COMMON PRE-BOARD EXAMINATION

APPLIED MATHEMATICS –Code No. 241

CLASS-XII-(2025-26)

SET: 1

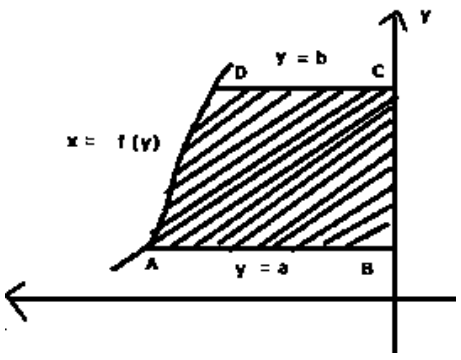
Time allowed: 3 Hrs. **Maximum Marks: 80**

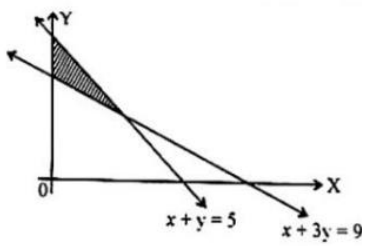
General Instructions:

Read the following instructions very carefully and strictly follow them:

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, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 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 of Section E.
9. Use of calculators is not allowed.

Q. No.	Questions	Marks
	SECTION-A	
1.	A retailer buys 250kg of wheat, a part of which he sells at 10% profit and the remaining at 5% loss. If the net profit made by the retailer in the whole transaction is 7%, then the quantity of wheat sold at 10% profit is: A) 200kg B) 150kg C) 100kg D) 50kg	1
2.	Two students Raj and Vijay finish 100meters race in 12 seconds and 16 seconds respectively. By how many meters does Raj defeat Vijay? A) 10.2 meters B) 15 meters C) 25 meters D) 33.3 meters	1

3.	Given that $x = at^2 \; and \; y = 2at$, 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) $-\frac{2a}{t}$	1
4.	A factory production is delayed for three weeks due to breakdown of a machine and unavailability of spare parts. Under which trend oscillation does this situation fall under? A) Seasonal B) Cyclical C) Secular D) Irregular	1
5.	The present value of a sequence of payments of ₹ 800 made at the end of every 6 months and continuing forever. If money is worth 4% per annum compounded semi-annually, then the present value of the sequence is : A) ₹20000 B) ₹40000 C) ₹60000 D) ₹80000	1
6.	For two distinct positive numbers $x \; and \; y$ A) $x + y > 2\sqrt{xy}$ B) $\frac{x+y}{2} > xy$ C) $\sqrt{xy} > \frac{x+y}{2}$ D) $\frac{2xy}{x+y} > \sqrt{xy}$	1
7.	In a 3 × 3 matrix A, value of $a_{12}c_{13} + a_{22}c_{23} + a_{32}c_{33}$, where c_{ij} is the cofactor of a_{ij} is A) 0 B) -1 C) 1 D) $\|A\|$	1
8.	In the given figure, the area bounded by the curve $x = f(y)$, $y-$axis and abscissa $y = a$ and $y = b$ is equal to A) $\int_a^b f(y)\,dy$ B) $\int_a^b f(x)\,dx$ C) $\int_a^b \|f(y)\|\,dy$ D) $\int_a^b \|f(x)\|\,dx$ 	1

9.	A machine makes a bike wheels and in a random sample of 26 wheels, the test statistic is found to be 3.07. As per the t-distribution test (of 5% level of significance), what can you say about the quality of wheels produced by the machine? (Use $t_{25}(0.05) = 2.06$) A) Superior quality B) Inferior quality C) Same quality D) Cannot say	1
10.	For the purpose of t-test of significance, a random sample of size (n) 34 is drawn from a normal population, then the degree of freedom (ϑ) is – A) $\frac{1}{34}$ B) 33 C) 34 D) 35	1
11.	If A is a square matrix of order 3 and $\|A\| = -2$, then $\|adj\ (A)\|$ is equal to A) -8 B) -2 C) 0 D) 4	1
12.	The order and degree of a differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^4 + x^{\frac{1}{5}} = 0$, respectively, are A) 2 and 4 B) 2 and 1 C) 2 and 3 D) 3 and 3	1
13.	If the cash equivalent of a perpetuity ₹300 payable at the end of each quarter ₹24000 then rate of interest compounded quarterly is A) 5% B) 4% C) 3% D) 2%	1
14.	If solving a system of linear equations in 3 variables by Cramer's rule, we get $\Delta = 0$ and at least one of $\Delta_x, \Delta_y, \Delta_z$ is non-zero then the system of linear equations has A) no solution B) unique solution C) infinitely many solutions D) trivial solution	1
15.	In the given figure , what is the LPP shaded region known as? A) Feasible region B) Feasible solution C) Optimal region D) Objective region 	1

