R7682

Sub. Code
521101

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Physics

CLASSICAL MECHANICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the questions.

1. Time derivative of the total angular momentum is equal to

   (a) $rx\, F_i$

   (b) Centre of mass

   (c) sum of the external torque

   (d) multiplication of position and velocity

2. A non-holonomic constraint may be expressed in the form of

   (a) equality (b) inequality

   (c) vector (d) scalar

3. For a conservative system, the Lagrange's equation of motion is

   (a) $\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_j}\right)+\frac{\partial V}{\partial q_j}=0$ (b) $\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_j}\right)-\frac{\partial V}{\partial q_j}=0$

   (c) $\frac{\partial V}{\partial \dot{q}_J}\neq 0$ (d) $\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_J}\right)=0$

4. The Hamiltonian corresponding to the Lagrangian $L = a\dot{x}^2 + a\dot{y}^2 - kxy$ is

(a) $\frac{p_x^2}{2} + \frac{p_y^2}{2} + kxy$ (b) $\frac{p_x^2}{2a} + \frac{p_y^2}{2b} + kxy$

(c) $\frac{p_x^2}{2} - \frac{p_y^2}{2} - kxy$ (d) $\frac{p_x^2}{2a} + \frac{p_y^2}{2b}$

5. The variation of action along the actual path between given time interval is known as ———————— and its expression is

(a) Hamilton's principle, $\Delta\int_{t1}^{t2} p_k \dot{q}_k \, dt$

(b) principle of Least action, $\Delta\int_{t1}^{t2} pk\dot{q}k \, dt$

(c) Lagrange's principle, $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_J}\right) - \frac{\partial L}{\partial q_j} = 0$

(d) principle of Least action, $L = T - V$

6. The moment of inertia of uniform hemisphere about its axis of symmetry is

(a) $\frac{2}{5}MR^2\left(\text{where } M = \frac{2\pi R^3}{3}\rho\right)$

(b) $\frac{2}{5}IR^2\left(\text{where } I = Mk^2\right)$

(c) $I_x = I_y = I_z = 0$

(d) $\frac{2}{5}MR^2\left(where\, M = \frac{2^{pR^3}}{3}\right)$

7. Euler's equation of motion for a rigid body for x - component of torque is

(a) $J_x = I_1\dot{\omega} + (I_3 + I_2)\omega_2\omega_3$

(b) $J_x = I_2\dot{\omega} + (I_3 - I_2)\omega_2\omega_3$

(c) $J_x = I_1\dot{\omega} + (I_3 - I_2)\omega_2\omega_3$

(d) $J_x = I_1 + (I_3 - I_2)\omega_1\omega_2\omega_3$

8. In the inverse square law, the effective potential energy $V(r)$ is represented as

(a) $\frac{k}{r} - \frac{l^2}{2mr^2}$ (b) $\frac{k}{r} + V'(r)$

(c) $\frac{k}{r} - V'(r)$ (d) $\frac{k}{r} + \frac{l^2}{2mr^2}$

9. The number of degrees of freedom for the general motion of a rigid body is

(a) 3 (b) 6

(c) $3n - 1$ (d) $n - 3$

10. The particle is slightly displaced from the point of stable equilibrium executing small oscillations. Then the potential energy function $V(x)$ is expressed as

(a) $V(x_0) + \frac{1}{2}\left(\frac{d^2V}{dx^2}\right)_{x_0}(x - x_0)^2 + \cdots$

(b) $V(x_0) + \left(\frac{d^2V}{dx^2}\right)_{x_0}(x - x_0)^2 + \cdots$

(c) $V(x_0)(x - x_0)^1 + \frac{1}{2}\left(\frac{d^2V}{dx^2}\right)_{x_0}(x - x_0)^2 + \cdots$

(d) $V(x_0) + \frac{1}{2}\left(\frac{d^2V}{dx^2}\right)_{x_0}(x - x_0) + \cdots$

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) For N particles system, explain the mechanics of system of particles and find the total linear momentum as $P = \sum_i m_i \dot{r}_i$

Or

(b) Deduce the expression of simple harmonic motion with period T by simple pendulum.

12. (a) Obtain the condition for a canonical transformation and show that the transformation $Q = \sqrt{(2q)} e^{a} \cos p$; $P = \sqrt{(2q)} e^{-a} \sin p$ is a canonical transformation.

Or

(b) Obtain the Hamilton's equation from variational principle.

13. (a) Find the kinetic energy of a rigid body rotating about a fixed point.

Or

(b) Give a theoretical idea behind torque free motion of a rigid body. If the system is conservative, discuss the conservation of kinetic energy and conservation of angular momentum.

14. (a) Obtain the equation of the relativistic law of addition of velocities.

Or

(b) Deduce the expression of motion under inverse square force by Kepler's problem.

