STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2015-16 and thereafter)

SUBJECT CODE :15PH/MC/ME34

B.Sc. DEGREE EXAMINATION NOVEMBER 2017
BRANCH III - PHYSICS
THIRD SEMESTER

COURSE : MAJOR – CORE
PAPER : MECHANICS
TIME : 3HOURS MAX. MARKS :100

SECTION – A
TO BE ANSWERED IN THE QUESTION PAPER ITSELF
ANSWER ALL QUESTIONS: (30 x 1 = 30)
I CHOOSE THE CORRECT ANSWER:

1. A ball is said to be perfectly elastic if the coefficient of restitution is
   a) < 1 b) 0 c) 1 d) >1
2. Two spheres impinge and move with velocities v_1 and v_2 after direct impact. If the two spheres are inelastic,
   a) $v_1 = v_2$ b) $v_1 > v_2$ c) $v_1 < v_2$ d) $v_1 = 2V_2$
3. If the impulse is negative, it means that its momentum is
   a))decreasing b) increasing c)positive d) negative
4. The total energy of a simple harmonic oscillator is 'E'. When the displacement is half of its amplitude, its kinetic energy will be
   a) E b) E/2 c) E/4 d) 3E/4
5. A particle executes S.H.M. Its acceleration is maximum,
   a) atthe mean position b) midway between mean & extreme positions
   c) at extreme positions d) acceleration is same at all positions
6. The differential equation of S.H.M. is given by $d^2y/dt^2 + 100y = 0$. Its frequency is
   a) 1 b) 10 c) $10/2\pi$ d) $100/2\pi$
7. The moment of inertia about the diameter of a uniform circular disc of radius 0.5 m and mass 640 kg rotating with a speed of 100 r.p.m. is
   a) 20 kg-m^2 b) 320 kg-m^2 c) 8 kg-m^2 d) 80 kg-m^2
8. In the absence of an external torque on a rotating system, _____ is conserved.
   a) momentum b) angular momentum c) energy d) none of these
9. The moment of inertia of a thin rod of mass M and length L about an axis passing through one end and perpendicular to its length is
   a) $ML^2/12$ b) $ML^2/3$ c) $ML^2/4$ d) $7ML^2/48$
10. When there is no gravitational attraction, the centre of gravity of a body
    a) is close to its midpoint b) is close to its edge
    c) can be anywhere in the body d) does not exist
11. A small part of weight 'w' having its C.G at 'G_1' is removed from a body of weight 'W' with its C.G at 'G'. The C.G of the remainder, 'G_2' is given by, CG_2 =
    a) w CG_1 /(W+w) b) w CG_1 /(W- w) c) W CG_1 /(W-w) d) (W-w)/ w CG_1
12. The location of the centre of gravity of a system of particles with different masses in a straight line is
    a) where more mass is concentrated b) where less mass is concentrated
    c) independent of mass distribution d) dependent on the total weight.
13. A system of two particles connected by a rigid rod moving freely in a plane has _____ degrees of freedom.
    a) 2 b) 3 c) 4 d) 6

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14. The constraint for a simple pendulum with a rigid support is
a) scleronomic b) non-holonomic c) dissipative d) rheonomic
15. The generalised coordinates of a system
a) need to be Cartesian coordinates b) depend on each other
c) should have the same dimension d) need not have the same dimension

II. STATE WHETHER TRUE OR FALSE:

16. During impact there is a strong tangential action between the spheres at the point of contact.
17. A critically damped oscillator is non-oscillatory.
18. Two cylinders of different densities, but of same mass and length have the same moment of inertia.
19. There may be more than one position of centre of gravity in the case of a compound body.
20. The constraint in a bead moving in a circular wire is holonomic.

III. FILL IN THE BLANKS:

21. The dimension of impulse is _____.
22. The time period of a simple harmonic oscillator is independent of its _____ .
23. The moment of inertia of a body comes into play only in _____ motion.
24. The centre of gravity of a body of uniform density coincides with its _____ .
25. The Lagrangian of a simple pendulum is _____.

IV. ANSWER BRIEFLY:

26. What is the difference between elastic and inelastic collisions?
27. Give two examples of simple harmonic motion.
28. State the theorem of perpendicular axes for a plane lamina.
29. Define Centre of gravity.
30. State the principle of virtual work.

SECTION – B

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

31. A particle of mass ‘m’ moving with a horizontal speed of 10 m/s collides with a heavy particle of mass M moving in the same direction with a speed of 6 m/s. If m<< M, then for one dimensional elastic collision, find the speed of the lighter particle after collision.

32. A body executing S.H.M. has velocities 16 cm/s and 12 cm/s when it passes through the points at 3 cm and 4 cm respectively, from the centre. Find the amplitude and the time period of motion.

33. Calculate the moment of inertia of a copper sphere of density 8.9×10^3 kg/m^3 and diameter 4.8 cm about a tangent to the sphere.

34. A solid hemisphere and a solid cone of the same material have their equal common base joined together. Find the ratio of the height of the cone to the radius of the hemisphere so that the C.G. of the combination may coincide with the centre of the common base.

35. Two masses m_1 and m_2 are connected by an inextensible string passing over a small smooth pulley. Set up the Lagrangian and the Lagrange’s equation for this system.

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36. Derive the expression for the total energy of a particle executing S.H.M. and show that it is conserved.

37. A wheel of mass 2 kg and radius 50 cm rolling on the road at 20 km/hour. What torque will have to be applied to the handle to turn it through 0.5 radian in 0.1 sec.? Consider the mass of the wheel to be concentrated at rim.

SECTION – C

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

38. Apply the laws of Impact to discuss a) the direct impact between two smooth spheres and b) impact of a smooth sphere on a smooth fixed plane.

39. Discuss the theory of forced harmonic vibrations and the phenomenon of resonance. How does sharpness of resonance depend on damping.

40. Derive an expression for the period of oscillation of a compound pendulum. Show that the centre of suspension and the centre of oscillation are interchangeable.

41. Find the centre of gravity of a) a hollow hemisphere and b) a solid tetrahedron.

42. What is D'Alembert's principle? Use it and derive Lagrange's equations of motion for a holonomic conservative system.

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