# UG (CBCS) Even Semester Examination, May 2025

## EDUCATION
## (B.Sc. B.Ed.)

6th Semester

**Course No. : BSPH - 601**

( Theory of Relativity, Computational Physics & Mathematical Physics II )

Full Marks : 50

Pass Marks : 20

Time : 2 hours

*The figures in the margin indicate full marks for the questions*

1. (a) Derive the Lorentz transformation equations. 8

   (b) Deduce Galilean transformation equations from Lorentz transformation equations when $v \ll c$. 2

Or

2. (a) Derive the energy-momentum relation: 6

   $E = \sqrt{p^2c^2 + m_0{}^2c^4}$

   (b) With what velocity a proton should move to increase mass by 50% of its rest mass? 4

3. (a) A function $f(x)$ is defined by $f(x) = 0$ if $x \leq 0$ or $x \geq 1$ and $f(x) = \dfrac{1}{2\sqrt{x}}$ for $0<x<1$. Check that the function $f(x)$ satisfies the two properties of a probability density function. 7

( Turn Over )

(b) A ball is drawn at random from a box containing 6 red balls, 4 white balls, and 5 blue balls. Determine the probability that it is (a) red, (b) white, (c) blue, (d) not red, (e) red or white. 3

Or

4. (a) Find the constant $c$ such that the function $f(x) = \begin{cases} cx^2, & if\ 0 < x < 3 \\ 0, & otherwise \end{cases}$ is a probability density function. Also compute P(1<x<2) 7

(b) Find the maximum relative error in the measurement of acceleration due to gravity usign Katter's pendulum. 3

5. (a) Derive the Newton-Raphson method for finding the solution of $f(x) = 0$ 4

(b) Show that the Newton-Raphson method produces quadratically convergent approximation. 3

(c) Solve $x^2 - 5 = 0$ upto 4th iteration using Newton-Raphson method by choosing $x_0 = 1$ 3

Or

6. (a) Derive trapezoidal rule for numerical integration. 5

(b) Aeroplane of m = 97000 kg lands at a speed of 93 m/s and applies it brakes at t = 0. The force of brake is $F = -5v^2 - 570000$. Use trapezoidal rule of numerical integration to determine how far it travels before its speed is reduced to 40m/s. 5



7. (a) Write an algorithm to find the sum of a series 1+3+5+ .....+N, where N is a positive odd integer. Also draw its corresponding flowchart. 5

(b) Write an algorithm to find the sum of a series 1+2+3+ ......... +N. Also draw its corresponding flowchart. 5

Or

8. (a) What is an and florchart? 2

(b) Write an algorithm to find the solutions of a quadratic equation $ax^2 + bx + c = 0$. Also draw its corresponding flowchart. 8

9. Solve the Legendre's equation using a series solution method. 10

$$(1 - x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + n(n+1)y = 0$$

Or

10. Solve the Bessel's equation using a series solution method 10

$$\frac{d^2y}{dx^2} + \frac{1}{x}\frac{dy}{dx} + \left(1 - \frac{n^2}{x^2}\right)y = 0$$

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