

DPSGS
SAMPLE PAPER FOR MID TERM ASSESSMENT-(2023-2024)
CLASS-XII (Maximum Marks: 80)
SUBJECT -APPLIED MATHEMATICS(CODE-241)

General Instructions:

1. This assignment contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

	SECTION-A(Multiple Choice Questions) Each question carries 1 mark
Q -1	If A and B are symmetric matrices of the same order, then $(AB' - BA')$ is a (a) Skew symmetric matrix(b) Null matrix(c) Symmetric matrix(d) None of these
Q -2	For any two matrices A and B, we have $A^2 + A + I = 0$, then A^{-1} is equal to (a) A- I (b) I - A (c) - (A + I) (d) None of the above
Q -3	$\int \frac{x^3 - x^2 + x - 1}{x - 1} dx$ is equal to (a) $\frac{x^3}{3} - x + c$ (b) $-\frac{x^3}{3} + x + c$ (c) $\frac{x^3}{3} + x + c$ (d) None of the above
Q -4	The function $f(x) = x^2 + 2x - 5$ is increasing is (a) $(-\infty, -1)$ (b) $(-1, \infty)$ (c) $(-1, -1)$ (d) R
Q -5	The equation of normal at (1,2) to the curve $y^2 = 4x$ is (a) $4x - y = 2$ (b) $x + y - 3 = 0$ (c) $y - x = 1$ (d) None of these.
Q -6	Evaluate $(57 - 42) \bmod 11$. (a) 3 (b) 5 (c) 9 (d) 4
Q -7	The smallest non - negative integer congruent to 2976 (mod 7) is (a) 3 (b) 1 (c) 2 (d) 4
Q -8	The speed of motorboat in still water is 45 km/h. If the motorboat travels 80 km along the stream in 1 h 20 min, then the time taken by it to cover the same distance against the stream will be (a) 1h 20 min (b) 3h 40 min (c) 2h 40 min (d) 2h 55min
Q -9	The area of a triangle with vertices $(-3, 0)$, $(3, 0)$ and $(0, k)$ is 9 sq. units. The value of k will be.

	(a) 9 (b) 3 (c) -9 (d) 6
Q -10	If $A = \begin{bmatrix} 2 & x+7 \\ 2x-3 & x+8 \end{bmatrix}$ is symmetric, then x is equal to (a) 1 (b) 5 (c) 10 (d) 4
Q -11	If $\Delta = \begin{vmatrix} \frac{1}{2} & \frac{1}{3} \\ -1 & 2 \end{vmatrix}$, then 3Δ is equal to (a) 1 (b) 2 (c) 3 (d) 4
Q -12	If $A^2 - 5A + 7I = 0$, then A^{-1} is equal to (a) $\frac{1}{7}(A-5I)$ (b) $\frac{1}{7}(5I - A)$ (c) $-\frac{1}{7}(5I-A)$ (d) None of these
Q -13	If $y = e^{ax}$, then $\frac{d^2y}{dx^2}$ is equal to (a) $e^{ax} a^2$ (b) e^{ax} (c) ae^{ax} (d) $a^2 e^x$
Q -14	The value of $\int a^{3\log_a x} dx$ is (a) $x^4 + C$ (b) $\frac{x^4}{4} + C$ (c) $4x^4 + C$ (d) $\frac{a^{3\log_a x}}{\log_a x} + C$
Q -15	If $x = 10(t + e^t)$ and $y = 12(t - e^{-t})$, then $\frac{dy}{dx}$ is equal to (a) $\frac{6}{5}(\frac{1+e^{-t}}{1-e^t})$ (b) $\frac{6}{5}(\frac{1-e^{-t}}{1+e^t})$ (c) $\frac{6}{5}(\frac{1+e^{-t}}{1+e^t})$ (d) None of these
Q -16	If $x = at^2$ and $y = 2at$, then value of $\frac{d^2y}{dx^2}$ is (a) $-\frac{1}{2at^3}$ (b) $-\frac{1}{2at^2}$ (c) $\frac{1}{t^2}$ (d) $-\frac{2a}{t}$
Q -17	The point(s) on the curve $y = x^2$, at which y-coordinate is changing six times as fast as x-coordinate is/are a) (6, 2) b) (2, 4) c) (3, 9) d) (3, 9), (9, 3)
Q -18	Evaluate $\int_2^3 3^x dx$. (a) $\frac{9}{\log 3}$ (b) $18 \log_3 \frac{1}{3}$ (c) $18 \log 3$ (d) $\frac{18}{\log 3}$
	Question number 19 and 20 contains two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below. a) Assertion is correct, reason is correct; reason is a correct explanation for assertion. b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion. c) Assertion is correct, reason is incorrect. d) Assertion is incorrect, reason is correct.
Q-19	Assertion (A) : The matrix $A = \begin{bmatrix} 1 & 2 \\ 4 & 8 \end{bmatrix}$ is singular.

