Reg. No. | | | | | | | | | |

BSCPHCN 101

First Semester B.Sc. Degree Examination, February/March 2023
(NEP 2020) (2021-22 Batch Onwards)
PHYSICS (DSCC)
Mechanics and Properties of Matter

Time : 2 Hours Max. Marks : 60

Instructions *: 1) Answer questions from* ***all*** *Parts.*
2) ***Scientific*** *calculators are* ***allowed****.*

PART – A

Answer **any four** questions. **Each** question carries **2** marks. **(2×4=8)**

1. Give the significance of null result in Michelson's experiment.
2. Distinguish between inertial and non-inertial frames of reference.
3. Define radius of gyration. On what factors does it depend ?
4. Define Young's modulus. Mention the general expression for the same.
5. Define Poisson's ratio and write its practical limits.
6. Why are rain drops spherical ?

PART – B

Answer **all** questions. **(10×4=40)**

Unit – I

7. a) Obtain the derivative of a planar vector of constant magnitude but changing direction. **4**

   b) Obtain the relativistic velocity addition formula using Lorentz transformation equations. Show that when v<< c, relativistic addition of velocity reduces to classical addition of velocities. **6**

OR

8. a) State and explain Galilean principle of relativity. 4

   b) Using Einstein's photon gun thought experiment derive the relation for mass energy equivalence. 6

Unit – II

9. a) State and prove the theorem of parallel axis of moment of inertia. 4

   b) Obtain the expression for the period of vertical oscillations of a loaded spring in terms of force constant. 6

OR

10. a) Show that areal velocity is constant in central force field. 4

    b) Find the MI of a circular disc about an axis passing through its centre and perpendicular to its plane. Also find the MI of the disc about its diameter. 6

Unit – III

11. a) Derive the expression for work done in twisting a wire. 4

    b) Derive the relation connecting three elastic constants. 6

OR

12. a) Obtain the expression for bulk modulus in terms of α and β. 4

    b) Derive an expression for the depression of a light cantilever. 6

Unit – IV

13. a) Obtain the expression for surface tension in terms of surface energy. 4

    b) With theory, explain how co-efficient of viscosity can be found by Stoke's method. 6

OR

14. a) Obtain the expression for critical velocity of a fluid. 4

    b) Define surface tension. Obtain the expression for the surface tension by drop weight method. 6

PART – C

15. Answer **any three** questions. **Each** question carries **4** marks. **(4×3=12)**

a) A rocket is designed to attain a maximum speed of 4.6 km/s. Mass of the rocket without fuel is 100 kg. What should be the mass of the fuel ? Given velocity of the escaping gas = 2 km/s.

b) A uniform rectangular plate has mass 1.2 Kg, length 15 cm and breadth 10 cm. Calculate MI about an axis passing through (i) its centre of gravity and perpendicular to the plane (ii) it's one end along the breadth.

c) What is the force required to stretch a steel wire 0.5 sq.cm in cross section to double its length ? Given Young's modulus 2×10^{11} N/m^2.

d) What amount of energy will be liberated if 1000 droplets of water each of diameter 10^{-8} m coalesce to form large spherical drop ? Given : Surface tension of water = 0.075 Nm^{-1}.

Reg. No. | | | | | | | | |

BSCMTCN 101

I Semester B.Sc. Degree Examination, February/March 2023
(NEP 2020) (2021-22 Batch Onwards)
MATHEMATICS
Number Theory – I, Algebra – I and Calculus – I (DSCC)

Time : 2 Hours Max. Marks : 60

Instructions : 1) *Answer **any ten** questions from Part – **A**. **Each** question carries **2** marks.*
2) *Answers to Part – **A** should be written in the **first few** pages of the answer book **before** answers to Part – **B**.*
3) *Answer **any eight** questions from Part – **B**, choosing **two** questions form **each** Unit. **Each** question carries **5** marks.*
4) ***Use** of scientific calculator is **permitted**.*

PART – A **(10×2=20)**

1. Show that square of any odd integer is of the form 8k + 1.
2. Find the remainder when 1! + 2! + 3! + 4! + ... + 100! is divided by 12.
3. Check whether the linear congruence $25x \equiv 15 \pmod{29}$ is solvable.
4. Without performing the division, determine whether the integers 176521221 are divisible by 9 or 11.
5. Show that the matrix $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is an orthogonal matrix.
6. Find the conjugate transpose of $A = \begin{bmatrix} 1+2i & 2-3i & 3+4i \\ 4-5i & 5+6i & 6-7i \\ 8 & 7+8i & 7 \end{bmatrix}$.
7. Under what condition, a system AX = B of m linear equations in n unknowns :
   a) has a unique solution b) has infinitely many solutions.
8. Find the characteristic polynomial of the matrix $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$.

P.T.O.

9. Convert $x^3 + y^3 = 3axy$ into polar form.
10. Show that the radius vector is inclined at a constant angle to the tangent at any point on the equiangular spiral $r = ae^{b\theta}$.
11. Find $\frac{ds}{dx}$ for the curve $y = a \cosh\frac{x}{a}$.
12. State Lagrange's mean value theorem.
13. Expand e^x using Maclaurin's theorem.
14. Determine $\lim_{x \to a}(x-a)^{x-a}$.

PART – B **(8×5=40)**

Unit – I

15. For positive integers a and b prove that gcd (a, b). lcm (a, b) = ab.
16. Determine all solutions of the Diophantine equation 56x + 72y = 40.
17. A customer bought a dozen pieces of fruit, apples and oranges for $1.32. If an apple cost 3 cents more than an orange and more apples than oranges were purchased. How many pieces of each kind were bought ?
18. Solve $18x \equiv 30 \pmod{42}$.

Unit – II

19. Show that every square matrix A can be expressed uniquely as a sum of a symmetric matrix B and a skew symmetric matrix C.
20. Using elementary transformation, find the rank of the matrix.

$$\begin{bmatrix} 1 & 3 & 4 & 5 \\ 3 & 9 & 12 & 3 \\ 1 & 3 & 4 & 1 \end{bmatrix}$$

21. Solve the system of equations $x_1 - x_2 + x_3 = 0$, $x_1 + 2x_2 + x_3 = 0$ and $2x_1 + x_2 + 3x_3 = 0$.
22. Using the characteristic equation of $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$ find A^{-1}.

Unit – III

23. Find the Pedal equation of the Parabola $y^2 = 4a(x + a)$.

24. Find the perpendicular length from the pole on the tangent to the curve $r(\theta - 1) = a\theta^2$.

25. Prove that the radius of curvature at any point on the curves $x = a \sec t$, $y = b \tan t$.

26. Trace the Polar curve of the equation $r = 1 - \sin\theta$.

Unit – IV

27. i) Evaluate $\lim_{x \to 1} \frac{1 + \log x - x}{1 - 2x + x^2}$.

    ii) Determine $\lim_{x \to 0} x \log x$.

28. Find 'c' satisfying Lagrange's theorem for the function $f(x) = (x - 1)(x - 2)(x - 3)$, $x \in [0, 4]$.

29. State and prove Cauchy's mean value theorem.

30. Use Maclaurin's theorem, show that

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots\ldots\ldots + \frac{(-1)^{2n} x^{2n}}{2n!} + \frac{(-1)^{n+1} x^{2n+1}}{(2n+1)!} \cos\theta x, \forall x \in R.$$