15. (a) Explain what are normal coordinates and normal frequencies of vibration?

Or

(b) Derive the equation of two coupled oscillator problem.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. Explain the principle of virtual work. Discuss conservation of linear and angular momentum.

17. Explain the invariance of Poisson brackets with respect to canonical transformation.

18. What is Lagrange's bracket? Discuss Lagrange bracket is invariant under canonical transformation as $\{u,v\}_{q.p} = \{u,v\}_{Q,P}$.

19. (a) Obtain the Euler's equation of motion of a rigid body.

(b) Bring the inverse transformation matrix for Eulerian second and third rotation about x_1 and z_1 axis respectively.

20. Deduce the expression of an equivalent one body problem for the conservative system of two mass points m_1 and m_2.

21. Obtain the Lorentz transformation equation. Also deduce the expression on the mass of a moving particle.

22. Find the equation of constrain by Atwood's machine and show that it is a holonomic conservative system.

23. Obtain the expression of vibrations of linear triatomic molecules.

R7683

Sub. Code
521102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022.

First Semester

Physics

MATHEMATICAL PHYSICS – I

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the questions.

1. Grad $\left(\frac{1}{r}\right)$ is equal to

   (a) $-\frac{1}{r^3}$ (b) $-\frac{r}{r^3}$

   (c) $-\frac{r}{r^2}$ (d) $-\frac{3r}{r^3}$

2. $\oint_C (Mdx + Ndy)$ is equal to

   (a) $\iint_S \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dx\, dy$

   (b) $\iint_S \left(\frac{\partial N}{\partial x} + \frac{\partial M}{\partial y}\right) dx\, dy$

   (c) $\iint_0^\pi \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dx\, dy$

   (d) $\iint_{-\pi}^\pi \left(\frac{\partial M}{\partial x} - \frac{\partial N}{\partial y}\right) dx\, dy$

3. Inverse of the matrix $A = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$ is

(a) $\begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$

(b) $\frac{1}{2}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

(c) $2\begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$

(d) $\frac{1}{2}\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$

4. The eigen value of the given matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$.

(a) 7, 1 (b) 5, 2

(c) 1, 6 (d) 3, 2

5. The metric tensor of spherical coordinate is given as

(a) $ds^2 = dr^2 + d\theta^2 + r^2 \sin^2 \theta \, d\phi^2$

(b) $ds^2 = dr^2 + r^2 d\theta^2 + r^2 \sin^2 \theta \, d\phi^2$

(c) $ds^2 = dr^2 + r^2 d\theta^2 + r^2 \cos^2 \theta \, d\phi^2$

(d) $ds^2 = dr^2 + r^2 d\theta^2 + \sin^2 \theta \, d\phi^2$

6. If $g_{\mu\nu} = 0$ for $\mu \neq \nu$ and μ, ν, σ are unequal indices, then which of the following vanishes.

(a) $\Gamma^{\mu}_{\nu\sigma}$ (b) $\Gamma_{\mu,\,\mu\nu}$

(c) $\Gamma^{\sigma}_{\nu\sigma}\sigma$ (d) $\Gamma^{\sigma}_{\nu\sigma}$

7. If mean of Poisson's distribution is 5, then the standard deviation is

(a) $\sqrt{5}$ (b) $\sqrt{5/n}$

(c) 5 (d) $5/n$

8. The binomial expansion of $(p+q)^n$ is given by

$(p+q)^n = q^n + c_1^n q^{n-1} + c_2^n q^{n-2} p^2 + ... + c_r^n q^{n-r} p^r + ... + p^n$, the mean binomial distribution is

(a) np (b) n/p

(c) np^{n-1} (d) p^{n-1}

9. Laplace tranform of the function $F(t) = \dfrac{e^{at} - 1}{a}$.

(a) $\dfrac{1}{(s-a)}$ (b) $\dfrac{1}{a}$

(c) $\dfrac{1}{s(s-a)}$ (d) $\dfrac{a}{s(s-a)}$

10. Laplace transform of $\sinh at$ is

(a) $\dfrac{a}{s^2 - a^2}; s > a$ (b) $\dfrac{1}{s^2 - a^2}; s < a$

(c) $\dfrac{a}{s^2 - 1}; s > a$ (d) $\dfrac{1}{s^2 - a^2}; s = a$

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11\. (a) Solve $curl\left(\frac{k}{r}\right) = \frac{-iy + jx}{r^3}$.

Or

(b) Obtain the function of $\nabla\varphi$ and $\nabla^2\varphi$ in cylindrical coordinate system.

12\. (a) Show that every square matrix can be uniquely expressed as the sum of Hermitian and Skew-Hermitian matrix.

Or

(b) Determine the eigen value of a matrix $A = \begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$.

13\. (a) Obtain Christoffel's 3 – index symbols.

Or

(b) What is an invariant tensor? Deduce the generalized Kronecker Delta symbol.

