, Its
   a) maximum potential energy is 50 J b) maximum kinetic energy is 100 J
   c) maximum kinetic energy is 50 J d) maximum potential energy is 75J

5. A particle executes SHM along a straight line with an amplitude ‘a’, potential energy is maximum when the displacement is
   a) $\pm a$ b) zero c) $+\frac{a}{2}$ d) $-\frac{a}{2}$

6. The particular case of forced vibration in which the frequency of the applied periodic force is equal to the natural frequency of the body itself is called
   a) resonance b) free vibration c) damped vibration d) forced vibration

7. The moment of inertia of a thin uniform rod about an axis passing through the end and perpendicular to its length is
   a) $\frac{Ml^2}{2}$ b) $\frac{Ml^2}{3}$ c) $\frac{Ml^2}{12}$ d) $\frac{Ml^2}{4}$

8. The moment of inertia of a body does not depend on
   a) the angular velocity of the body b) the mass of the body
   c) the axis of rotation of the body d) the distribution of mass in the body

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9. Moment of inertia of the rectangular lamina about an axis passing through the midpoint of one side and perpendicular to the plane
   a) $M\left(\frac{l^2}{3}+\frac{b^2}{12}\right)$ b) $M\left(\frac{l^2}{12}+\frac{b^2}{3}\right)$ c) $M\left(\frac{l^2}{12}+\frac{b^2}{12}\right)$ d) $M\left(\frac{3}{l^2}+\frac{12}{b^2}\right)$

10. The centre of gravity of a solid cone is
    a) $\frac{3}{4}h$ b) $\frac{4}{3}h$ c) $\frac{2}{3}h$ d) $\frac{1}{3}h$

11. The centre of gravity of a compound body is
    a) $\frac{W_2}{W_1+W_2}G_1G_2$ b) $\frac{W_1W2}{W_1+W_2}G_1G_2$ c) $\frac{W_1+W_2}{W_1}G_1G_2$ d) $\frac{W_2}{W_1}G_1G_2$

12. In a circus, a motor cyclist moves inside a spherical cage of radius 5m. The least velocity with which he must pass the highest point of the cage without losing contact with the surface of the cage is
    a) 6 m/s b) 5 m/s c) 7 m/s d) 9 m/s

13. The constraint on the motion of the particle in a plane radius the number of degrees of freedom by
    a) 2 b) 1 c) 3 d) zero

14. The functions and their derivatives in the transformation equations are supposed to be
    a) continuous b) finite c) infinite d) constant

15. D'Alembert's principle may be written as
    a) $(F_i - P_i)\delta r_i \quad = 0$ b) $(P_i - F_I)^{\delta r_i} = 0$
    c) $\sum_i (F_i - P_i)\delta r_i = 0$ d) $\sum_i (P_i - F_i)\delta r_i = 0$

II. STATE WHETHER TRUE OR FLASE:

16. For a circular motion, a constant force should act on the body along the radius towards the centre and perpendicular to the velocity of the body. This force is known as centrifugal force.
17. Every SHM is periodic motion but every periodic motion need not be SHM.
18. A compound pendulum is rigid mass capable of oscillating about a perpendicular axis passing through any point of mass. This point is called point of suspension.
19. The centre of gravity of a remainder is $\frac{W_2}{W-W_2}G_2G$
20. Generalized coordinates may be lengths or angles or any other set of independent quantities which define the position of the system.

III. FILL IN THE BLANKS:

21. An impulsive force is an infinitely great force acting for a very short interval of time, such that their product is _____.
22. The _____ of the forced vibration of the body depends on the difference between the natural frequency and the frequency of the applied force.
23. Moment of inertia of a thin circular ring about a tangent is _____.
24. The centre of gravity of solid hemisphere is _____.
25. Constraints are restrictions imposed on the position or motion of system, because of _____.

IV. ANSWER BRIEFLY:

26. Define coefficient of restitution.

27. Define SHM.

28. Define moment of inertia.

29. Define centre of gravity.

30. Define degrees of freedom.

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SECTION B

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

1. A ball of mass 8 kg, moving with a velocity of 10 m/s impinges directly on another mass 24 kg, moving at 2 m/s in the opposite direction. If e=0.5, find the velocities of the balls after impact.
2. Derive an expression for the total energy of a particle executing SHM.
3. The equation of a particle executing SHM is $= 5\sin\left(\pi t + \frac{\pi}{3}\right)$.
   Calculate 1) amplitude 2) Period 3) maximum Velocity
4. Obtain the expressions for the moment of inertia of a solid sphere about a diameter.
5. A solid cone and a solid hemisphere of the same material have a common base. Find the ratio of the height of the cone to the radius of the hemisphere of the centre of gravity of the combination coincides with the centre of the common base.
6. Find the acceleration of a solid cylinder rolling down an inclined plane without slipping.
7. State and explain principle of virtual work.

SECTION – C

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

8. What is impact? State the laws of Impact. Discuss the oblique impact of two smooth spheres.
9. Apply Fourier's theorem to analyze a saw-tooth wave into its harmonic components.
10. Derive an expression for acceleration due to gravity of a compound pendulum.
11. Find the position of centre of gravity in the following cases . 1) Hollow Hemisphere, 2) Solid tetrahedron
12. Derive Lagrange's equations of motion form D'Alembert's principle for a holonomic conservative system.