B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

PRE BOARD 3 (2025-26)
APPLIED MATHEMATICS(241)

Class: XII | **Time: 3hrs**
Date: 17-01-26 | **Max Marks: 80**
Admission no: | **Roll no:**

General Instructions

1. **This question paper contains 38 questions. All questions are compulsory.**
2. **This question paper is divided into FIVE Sections – A, B, C, D and E.**
3. **In Section A, Question number 1 to 18 are Multiple Choice Questions (MCQs) and Question number 19 and 20 are Assertion-Reason based questions of 1 mark each.**
4. **In Section B, Question number 21 to 25 are Very Short Answer (VSA) type questions carrying 2 marks each.**
5. **In Section C, Question number 26 to 31 are Short Answer (SA) type questions carrying 3 marks each.**
6. **In Section D, Question number 32 to 35 are Long Answer (LA) type questions carrying 5 marks each.**
7. **In Section E, Question number 36 to 38 are Case Study Based questions carrying 4 marks each.**
8. **There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and one sub-part each in 2 questions in Section E.**
9. **Use of calculator is NOT allowed.**

SECTION A

Multiple Choice Questions (1 Mark Each)

1. The value of (486 + 729) mod 12 is
(a) 4
(b) 2
(c) 3
(d) 1

2. A 95% confidence interval for a population was reported to be 152 to 160. If σ = 15 then sample size is
(a) 60
(b) 54
(c) 72
(d) 58

3. A printing machine costing ₹ 50000 has a useful life of 4 yr. If the estimated scrap value is ₹ 10000 then the annual depreciation is
(a) ₹ 2500
(b) ₹ 10000
(c) ₹ 7500
(d) ₹ 1000

4. Two pipes A and B can fill a tank in 18 h and 12 h, respectively. If both pipes are opened simultaneously then the time taken to fill the tank is
(a) 6 h
(b) $7\frac{1}{5}$h
(c) 7 h
(d) $6\frac{1}{5}$h

5. The order and the degree of the differential equation
$\frac{d^3y}{dx^3} + x^2\left(\frac{d^2y}{dx^2}\right)^3 = 0$**respectively are**
(a) 2, 1
(b) 2, 2
(c) 3, 1
(d) 1, 3

6. The total revenue (in ₹) received from the sale of x units of a product is given by
$R(x) = 3x^2 + 6x + 5$**.**
The marginal revenue, when x = 5 is
(a) ₹ 36
(b) ₹ 35
(c) ₹ 34
(d) ₹ 33

7. The feasible region for an LPP is shown in the given figure.
Diagram description:
A coordinate plane is shown with feasible region in blue (a triangle-like shaded region). The constraints include two slant lines meeting and forming a polygon bound in the first quadrant. Axes marked X and Y.
Then, the minimum value of
Z = 11x + 7y is
(a) 21
(b) 47
(c) 20
(d) 31

8. If X has a Poisson variable such that
P(X = 1) = 2 P(X = 2) then P(X = 0) is
(a) e
(b) e^{-1}
(c) 1
(d) e^2

9. A person has set up a sinking fund in order to have ₹ 100000 after 10 yr for his children's college education. How much amount should be set aside bi-annually into an account paying 5% per annum compounded half-yearly?

$$(1.025)^{20} = 16386$$

(a) ₹ 3914.81
(b) ₹ 2914.81
(c) ₹ 3614.81
(d) ₹ 3814.81

10. A random variable X has the following probability distribution:

X	1	2	3	4
P(X)	k	2k	3k	4k

Then, the mean of X is
(a) 3
(b) 1
(c) 4

(d) 2

11. Ravi can row upstream 8 km/h and downstream 16 km/h. The rate of current is
(a) 2 km/h
(b) 3 km/h
(c) 4 km/h
(d) 5 km/h

12. Assume an investment's starting value is ₹ 50000 and it grows to ₹ 100000 in 4 years. Find compound annual growth rate.
Given $(2)^{1/4} = 1.189$
(a) 17.1%
(b) 8.6%
(c) 18.9%
(d) 15.5%

13. If 3x + 2y = sin x then $\frac{dy}{dx}$ is equal to
(a) $\frac{\cos x+3}{2}$
(b) $\frac{\cos x-3}{2}$
(c) $\frac{\cos x+2}{3}$
(d) $\frac{\cos x-2}{3}$

14. ***Match the following columns to complete the sentence and choose the correct option.***

Column 1	Column 2	Column 3
I. The critical region	A. is a probability that provides a measure	i. for which we reject the null hypothesis.
II. The level of significance	B. is the values of the test statistics	ii. of Type-I error.
III. The P-value	C. is the probability	iii. of the evidence against the null hypothesis provided by the sample.