14\. (a) Write the basic concept of probability and explain the addition law of probability and multiplication law of probability.

Or

(b) What is random variable? Elucidate the discrete random variable and continuous random variable.

15. (a) Write the parseval's properties of Fourier's transform.

Or

(b) Use convolution theorem, find the Laplace transform of $\frac{1}{(s+a)(s+b)}$.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. (a) State and prove Gauss divergent theorem.

(b) Evaluate $\iiint_V \left(x^2 + y^2 + z^2\right) dx\, dy\, dz$, where v is sphere having centre at origin and radius equal to a.

17. Verify the Cayley – Hamilton theorem of the matrix $A = \begin{bmatrix} 1 & -1 & 0 \\ -1 & 0 & 2 \\ -2 & 1 & 1 \end{bmatrix}$ and hence find the inverse of it.

18. Find the adjoint and inverse of the matrix $A = \begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 2 \\ 3 & 1 & 2 \end{bmatrix}$.

19. Obtain the expression of Laplacian in terms of orthogonal curvilinear coordinate system.

20. Discuss the antisymmetric tensors with respect to two indices.

21. State and deduce the expression of Gauss's normal distribution.

22. Deduce the expression of Fourier integral as $f(x) = \frac{1}{n}\int_0^{\infty} du \int_{-\infty}^{\infty} f(x) \cos u(x-t)\, dt$.

23. (a) Obtain the expression of Faltung theorem.

(b) Find the inverse Laplace transform of $\frac{1}{\sqrt{2s+5}}$.

R7684

Sub. Code
521103

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Physics

ELECTRONICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A ($10 \times 1 = 10$)

Answer **all** questions.

1. LED are manufactured using ________ and _______ in colour.

   (a) silicon, blue

   (b) germanium, green

   (c) gallium arsenide, red

   (d) yttrium, aluminium, granite and blue

2. The breakdown mechanism in a lightly doped PN junction under reverse bias condition is

   (a) avalanche breakdown

   (b) zener breakdown

   (c) knee voltage

   (d) saturated region

3. Consider a transistor circuit is in voltage divider biasing. If $R_1 = 10\,\Omega, R_2 = 5\,\Omega,\ V_{cc} = 15\,V, R_e = 10\,K\,\Omega$, then I_E is equal to

(a) 0.5 mA (b) 2.5 mA

(c) 10 mA (d) 5 mA

4. CB configuration is rarely employed for audio frequency circuits because, its

(a) impedance matching is good

(b) current gain is infinite

(c) current gain is 500

(d) current gain is less than unity

5. Differential amplifier essentially consists of

(a) two input and two output terminals

(b) one input and two output terminals

(c) two input and one output terminals

(d) one input and one output terminals

6. Op amp is classified as

(a) push pull amplifier

(b) linear amplifier

(c) class A amplifier

(d) audio amplifier

7. The flip flop has two possible states so an array of n flip flops has 2n states and counts from

(a) 0 to 2n -1 numbers in binary form

(b) 0 to 2^n -1 numbers in binary form

(c) 0 to n-1 numbers in binary form

(d) 0 to n^2-1 numbers in binary form

8. ROM is ———— and used for ————

(a) non-volatile, temporary storage

(b) R/W memory, permanent storage

(c) non-volatile, permanent storage

(d) read only memory, accumulator

9. The change in output voltage corresponding to change of 1 bit in the digital input is known as

(a) ADC

(b) comparator

(c) resolution for a DAC

(d) time division multiplexing

10. In successive approximation ADC can be employed to conversion speeds of upto about

(a) 1,00,000 samples/second

(b) 1,000 samples/second

(c) 1 sample/second

(d) nano seconds

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Discuss the construction mid working zener diode in forward and reverse bias conditions.

Or

(b) What is Schottky diode? Explain its operation with its circuit.

12. (a) Explain how a transistor is working as an amplifier.

Or

(b) Describe the working DIAC with its characteristics.

13. (a) Construct the circuit and explain the generation of triangular wave using op amp.

Or

(b) Discuss the working of sample and hold circuit using op amp.

14. (a) What is a flip flop? Explain the principle of operation of S-R flip flop with truth table.

Or

(b) Explain the detailed information of static RAM and dynamic RAM.

15. (a) Draw the voltage to frequency A/D conversion circuit. Describe its operation.

Or

(b) Sketch the DAC by weighted resistor method. Discuss its working function.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. Describe the operation of Laser diode. Explain its characteristics and applications.

17. Explain the construction and working of push pull amplifier. Mention its advantages.

18. (a) Explain the working of NPN transistor with neat diagram.

(b) Define Q – point. Discuss how to draw a DC load line graph of a transistor operation.

19. Explain the working of (i) integrator and differentiator circuit with suitable diagram using op amp.

20. (a) Sketch the circuit and explain the operation of instrumentation amplifier.