	Reason(R): A square matrix A , is said to be singular , if $A = 0$ a) Both A and R are true and R is the correct explanation of A b) A is true but R is not the correct explanation of A c) A is true but R is false d) A is false but R is true
Q -20	Assertion(A) : If $y = \log_{10}x + \log_e x$, then $\frac{dy}{dx} = \frac{\log_{10}e}{x} + \frac{1}{x}$. Reason(R) : $\frac{d}{dx}(\log_{10}x) = \frac{\log x}{\log 10}$ and $\frac{d}{dx}(\log_e x) = \frac{\log x}{\log e}$. a) A is true and R is the correct explanation of A b) Both A and R are true but R is NOT the correct explanation of A. c) A is true but R is false d) A is false but R is true
	SECTION-B (This section comprises of very short answer type-questions (VSA) of 2 marks each)
Q -21	Evaluate $\int \frac{x^2}{1-x^6} dx$
Q -22	If $A = \begin{bmatrix} p & 2 \\ 2 & p \end{bmatrix}$ and $ A^3 = 125$,then find the value of p.
Q -23	The length x of a rectangle is decreasing at the rate of 3 cm/ mint and the width y is increasing at the rate of 2cm/min. when x = 10cm and y = 6cm, find the ratio of change of (a) the perimeter (b) the area of the rectangle. OR The volume of a cube is increasing at the rate of 8 cm³/s. How fast is the surface area increasing when the length of its edge is 12 cm?
Q -24	If $(x^2 + y^2)^2 = xy$, then find $\frac{dy}{dx}$.
Q -25	Find the least non - negative remainder when 89 X 111 X 135 is divided by 11. OR Find the value of x in the set { 0,1,2,3,4,5} such that $73583 \equiv x \pmod{6}$.
	SECTION-C (This section comprises of short answer type questions (SA) of 3 marks each)
Q -26	Express the matrix

$$B = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$$

as the sum of a symmetric and a skew symmetric matrix.

Q -27 Show that the Matrix $A = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ satisfies the equation $A^2 - 4A + I = O$, where I is the identity matrix and O is 2 X 2 zero matrix. Using this equation, Find A^{-1} .

OR

Given $A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$, compute A^{-1} and show that $2A^{-1} = 9I - A$

Q -28 If $x^y = e^{x-y}$, then prove that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$.

OR

If $e^y(x+1) = 1$, then prove that $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$.

Q -29 If $C(x) = ax^2 + bx + K$ is the total cost function, then find the slope of average cost curve.

Q -30 A mixture of certain quantity of milk with 16 L of water is worth Rs 0.75 per litre. If pure milk is worth Rs 2.25 per litre, then find the amount of milk in the mixture.

Q -31 Evaluate:

$$\int \frac{1}{x-x^3} dx.$$

OR

Evaluate:

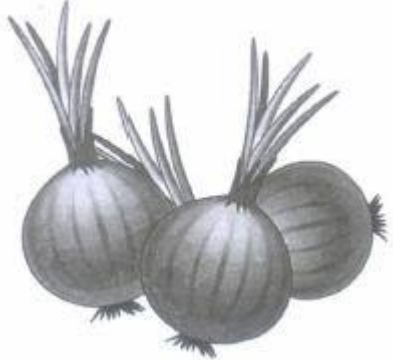
$$\int x^2 e^x dx.$$

SECTION-D

(This section comprises of long answer-type questions (LA) of 5 marks each)

Q -32 Show that the right circular cylinder of given surface and maximum volume is such that its height is equal to the diameter of the base.

Q -33 Evaluate:

	$\int \frac{dx}{3x^2 + 13x - 10}$ OR Evaluate: $\int \frac{e^x}{(1+e^x)(2+e^x)} dx$
Q- 34	Two pipes A and B can fill a tank in 24 min and 32 min , respectively . If both the pipes are opened together , then after how much time pipe B should be closed so that tank is full in 9 min.
Q -35	If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix}$, Find A^{-1}. Hence, solve the system of equations $x + y + z = 6$, $x + 2z = 7$, $3x + y + z = 12$. OR Determine the product of $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ and then Use to solve the system of equations $x - y + z = 4$ $x - 2y - 2z = 9$ and $2x + y + 3z = 1$
	SECTION-E (This section comprises of 3 case-study/passage-based questions of 4 marks each with two sub-parts. First two case study questions have three sub-parts (i),(ii) ,(iii) of marks 1, 1, 2 respectively. The third case study question has two sub-parts of 2 marks each.)
Q -36	The Government declare that farmers can get Rs.300 per quintal for their onions on 1st July and after that, the price will be dropped by Rs.3 per quintal per extra day. Rohan's father has 80 quintal of onions in the field on 1st July and he estimates that crop is increasing at the rate of 1 quintal per day.  Based on the above information, answer the following questions. (i) If x is the number of days after 1st July, then write the expression representing the price and quantity of onion . (1mark)

	(ii) Write the Revenue R as a function of x. (1mark) (iii) Find the number of days after 1st July, when Rohan's father attain maximum revenue. (1mark) (iv) On which day should Rohit's father harvest the onions to maximise his revenue? Also find the maximum Revenue. (1mark)
Q -37	On the occasion of children's day class teacher of class XII, Sh. Vinod Kumar, decided to distribute some chocolates to students of class XII. If there were 8 students less everyone would have got 10 chocolates more compared to the original number of chocolates received. However, if there were 16 students more, everyone would have got 10 chocolates less compared to the original number of chocolates received.  Based on the above information answer the following. (i) If the number of students in class be 'x' and Sh. Vinod Kumar has decided to distribute 'y' chocolates to each student, then write the system of linear equations for the given problem. (1mark) (ii) Write the matrix equation for given problem. (1mark) (iii) If $A = \begin{bmatrix} 5 & -4 \\ 5 & -8 \end{bmatrix}$, then find A^{-1} (1mark) (iv) Find the number of students in Class XII (1mark) OR Write the number chocolates distributed per student.
Q -38	A ,B,C,D are the four contestant in a 1 km race . A can run 2.16 km in 9 min , B can run 1.8 km in 7.5 min C can run 1.5 km in 5 min and D can run 9 km/h. Based on the above information answer the following question (i) Find the ratio of speed A: D. [1] (ii) Which contestant win the race without any start ? [1] (iii) If C gives a start of 40 m to B and still beat him by how much seconds ? OR Find the B's time over the course.