16.	An automatic machine produces 20000 pins per day. On rare occasion it produces a perfect pin whose chance is $\frac{1}{10000}$. Assuming Poisson distribution, the mean and variance of the number of perfect pins are respectively A) $\sqrt{2}, \sqrt{2}$ B) 2,2 C) 2,4 D) 4,2	1
17.	For two matrices $P = \begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix}$ and $Q^T = \begin{bmatrix} -1 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$; Where Q^T is the transpose of the matrix Q. Then $P - Q$ is : A) $\begin{bmatrix} 2 & 3 \\ -3 & 0 \\ 0 & -3 \end{bmatrix}$ B) $\begin{bmatrix} 4 & 3 \\ -3 & 0 \\ -1 & -2 \end{bmatrix}$ C) $\begin{bmatrix} 4 & 3 \\ 0 & -3 \\ -1 & -2 \end{bmatrix}$ D) $\begin{bmatrix} 2 & 3 \\ 0 & -3 \\ 0 & -3 \end{bmatrix}$	1
18.	Using flat rate method, the EMI to repay a loan of ₹20000 in 2 ½ years at an interest rate of 8% p.a is : A) ₹100 B) ₹700 C) ₹800 D) ₹900	1
	ASSERTION-REASON BASED QUESTIONS **(Questions number 19 and 20 are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below** **(A) Both (A) and (R) are 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.**	
19.	**Assertion (A):** For a square matrix of order 3, if $\|adj\ A\| = 49, then\ \|A\| = \pm 7$. **Reason (R):** For a square matrix of order n, $\|adj\ A\| = \|A\|^n$.	1
20.	**Assertion (A):** The area under the normal distribution curve above the base line and between $0\ to \infty\ is\ 1$ i.e $\int_0^\infty f(x)dx$ =1 **Reason (R):** When mean = 0 and standard deviation = 1 for a data set, then the normal distribution is called as standard normal distribution.	1

	SECTION-B **[This section comprises of solution of very short answer type questions (VSA) of 2 marks each]**	
21.	A) Find the last digit of 17^{16}. **OR** B) Solve the inequality for real x: $4 - 2x \geq 3x + 19$	2
22.	A random variable x has the following probability distribution, where k is a constant. x | 0 | 1 | 2 | Otherwise P(x) | k | 2k | 3k | 0 i) Determine the value of k? ii) Find mean.	2
23.	Mr. Rahul invested ₹5000 in a fund at the beginning of year 2021 and by the end of year 2021 his investment was worth ₹9000. Next year market crashed and he lost ₹3000 and ending up with ₹6000 at the end of year 2022. Next year i.e. 2023 he gained ₹4500 and ending up with ₹10500 at the end of the year. Find CAGR (Compounded Annual Growth Rate) of his investment. (Use $(2.1)^{1/3} = 1.2805$).	2
24.	A) Experience shows that 1.4% of telephone calls received are wrong numbers. Determine the probability that among 150 calls received 2 are wrong numbers. [Use $e^{-2.1} = 0.122$]. **OR** B) Assume that the probability that a bomb dropped from an aeroplane will hit a target is 1/5. If 6 bombs are dropped, find the probability that at least two will hit the target? [Use $e^{-1.2} = 0.301$]	2
25.	The initial value of the machine is ₹ 25,000 and it depreciates by ₹2,500 each year. At what time will the value of the machine be half of its initial value? Find the value of the machine after 6 years.	2
	SECTION-C **[This section comprises of solution short answer type questions (SA) of 3 marks each]**	
26.	A boat goes 30km downstream and comes back to the starting point in 4 hours and 30 minutes. If the speed of the boat in still water is 15km/hr, find the speed of the stream.	3
27.	A) Find the intervals in which the function $f(x) = 2x^3 - 9x^2 + 12x - 5$ is increasing or decreasing. **OR** B) The cost function for x units of a commodity is given by $C(x) = \frac{x^3}{3} + x^2 - 15x + 3$ a) Find the Average cost function. b) Find the marginal cost function. c) Find the Marginal cost when 25 units are produced.	3

