

HALF - YEARLY EXAMINATION (2025 - 26)
Class - XII
Subject - Applied Mathematics (241)

Time : 3 hours

M. M. : 80

General Instructions:-

- The question paper contains three sections - A, B, C, D and E. Each part is compulsory.
Section A has 20 questions of 1 marks each.
Section B has 5 questions of 2 marks each.
Section C has 6 questions of 3 marks each.
Section D has 4 questions of 5 marks each.
Section E has 3 case-study based questions.

SECTION - A

- Q.1 Find the remainder when $671 \times 541 \times 861 \times 383 \times 295 \times 101$ is divided by 7. (1)
(a) 3 (b) 5 (c) 1 (d) 0
- Q.2 Find the least non-negative remainder when 9^{10} is divided by 11. (1)
- Q.3 Using flat rate method, the EMI to repay a loan of Rs.20000 in two and half years at an interest Rate of 8% p.a. is (1)
(a) Rs.700 (b) 800 (c) 900 (d) 100
- Q.4 The moving averages method is used to find the (1)
(a) seasonal variation (b) irregular variation
(c) secular trend (d) cyclical variation
- Q.5 If A is a square matrix of order 3 and $|3A| = k|A|$, the value of K is (1)
(a) 3 (b) 9 (c) 21 (d) 27
- Q.6 Solve the given inequality for x :- $\frac{3x-4}{2} \geq \frac{x+1}{4} - 1$. (1)
- Q.7 The marks obtained by a student of class XI in first terminal and second terminal examination are 62 and 48 respectively. Find the number of minimum marks he should get in the annual examination to have an average of atleast 60 marks. (1)
- Q.8 If $\text{Adj } A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$. Then matrix A is (1)
(a) $\begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ (b) $\begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ (c) $\begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$
- Q.9 Solve the given matrix equations : $2 \begin{bmatrix} x & y \\ 0 & 1 \end{bmatrix} + 3 \begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix} = 3 \begin{bmatrix} 3 & 5 \\ 4 & 6 \end{bmatrix}$. Values of x and y are (1)
(a) 2, 6 (b) 3, 6 (c) 3, 9 (d) 3, 15
- Q.10 The relation between 'Marginal cost' and 'Average cost' of producing 'x' units of a product is: (1)
(a) $\frac{d(AC)}{dx} = x(MC - AC)$ (b) $\frac{d(AC)}{dx} = x(AC - MC)$
(c) $\frac{d(AC)}{dx} = \frac{1}{x}(MC - AC)$ (d) $\frac{d(AC)}{dx} = \frac{1}{x}(AC - MC)$
- Q.11 For what value of 'x', the given matrix $A = \begin{bmatrix} 3-2x & x+1 \\ 2 & 4 \end{bmatrix}$ is a singular matrix? (1)
- Q.12 Which of the following is a component of time series (1)
(a) secular trend (b) seasonal variation
(c) cyclical variational (d) all of these

- Q.13 Region represented by $x \geq 0, y \geq 0$ lies in which quadrant (1)
 (a) first (b) second (c) third (d) fourth
- Q.14 Solve the given system of equations using determinants : $x - 3y = 4, 3x - 2y = 5$ (1)
 (a) 1, -1 (b) 1, 1 (c) -1, 1 (d) -1, -1
- Q.15 If $x = 2bt, t = bt^2$, where b is a constant, then $\frac{d^2y}{dx^2}$ at $x = 1/2$. (1)
 (a) $\frac{1}{2b}$ (b) b (c) $2b$ (d) $\frac{b}{2}$
- Q.16 If $e^y(x+1) = 1$, then $\frac{dy}{dx}$ is equal to (1)
 (a) e^y (b) e^{-y} (c) $-e^y$ (d) $-2e^y$
- Q.17 The present value of a perpetuity payable at the end of each payment period is given by (1)
 (a) Ri (b) $R + \frac{R}{i}$ (c) $\frac{R}{i}$ (d) $R - Ri$
- Q.18 Objective function of a L.P.P. is (1)
 (a) a relation between two variables (b) a constant
 (c) a function to be optimised (d) none of these

Assertion - Reasoning

In the questions 19 and 20 statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
 (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
 (c) Assertion (A) is true, but Reason (R) is false.
 (d) Assertion (A) is false, but Reason (R) is true.
- Q.19 Assertion (A): The maximum profit that a company makes if profit function is given by (1)
 $P(x) = 41 + 24x - 8x^2$, where x is the number of units is Rs.59.
 Reason(R): The profit is maximum at $x = a$ if $P'(a) = 0$ and $P''(a) > 0$

- Q.20 Assertion (A): If matrix $A \begin{bmatrix} 7-x & x+2 \\ 5 & 4 \end{bmatrix}$ is singular then $x = 2$. (1)

Reason (R): If any matrix A is singular then $|A| = 0$.

