SAHODAYA SCHOOL COMPLEX KOCHI,
MODEL EXAMINATION 2024 -2025

Time: 3 Hours **Std XII – Applied Mathematics [241]** **Max. Marks:80**

General instructions:
Read the following instructions very carefully and strictly follow them:

(i) This Question paper contains **38** questions. **All** questions are **compulsory**.
(ii) This Question paper is divided into **five** Sections - **A, B, C, D** and **E**.
(iii) 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**.
(iv) In **Section B**, Questions no. **21** to **25** are **Very Short Answer (VSA)-type** questions, carrying **2 marks each**.
(v) In **Section C**, Questions no. **26** to **31** are **Short Answer (SA)-type** questions, carrying **3 marks each**.
(vi) In **Section D**, Questions no. **32** to **35** are **Long Answer (LA)-type** questions, carrying **5 marks each**.
(vii) In **Section E**, Questions no. **36** to **38** are **case study-based questions** carrying **4 marks each**.
(viii) 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.
(ix) Use of calculators is **not** allowed.

SECTION-A **[1x20 =20]**

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)
Select the correct option (Question 1 - Question 18):

1. (-6 x 5) mod 7 is

(A) -2 (B) -5
(C) 5 (D) 2

2. If the total cost function for a production of x units of a commodity is given by $\frac{3}{4}x^2 - 7x + 27$, then the number of units produced for which MC = AC is

(A) 4 (B) 6
(C) 9 (D) -36

3. If the matrix $\begin{bmatrix} 0 & -1 & 3x \\ 1 & y & -5 \\ -6 & 5 & 0 \end{bmatrix}$ is skew symmetric, then

(A) x = -2, y = 0 (B) x = 2, y = 0
(C) x = -2, y = 1 (D) x = 2, y = 1

4. The sum of order and degree of the differential equation $\left(\frac{dy}{dx}\right)^5 + 3xy\left(\frac{d^3y}{dx^3}\right)^2 + y^2\left(\frac{d^2y}{dx^2}\right)^3 = 0$ is

(A) 5 (B) 6
(C) 8 (D) 7

5. If A = $[a_{ij}]$ is a square matrix of order 3 and A_{ij} denote cofactor of the elements a_{ij} in $|A|$, then the value of $|A|$ is given by

(A) $a_{11} A_{11} + a_{12} A_{21} + a_{13} A_{31}$ (B) $a_{11} A_{21} + a_{12} A_{22} + a_{13} A_{23}$
(C) $a_{11} A_{13} + a_{21} A_{23} + a_{31} A_{33}$ (D) $a_{11} A_{11} + a_{12} A_{12} + a_{13} A_{13}$

6. An asset costing ₹15000 is expected to have a useful life of 5 years. If scrap value of the asset is ₹3000, then the annual depreciation charge is

(A) ₹2400 (B) ₹3000
(C) ₹2800 (D) ₹3600

7. For a binomial variate X, if n = 4 and P(X = 0) = $\frac{16}{81}$, then P(X = 4) is

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$
(C) $\frac{1}{8}$ (D) $\frac{3}{8}$

8. The solution of differential equation $\frac{dx}{x} + \frac{dy}{y} = 0$ is

(A) $\frac{1}{x} + \frac{1}{y} = C$ (B) xy = C
(C) log x log y = C (D) x + y = C

9. The present value of a perpetuity of ₹750 payable at the beginning of each year, if money is worth 5% p.a is

(A) ₹15000 (B) ₹15750
(C) ₹14250 (D) ₹3750

10. If A is a non-singular matrix such that $A^2 - A + I = 0$, then A^{-1} is equal to

(A) A + I (B) A - I
(C) A + 2I (D) I - A

11. $\int_{-1}^{1} log\left(\frac{2-x}{2+x}\right) dx$ is equal to

(A) 3 (B) 1
(C) 0 (D) -3

12. A specific characteristic of a sample is known as

(A) population
(B) parameter
(C) variance
(D) statistic

13. If the objective function for an L.P.P is Z = 3x – 4y and the corner points of the bounded feasible region are (0,0), (5,0), (6,5), (6,8), (4,10) and (0,8), then the minimum value of Z occurs at

(A) (0,0)
(B) (0,8)
(C) (5,0)
(D) (4,10)

14. If x and b are real numbers such that b > 0 and $|x| > b$, then

(A) $x \in (-b, \infty)$
(B) $x \in (-\infty, b)$
(C) $x \in (-b, b)$
(D) $x \in (-\infty, -b) \cup (b, \infty)$

15. The point on the curve $x^2 = 2y$ which is nearest to the point (0,5) is

(A) $(2\sqrt{2}, 4)$
(B) $(2\sqrt{2}, 0)$
(C) (0, 0)
(D) (2, 2)

16. A fire in a factory delaying production for some time is

(A) Long term trend
(B) Cyclical trend
(C) Seasonal trend
(D) Irregular trend

17. The effective rate of return, which is equivalent to a declared rate of 12% compounded annually is

(A) 11.86%
(B) 12.36%
(C) 11.98%
(D) 12%

18. If we reject the null hypothesis, we might be making

(A) Type – I error
(B) Type – II error
(C) A correct decision
(D) A wrong decision

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.)

