



বিদ্যাসাগর বিশ্ববিদ্যালয়

VIDYASAGAR UNIVERSITY

B.Sc. Honours Examination 2021

(CBCS)

1st Semester

PHYSICS

PAPER—C1T & C1P

MATHEMATICAL PHYSICS

Full Marks : 60

Time : 3 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

THEORY : C1T

Group - A

Answer any *three* questions.

3×12

1. (a) If $A = 4i - j + 3k$ and $B = -2i + j - 2k$, find a unit vector perpendicular to both A and B .

(b) Evaluate $\iint_S A \cdot n \, ds$ for the vector $A = zi + xj - 3y^2zk$ and S is the surface of the cylinder $x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$.

(c) Solve $(D^2 - 4D + 3)y = 2xe^{3x}$. 2+4+6

2. (a) Solve: $(D^2 + 9)y = \sec 3x$.

(b) The probability that a pen manufactured by a company will be defective is $1/10$. If 12 such pens are manufactured, find the probability that (i) exactly two will be defective, (ii) at least 2 will be defective, (iii) none will be defective.

(c) Use Stokes' theorem to evaluate the integral: $\oint_C (ydx + zdy + xdz)$, where C is the curve of intersection of $x^2 + y^2 + z^2 = a^2$ and $x + z = a$. 4+3+5

3. (a) Find a unit vector parallel to the xy plane and perpendicular to the vector $4i - 3j + k$.

(b) Find the expressions for the surface and volume elements in cylindrical polar coordinate.

(c) Motion of a particle is determined by the equation

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 8x = 20 \cos 2t$$

The particle starts from rest at $x = 0$. Find $x(t)$. 2+4+6

4. (a) Solve $\frac{dy}{dx} = \frac{\tan y}{1+x} + (1+x)e^x \sec y$.

(b) Using Poisson's distribution calculate the probability that ace of spades will be drawn from a pack of well shuffled cards at least once in 104 consecutive trials.

(c) Verify divergence theorem for the vector $A = 4xi - 2y^2j + z^2k$ over the region bounded by $x^2 + y^2 = 4$, $z = 0$, $z = 3$. 4+3+5

5. (a) Show that the $\lim_{a \rightarrow \infty} \frac{a}{\sqrt{\pi}} e^{-a^2 x^2}$ is a Dirac-Delta function.

(b) Verify Green's theorem in the plane for $\int_C [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$, where, C is the boundary of the region defined by $y = \sqrt{x}$, $y = x^2$.

(c) (i) In what direction from the point $(2,1,-1)$ is the directional derivative of $\Phi = xyz^3$ a maximum?

(ii) What is the magnitude of this maximum? 2+6+4

6. (a) In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and the standard deviation of the distribution.

(b) Find the expression for $\nabla \cdot A$ in spherical polar coordinate.

(c) Solve : $\frac{dy}{dx} = \frac{7y - 3x - 7}{-3y + 7x + 3}$. 3+4+5

Group - B

Answer any *two* questions. 2×2

7. Give the physical significance of the Curl of a vector.

8. Evaluate : $\int_0^{\infty} e^{-3t} \delta(t-4) dt$.

9. Solve : $\frac{dy}{dx} = -2xy$, $y(0)=1.5$.

10. Calculate the probability of obtaining 4 heads in six tosses, using an unbiased coin.

PRACTICAL : C1P

Answer any *one* question.

1×15

1. (a) Write a Python program to calculate the volume of a sphere.
 (b) Write a Python program to print all Prime numbers in the interval [2 - 20].
 (c) Given some data: $x = 92, 100, 75, 57, 48, 68, 77, 65, 81, 71$. Write a Python program to find the (arithmetic) mean and r.m.s. value of the variable x . 3+6+6

2. (a) Write a Python program to compute $(n+1)!$ where $n = 13$.
 (b) Write a Python program to find the sum of the series (till the 25th term) :

$$\frac{1}{1!} + \frac{2}{2!} + \frac{3}{3!} + \frac{4}{4!} + \dots$$

- (c) Write a Python program to compute the sum of the digits 970315.

4+6+5

3. (a) Write a Python program to evaluate the integral $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's 1/3 rule.

(b) Write a Python program to find the largest number in given list [20, 10, 45, 4, 99].

(c) Write a Python program to compute: $\binom{N}{n} = \frac{N!}{n!(N-n)!}$ for $N = 10$ and $n = 7$. 7+3+5

Answer any *one* question. 1×5

4. What are the common built-in data types in Python?

5. What is the difference between arrays and lists in Python?

6. LNB / Viva-voce.