28.	A) Mr. Satish wants to send his daughter abroad for higher studies after 10 years. He sets up a sinking fund in order to have ₹500,000 after 10 years. How much should he set aside semi-annually into an account paying 5% per annum compounded annually. [Use $(1.025)^{20} = 1.6386$] **OR** B) Consider a bond with a coupon rate of 10% charged annually. The par value is ₹2000 and the bond has 5 years to maturity. The yield to maturity is 11%. What is the value of the bond? [Use: $(1.11)^{-5} = 0.593451$]	3
29.	A cistern can be filled by two pipes A and B in 12 minutes and 15 minutes respectively. Another tap C can empty the full tank in 20 minutes. If the tap C is opened 5 minutes after the pipes A and B are opened, find when the cistern becomes full?	3
30.	A machine produces washers of thickness 0.50mm. To determine whether the machine is in proper working order, a sample of 10 washers is chosen for which the mean thickness is 0.53 mm and the standard deviation is 0.03mm. Test the hypothesis at 5% level of significance that the machine is working in proper order. (Given $t_{0.05} = 2.262 \; at \; 9 \; degree \; of \; freedom$).	3
31.	A small firm manufactures necklaces and bracelets. The total number of necklaces and bracelets that it can handle per day is at most 25. It takes one hour to make a bracelet and half an hour to make a necklace. The maximum number of hours available per day is 14. If the profit on a necklace is ₹100 and that on a bracelet is ₹300, formulate an L.P.P for finding how many of each should be produced daily to maximize the profit? It is being given that at least one of each must be produced. (Note: No need to find the optimal solution).	3
	SECTION-D **[This section comprises of solution of long answer type questions (LA) of 5 marks each]**	
32.	A) Using Matrix method, solve the following system of equations for x, y and z: $x - y + z = 4$ $2x + y - 3z = 0$ $x + y + z = 2$ OR B) Find the inverse of the matrix: $A = \begin{bmatrix} -1 & 1 & 2 \\ 3 & -1 & 1 \\ -1 & 3 & 4 \end{bmatrix}$ And hence show that $AA^{-1} = I$.	5
33.	A firm has the following total cost and demand functions: $C(x) = \frac{x^3}{3} - 7x^2 + 111x + 50 \; and \; x = 100 - p$ i) Find the total revenue function in terms of x. ii) Find the total profit function in terms of x. iii) Find the profit maximizing level of output of x. iv) What is the maximum profit, taking rupee as a unit of money?	5

34. A) The average number, in lakhs, of working days lost in strikes during each year of the period 2001-2010 was 5

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Working days lost in strikes	1.5	1.8	1.9	2.2	2.6	3.7	2.2	6.4	3.6	5.4

Calculate the 3-yearly moving averages and draw the moving averages graph.

OR

B) Fit a straight-line trend by using the method of least squares for the following data and calculate the trend values.

Year	Production (in tonnes)
1962	2
1963	4
1964	3
1965	4
1966	4
1967	2
1968	4
1969	9
1970	7
1971	10
1972	8

35. Akshitha bought a car worth ₹12,50,000 and makes a down payment of ₹3,00,000. The balance amount is to be paid in 4 years by equal monthly instalments at an interest rate of 15% p.a. Find the EMI and the total interest that Akshitha has to pay for the car. (Given $(1.0125)^{-48} = 0.5508$) 5

	SECTION-E **[This section comprises solution of 3 case- study based questions of 4 marks each with three sub parts of 1, 1 and 2 marks each respectively]**	
36.	**Case Study 1:** 2000 students appeared in an examination. Distribution of marks is assumed to be normal with mean 30 and standard deviation 6.25. i) Give the formula to find standard normal variate Z. ii) What is the probability of geting marks less than 25? iii) A)how many students are expected to get marks between 20 and 40? **OR** B)Find the probabiity of getting marks greater than 25 and represent it on nomal distribution curve . [Use: $P(0 \leq z \leq 1.6) = 0.4452,\ P(0 \leq z \leq 0.8) = 0.2881$]	4 1 1 2
37.	**Case Study 2:** A tyre manufacturer estimates that (thousand) radial tyres will be purchased i.e. demanded by whole sales when price is $p = D(x) = 90 - \frac{x^2}{10}$ thousand rupees per tyre and the same number of tyres will be supplied when the price is $p = S(x) = \frac{1}{5}x^2 + x + 50$ thousand rupee per tyre. Based on the above information, answer the following questions. i) Show graphically consumer surplus. ii) Show graphically producer surplus. iii) A)Find the equilibrium price and the quantity supplied and demanded at that price. **OR** B)Find the consumer's surplus for the demand function $p = 25 - x - x^2$ when $p_0 = 19$.	4 1 1 2
38.	**Case Study 3:** A manufacturer has three machines I,II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours where as machine III must be operated for at least 5 hours a day. He produces only two items M and N, each requiring the use of all the three machines. The number of hours required for producing 1 unit of M and N on three machines are given in the following table: **Items** / **Number of hours required on machines** I II III M 1 2 1 N 2 1 1.25 He makes a profit of ₹600 and ₹400 on one unit of items M and N respectively. Based on the above information, answer the following: i) Formulate the above problem as LPP ii) Solve it graphically to find how many units of each item be produced to maximize profit.	4 2 2