Options:
(a) I – A – iii; II – C – ii; III – B – i
(b) I – C – ii; II – B – i; III – A – iii
(c) I – B – ii; II – C – iii; III – A – i
(d) I – A – ii; II – B – iii; III – C – i

15. The present value of a perpetuity of ₹ 1800 payable at the end of each year, when money worth 12% per annum is
(a) ₹ 14000
(b) ₹ 18000
(c) ₹ 15000
(d) ₹ 12000

16. For a random variable X, E(X) = 3 and E(X²) = 11 then variance of X is
(a) 8
(b) 5
(c) 2
(d) 1

17. The value of $\int_2^6 2^x\,dx$is
(a) $\frac{16}{\log 3}$
(b) $\frac{12}{\log 2}$
(c) $\frac{\log 12}{12}$
(d) None of these

18. $f(x) = 2x^3 - 9x^2 + 12x - 3$is increasing
(a) inside the interval (1, 2).
(b) inside the interval (2, 3).
(c) outside the interval (1, 2).
(d) outside the interval (2, 3).

Assertion–Reason Based Questions (19 & 20)
19. Assertion (A)
If 2x + 1 < 2 < 2x + 1, x ∈ R, then x ∈ $\left(-\infty, -\frac{1}{2}\right)$
Reason (R)
$|x| \geq |y|$ iff $x^2 \geq y^2$.
Options:
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

20. Assertion (A)
A scalar matrix $A = [a_{ij}] = \begin{cases} k; & i = j \\ 0; & i \neq j \end{cases}$, where k is a scalar, is an identity matrix when k = 1.
Reason (R)
Every identity matrix is not a scalar matrix.
Options:
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

SECTION – B

Very Short Answer Type Questions (2 Marks Each)

21.
If

$$A = \begin{bmatrix} x+4 & 2 \\ 3 & 1 \end{bmatrix}, B = \begin{bmatrix} x & 2x-1 \\ 2 & 5 \end{bmatrix}$$

and $|AB| = 12$, find x.

22.
The mean and standard deviation of a random sample of 64 observations were found to be 100 and 16. Find the 95% confidence limits for the mean of the population.

23.
(a) Evaluate

$$\int \frac{x^3 + 3x + 4}{\sqrt{x}}\,dx$$

OR

(b) Evaluate

$$\int \frac{1}{\sqrt{x+a}-\sqrt{x+b}}\,dx$$

24.

(a) Find the general solution of

$$x\,dy - y\,dx = 0$$

OR

(b) The supply function is $p = 8 + x$. If 10 units are sold, find the producer's surplus.

25.

Find the maximum value of

$$Z = 11x + 7y$$

subject to:

$$x \leq 3, y \leq 2, x \geq 0,\ y \geq 0.$$

Section C: Short Answer Type Questions (3 Marks Each)

26. Find a matrix Asuch that

$$2A - 3B + 5C = O,$$

where

$$B = \begin{bmatrix} -2 & 2 & 0 \\ 3 & 1 & 4 \end{bmatrix} \text{ and } C = \begin{bmatrix} 2 & 0 & -2 \\ 7 & 1 & 6 \end{bmatrix}.$$

27. The mean and the variance of a binomial distribution are 4 and 2 respectively. Find the probability of at least 6 successes.

28. A company ABC Ltd has issued a bond having a face value of ₹10,000 paying annual dividends at 10%. The bond will be redeemed at par at the end of 10 years. Find the purchase price of this bond if the investor wishes a yield of 8%.

[Given $(1.08)^{-10} = 0.46319349$]

29. A person buys a house for which he agrees to pay ₹25,000 at the end of each month for 8 years. If money is worth 12% converted monthly, then what is the cash price of the house?

[Given $(1.01)^{-96} = 0.3847$]

30.

(a) Find the maximum value of

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$$

where $x$and $y$are real numbers such that

$$x^2 + y^2 = 1.$$

Or

(b) If

$$A = \begin{bmatrix} a & -b \\ b & a \end{bmatrix},$$

where

$$a^2 + b^2 = 1,$$

show that

$$AA' = I.$$

31.

