REV-01
BSP/10/15

2023/06

SET A

B.Sc. PHYSICS
SECOND SEMESTER
MATHEMATICAL PHYSICS-I
BSP – 202

[USE OMR FOR OBJECTIVE PART]

Duration: 1:30 hrs. Full Marks: 35

Objective

Time: 15 mins. Marks: 10

Choose the correct answer from the following: *1×10=10*

1. The order of the following matrix $\begin{pmatrix} 1 & 0 & -1 \\ 2 & 1 & 3 \end{pmatrix}$ will be
   a. 3×2 b. 2×3
   c. 3×1 d. 1×2

2. For what value of x the matrices $\begin{pmatrix} -2 & 4 \\ 6 & x+1 \end{pmatrix} = 2\begin{pmatrix} -1 & 2 \\ 3 & 1 \end{pmatrix}$ are equal?
   a. 1 b. 2
   c. 3 d. 4

3. For what values of x the Legendre polynomial $p_2(x)$ will be zero?
   a. $\pm\frac{1}{2}$ b. $\pm\frac{1}{\sqrt{2}}$
   c. $\pm\frac{1}{\sqrt{3}}$ d. $\pm\frac{1}{3}$

4. The value of $p_1(-1)$ will be
   a. 0 b. 1
   c. -1 d. 2

5. The value of $\int_{-1}^{1}[p_1(x)]^2\,dx$ will be
   a. $\frac{1}{3}$ b. $\frac{2}{3}$
   c. $\frac{1}{2}$ d. 1

6. The partial differential equation form by $y(x) = a\,x$ is?
   a. $x = y\frac{dy}{dx}$ b. $y = x\frac{dy}{dx}$
   c. $x = a\frac{dy}{dx}$ d. $y = a\frac{dy}{dx}$

7. The order of the partial differential equation $x^2\frac{dy}{dx} + \frac{dy^2}{dx^2} + x\left(\frac{dy}{dx}\right)^2 = 0$ is
   a. 1 b. 0
   c. 3 d. 2

8. The Legendre polynomial $p_n(-x)$ is
   a. $p_n(x)$ b. $-p_n(x)$
   c. $(-1)^n\,p_n(x)$ d. $(-1)^{n+1}\,p_n(x)$

9. If $A = \begin{pmatrix} 0 & -1 \\ 2 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & -1 \\ 2 & 0 \end{pmatrix}$ then $(A - B)$ will be

a. $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

b. $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

c. $\begin{pmatrix} -1 & -2 \\ 4 & 1 \end{pmatrix}$

d. $\begin{pmatrix} -1 & 1 \\ 4 & 1 \end{pmatrix}$

10. If trace of a matrix A is 2, then the trace of the matrix 2A will be

a. 2

b. 3

c. 4

d. 1

Descriptive

Time : 1 hr. 15 mins. Marks: 25

[Answer question no.1 & any two (2) from the rest]

1. Construct a second-order partial differential equation of the following: $y = A\, e^{c\,p\,t} \sin(px)$. 5

2. a. If $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $A = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$ and show that $(a\,I + b\,A)^3 = a^3 I + 3\,a^2 b\,A$ 6+4=10

   b. If $A = \begin{pmatrix} 3 & -4 \\ 1 & -1 \end{pmatrix}$ then show that $A^k = \begin{pmatrix} 1+2k & -4k \\ k & 1-2k \end{pmatrix}$

3. a. Show that $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$ 6+4=10

   b. Evaluate $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix}$, where ω is the cube root of unity.

4. a. Solve the following equations using inverse matrix method: 6+4=10

   $x + 2y = 3; \quad 3\,x + 2y = 5$

   b. Show that $y = e^{-3x}$ is a solution of the following differential equation:

   $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0.$

5. a. If $p_n(x)$ is the Legendre polynomial of order n then find an expression of $p_3(x)$ and the value of $p_3(-1)$. 4+2+4 =10

   b. Express the polynomial function $f(x) = (1 + 2x + 3x^2)$ into the Legendre polynomials $p_n(x)$.

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