(b) Find the input impedance of an op amp for the given data:

$$V_1 = V_2 = V_{in} = V_{out} \frac{R_1}{R_1 + R_2} ;\ I_{in} = \frac{-V_{in}}{R + jwL}$$

21. Sketch and describe the working of Master Slave flip flop with neat circuit.

22. Explain the operation of four stage ring counter using J-K flip flop.

23. Sketch the block diagram of successive approximation ADC and briefly explain the working of individual blocks.

R7685

Sub. Code
521501

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Physics

NUMERICAL ANALYSIS AND C-PROGRAMMING

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the questions.

1. The principle of least square does not suggest to determine the form of the curve $y = f(x)$, but it determines the

   (a) coefficient of the equation

   (b) solution of the equation

   (c) parameters of the equation of the curve

   (d) limits in the curve

2. The bisection method is used to find the roots of

   (a) transcendental equation

   (b) algebraic equation

   (c) differential equation

   (d) logarithmic equation

3. Using the method of proportional parts, find y at $x = 0.5$ for the given value.

x:	0	1	2	5
y:	2	3	12	147

(a) 5 (b) 5.5

(c) 3 (d) 2.5

4. The correct formula related to divided difference is

(a) $cf(x) = c\left[\frac{f(x_1) - f(x_0)}{x_1 - x_0}\right]$

(b) $cf(x) = c\left[\frac{f(x_1) + f(x_0)}{x_1 + x_0}\right]$

(c) $f(x) = \left[\frac{f(x_1) - f(x_0)}{x_1 - x_0}\right]$

(d) $f(x) = f(x_1) - f(x_0)$

5. The error in the Trapezoidal is the order of

(a) h^3 (b) h

(c) h^2 (d) $1/h$

6. The Simpson's rule gives exact result, if the entire curve $y = f(x)$ is itself a

(a) curved path

(b) parabola

(c) straight line

(d) integral function

7. Find the solution of $x - 4y = -2$; $3x + y = 7$, using Jordan method.

(a) $x = -1, y = 2$

(b) $x = 1, y = 2$

(c) $x = -1, y = 3$

(d) $x = 1, y = -2$

8. The convergence in the Gauss — Seidel method is ———— as fast as in Jacobi's method.

(a) thrice (b) twice

(c) four times (d) mega times

9. In C programming, ———— type of operators has the highest precedence.

(a) relational operator

(b) equality operator

(c) arithmetic operator

(d) logical operator

10. An array is a data structure in which

(a) more than one value can be stored in a single data name

(b) less than three value can be stored in a single data name

(c) more than one value can he stored in a multiple data name

(d) the data is executed in multiple name

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Solve the given equation by Regula Falsi method $f(x) = x - \cos x$.

Or

(b) Describe how Horner's rule applies to solve polynomial equations?

12. (a) Explain the following properties of divided difference.

(i) The value of any divided difference is independent of the order of the arguments.

(ii) The operator $\Delta\!\!\!\!|$ is linear.

Or

(b) Using Lagrange's formula of interpolation, find $y(9)$ given

x:	7	8	9	10
y:	3	1	1	9

13. (a) Evaluate $\int_0^6 \frac{dx}{1 + x^2}$ by Simpson's rule.

Or

(b) Deduce the expression of Newton-Cote's quadrature formula.

14. (a) Solve the equations by Gauss-Jacobi's method.

$8x + y + z = 8;\ 2x + 4y + x = 4;\ x + 3y + 3z = 5.$

Or

(b) Solve the system of equations by Gauss — Seidel method.

$10x - 5y - 2z = 3$; $4x - 10y + 3z = -3$;
$x + 6y + 10z = -3$

15. (a) Explain the term: arrays and strings.

Or

(b) Give a brief explanation on structures and unions.

Part C $(5 \times 8 = 40)$

Answer any **five** questions.

16. Fit a parabola of the pattern $y = ax^2 + bx + c$ to the given data.

x:	1	2	3	4	5
y:	10	12	8	10	14

17. Using Newton's divided difference formula, find the values of $f(2)$ and $f(4)$ for the given data.

x:	4	5	7	10	11	13
y:	48	100	294	900	1210	2028

18. Using Taylor series, find the four decimal value of $y(0.1)$, given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$.

19. Using Gauss elimination method, find the inverse of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$.

20. What are the different types of operator in C — programming? Describe (a) arithmetic (b) logical and (c) conditional operators.

21. Find the positive root of $x^3 - 6x + 4 = 0$ correct to four decimal places by Newton Raphson's method.

22. Solve the given equation by triangularization method.

$x + 5y + z = 14$; $2x + y + 3z = 13$; $3x + y + 4z = 17$

23. Solve by Euler's method, $y' = -y$ given $y(0) = 1$ and find $y(0.04)$.