(a) The radius r of a right circular cone is decreasing at the rate of 3 cm/min and the height h is increasing at the rate of 2 cm/min. When $r = 9$cm and $h = 6$cm, find the rate of change of its volume.

Or

(b) Find the maximum profit that a company can make if the profit function is given by

$$P(x) = 41 + 24x - 18x^2.$$

Section D – Long Answer Type Questions

(5 Marks Each)

32.

(a) Three pipes A, B and C can fill a tank together in 8 hours. After working together for 2 hours, pipe B is closed and pipes A and C can fill the remaining part in 12 hours. Find the time in which pipe B alone can fill the tank.

Or

(b) Two pipes can fill a tank in 20 minutes and 24 minutes respectively, and a waste pipe can empty 4 gallons of water per minute. If all the three pipes working together can fill the tank in 15 minutes, find the capacity of the tank.

33. One kind of cake requires 200 g of flour and 25 g of fat, and another kind of cake requires 100 g of flour and 50 g of fat. Find the maximum number of cakes which can be made from 5 kg of flour and 1 kg of fat, assuming that there is no shortage of the other ingredients used in making the cakes.

34. A piece of machinery costing ₹1,00,000 is expected to have a useful life of 5 years and a scrap value of ₹20,000. Using the straight-line method, find the annual depreciation and construct a schedule for depreciation. Also, find the depreciation rate percent.

35.

(a) The random variable *X* can take only the values 0, 1, 2, and 3. Given that

$$P(X = 0) = P(X = 1) = p \text{ and } P(X = 2) = P(X = 3),$$

such that

$$\sum p_i x_i^2 = 2\sum p_i x_i,$$

find the value of p.

Or

(b) For 6 trials of an experiment, let *X* be a binomial variate which satisfies the relation

$$9P(X = 4) = P(X = 2).$$

Find the probability of success.

Section E – Case-Study / Passage-Based Questions
(4 Marks Each)

36.

The average number (in lakh) of working days lost in strikes during each year of the period 1981–1990 is given below:

Year	Average (in lakh)
1981	1.5
1982	1.8
1983	1.9
1984	2.2
1985	2.6
1986	3.7
1987	2.2
1988	6.4
1989	3.6
1990	5.4

Using 3-yearly moving averages, answer the following questions:

(i) Determine the trend value for the year 1982.

(ii) Determine the moving average for the year 1985.

(iii) (a) Determine the sum of the moving averages for the years 1984 and 1986.

Or

(b) Draw the moving average graph.

37.

The graph given below shows the demand and supply curves of a tyre manufacturing company.

An 'ABC' tyre manufacturer sold 25 units per month when the price of a tyre was ₹20,000 per unit.

The company sold 125 units per month when the price dropped to ₹15,000 per unit.

When the price was ₹25,000 per unit, 180 tyres were available per month for sale, and when the price was only ₹15,000 per unit, 80 tyres remained.

On the basis of the above information, solve the following questions:

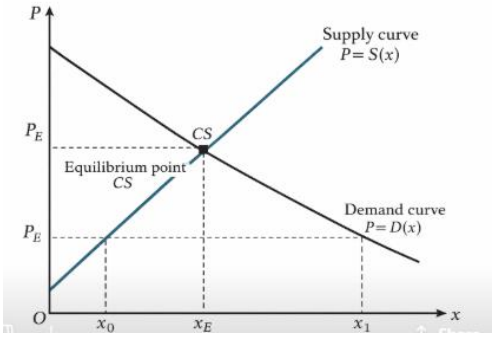
(i) Find the demand function $D(x)$.

(ii) Find the supply function $S(x)$.

(iii) (a) Find the consumer surplus (CS).

Or

(b) Find the producer surplus (PS).



38.

Madhav is rowing a boat. He takes 3 hours to row 24 km upstream, whereas he takes 1.5 hours to cover the same distance downstream.

Based on the above information, answer the following questions:

(a) Find the upstream speed of the boat.

(1 mark)

(b) Find the downstream speed of the boat.

(1 mark)

(c) Find the speed of the boat in still water and the speed of the stream.

(2 marks)

Or

If the stream is flowing at a speed of 4 km/h, and Madhav rows a certain distance upstream in 2 hours and returns to the same place in 1 hour, find the speed of Madhav's boat in still water.
(2 marks)

**********BEST OF LUCK**********