R-20

Code:1310/BL

Faculty of Science

B.Sc (Physics) I-Year, CBCS –I Semester

Backlog Examinations –June/July, 2022

PAPER: Mechanics and Oscillations

Time: 3 Hours Max Marks: 80

Section-A

I. Answer any *eight* of the following (8x4=32 Marks)

1. Show that the vector F = $(x^2-yz)\mathbf{i} + (y^2-zx)\mathbf{j} + (z^2-xy)\mathbf{k}$ is irrotational.
2. Show that $\nabla.(\nabla XA) = 0$
3. If $V=x^2z-2y^2z^2+xy^2z$, find $\nabla.V$ at the point (1,-1,1).
4. Derive the relation between angular momentum and kinetic energy.
5. State and explain the law of conservation of angular momentum.
6. Calculate the rotational kinetic energy if angular velocity is 7.29×10^{-5} rad s^{-1} and the moment of inertia is 8.04×10^{37} kgm^2.
7. What is a central force? List out its characteristics.
8. $F=(2xy+z^2)\mathbf{i}+x^2\mathbf{j}+axz\mathbf{k}$, what is the value of 'a' if F is conservative force.
9. Derive the relativistic law of addition of velocities.
10. Show that the band width is reciprocal of relaxation time of forced oscillations.
11. What are damped oscillations?
12. A particle executing simple harmonic oscillations has a maximum velocity of 0.4m/s and a maximum acceleration of $0.8m/s^2$. Calculate the amplitude and time period.

Section-B

II. Answer the following questions (4x12=48 Marks)

13. (a) State and prove Gauss divergence theorem. The surface 'S' is occupying a volume 'V', the force vector $F = 2xi + 3yj + 3zk$, prove that $\iint F.ds$ = 8V.

(OR)

(b) State and prove stokes's theorem. Evaluate $\oint_c\ yzdx + zxdy + xydz$ by stoke's theorem where c is the curve bound by $x^2 + y^2 = 1$ and $z = y^2$.

14. (a) Define elastic and inelastic collisions. Derive the equations for final velocities of particles in two-dimensional oblique elastic collision.

(OR)

(b) Derive Euler equations of motion for a rigid body rotating about a fixed point.

15. (a) State and prove Kepler's laws of planetary motion.

(OR)

(b) Explain (a) Length contraction (b) Time dilation

16. (a) What is SHM? Deduce an expression for energy for the total energy of a simple harmonic oscillator.

(OR)

(b) Obtain an expression for the amplitude of forced vibrations and deduce the conditions for resonance.

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Section-A

I. Answer any *eight* of the following questions (8x4=32 Marks)

1. Prove that Curl grad $\Phi=0$.
2. Explain the concept of scalar and vector fields.
3. If $\bar{r}$ is a position vector then prove that $\bar{\nabla}r^n=nr^{n-2}\bar{r}$.
4. State and explain the Newton's laws of motion with examples.
5. Explain the construction and working of a Gyroscope.
6. A wheel is rotating with an angular velocity of 500rev/minute on an axel. Another wheel same as the first and it is at rest is joined to the axel. Both the wheels are rotating with a common speed. Find their common speed?
7. What are the Coriolis forces? Write their consequences.
8. Derive the expression for relativistic mass.
9. A meter scale length recorded as 96 cm by an observer. Find its velocity.
10. What are Lissajou's figures? Explain with examples.
11. Explain resonance with examples.
12. A mass of 0.3Kg is tied to a spring. Its frequency is 2Hz and Q-Factor is 60. Find spring constant, damping factor and mechanical resistance.

Section-B

II. Answer the following questions (4x12=48Marks)

13.(a) State and prove Gauss divergence theorem.

(OR)

(b) Define the gradient of a scalar field and explain its physical significance.

14.(a) Explain variable mass system. Obtain rocket first and second equations of motion of rocket.

(OR)

(b) What is a symmetric top? If the axis of rotation of a symmetric top is inclined to the vertical with an angle θ, derive its precessional angular velocity.

15.(a) State Kepler's laws. Derive second and third laws of Planetary motion.

(OR)

(b) Explain Michelson-Morley experiment with proper theory.

16.(a) Obtain equation of motion of a simple oscillator. Find it's solution.

(OR)

(b) Obtain equation for Damped Harmonic Oscillator and find its solutions. Explain over damping.

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