SECTION - B

- Q.21 Find the unit digit of $(11)^{132}$.

- Q.22 Solve the following system of linear inequalities : (2)

$3x + 7 > 5 - 2x \geq 13 - 6x; x \in R.$

- Q.23 If the matrix $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix}$, is skew-symmetric, find the values of $a, b,$ and c . (2)

OR

If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$, find the value of $A^2 = kA - 2I$

- Q.24 If $x = 4z^2 + 5, y = 6z^2 + 7z + 3$, find $\frac{d^2y}{dx^2}$. (2)

OR

A particle moves along the curve $y = \frac{2}{3}x^3 + 1$. Find the points on the curve at which the y -coordinate is changing twice as fast as the x -coordinate.

Handwritten notes:
 $1 - 34$
 $3 - 25$
 1

Handwritten notes:
 $2 - 34$
 7
 5
 2
 5
 $7 (25)$

Handwritten notes:
 $1 - 34$
 $3 - 25$
 $1 - 34$

- Q.25 The present value of perpetuity of Rs.2400 payable at the end of each six months is Rs.1,20,000. Find the rate of interest convertible half yearly. (2)

SECTION - C

- Q.26 A bond has a face value of Rs.1000 and matures in 15 years to be redeemed at par. The coupon Rate is 7% p.a. Find the purchase price of the bond that will yield an effective interest rate of 8%.
 (Given $(1.08)^{-15} = 0.3152$) (3)

- Q.27 A man bought a refrigerator for his house worth Rs.75,000. The refrigerator is expected to have a useful life of 8 years and scrap value of Rs.5,000. Find the depreciation rate of percentage. (3)

- Q.28 Solve the given system of inequations and represent the solution set on the number line :
 $5(2x - 7) - 3(2x + 3) \leq 0$ and $2x + 19 \leq 6x + 47$ (3)

- Q.29 If $A = \begin{bmatrix} 3 & 2 \\ 2 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 1 \\ 3 & 7 \end{bmatrix}$, then show that $(AB)^T = B^T A^T$. (3)

OR

- Express the matrix $A = \begin{bmatrix} 1 & -2 \\ -1 & 3 \end{bmatrix}$ as the sum of a symmetric and a skew symmetric matrix. (3)

- Q.30 If $y = x \log x + e^{2x}$, then $\frac{d^2 y}{dx^2}$. (3)

- Q.31 Determine the intervals on which the given function is strictly increasing or strictly decreasing :

$f(x) = \frac{x^4}{4} - x^3 - 5x^2 + 24x + 12$. (3)

SECTION - D

- Q.32 A diet is to contain at least 80 units of vitamin A and 100 units of minerals. Two foods F_1 and F_2 are available. Food F_1 costs Rs.400 per unit food and F_2 costs Rs.600 per unit. One unit of food F_1 contains 3 units of vitamin A and 4 units of minerals. One unit of food F_2 contains 6 units of vitamin A and 3 units of minerals. Formulate this as linear programming problem and solve it graphically to find the maximum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements. (5)

- Q.33 If $y = x^3 \log \left(\frac{1}{x}\right)$, then prove that $x \left(\frac{d^2 y}{dx^2}\right) - 2 \frac{dy}{dx} + 3x^2 = 0$. (5)

- Q.34 For the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{bmatrix}$, show that $A^3 - 6A^2 + 5A + 11I_3 = O$. Hence, find A^{-1} . (5)

- Q.35 Find the trend values by taking five moving averages for the following data:

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Annual Production (million tons)	16	14	20	18	22	17	19	21	20

Also plot the actual data and trend values on the graph paper. (5)

Handwritten notes and calculations on the left margin, including $\frac{2x+3}{x}$, $\frac{2x^2+1}{x}$, and $\frac{-3x+5}{x}$.

Handwritten notes on the right margin, including $\frac{3}{x}$, $\frac{17}{x}$, and $\frac{16}{x}$.