[1x2 = 2]

(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):** The function $f(x) = x^x$, $x > 0$ is strictly increasing in $\left[\frac{1}{e}, \infty\right)$

Reason (R): $\log_a x > b$ implies $x > a^b$ if $a > 1$

20. **Assertion (A):** A coin is biased such that head is two times likely to occur as tail. If the coin is tossed 4 times, then the variance of number of heads is $\frac{8}{9}$

Reason (R): Variance of Bernoulli trial is $\sqrt{npq}$

SECTION-B [2 x 5 = 10]

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)

21. (a) It is given that 2% of screws manufactured by a company are defective. Use Poisson distribution to find the probability that a packet of 100 screws contains

(i) no defective screw (ii) one defective screw [Given $e^{-2} = 0.14$]

OR

21. (b) Find the probability distribution of a number of successes in two tosses of a die, where a success is defined as a number greater than 4.

22. In a 500m race, the ratio of speeds of two contestants A and B is 3 : 4. If A has a start of 140m, then find the distance by which A will win.

23. If $A = \begin{bmatrix} -1 & 2 \\ 3 & 1 \end{bmatrix}$, find f(A), where $f(x) = x^2 - 2x + 3$.

24. (a) A man can swim upstream at 6 km/hr and downstream at 10 km/hr. Find the speed of stream and speed of man in still water.

OR

24. (b) The cost of one type of rice is ₹85 per kg and the cost of other type of rice is ₹125 per kg. If both type of rice are mixed in the ratio 2 : 3, find the cost per kg of mixed rice.

25. A container contains 40 litres of milk. From this container 4 litres of milk was taken out and replaced by water. This process was repeated two more times. How much milk is now left in the container?

SECTION-C [3 x 6 = 18]

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26. A startup company invested ₹ 1,50,000 in shares for 4 years. The value of the investment was ₹1,90,000 at the end of second year, ₹ 1,75,000 at the end of third year and on maturity, the final value stood at ₹2,25,000. Calculate the CAGR on the investment.

27. (a) A sample size of 10 drawn from a normal population has a mean 31 and a variance 2.25. Is it reasonable to assume that the mean of the population is 30 ?
[Use 1% level of significance, given that $[t_9(0.01)=3.25]$

OR

27. (b) From a sample size of 14 with 52 as mean, the sum of squares of deviations from mean is 117. Can this sample be regarded as taken from the population having 54 as mean? [Given $t_{13}(0.05) = 1.77$].

28. Three pipes A, B and C can fill a tank together in 8 hours. After working at it together for 2 hours B is closed and A and C can fill the remaining part of the tank in 9 hours. Find the time in which B alone can fill the tank.

29. A box contains 4 white and 6 black balls. If 3 balls are drawn at random, find the mathematical expectation of the number of white balls.

30. (a) A medicine company has factories at two places A and B. From these places, supply is made to each of its three agencies situated at P, Q and R. The monthly requirements of the agencies are respectively 40, 40 and 50 packets of the medicines, while the production capacity of the factories at A and B are 60 and 70 packets respectively. The transportation cost per packet from the factories to the agencies are given below.

From / To	Transportation cost per packet (in ₹)	
	A	B
P	5	4
Q	4	2
R	3	5

Formulate the objective function and the constraints of the above linear programming problem.

OR

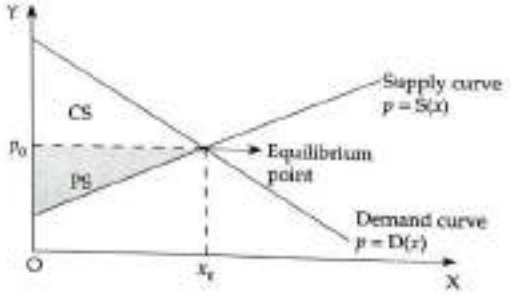
30. (b) Consider the following Linear Programming Problem:
Minimise $Z = x + 2y$,
Subject to $2x + y \geq 3$, $x + 2y \geq 6$, $x, y \geq 0$.
Show graphically that the minimum of Z occurs at more than two points.

31. 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-D [5 x 4 = 20]

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32. The graph given below showing the demand and supply curves of a mobile phone company are linear.



When the price of mobile phone was ₹16000 per unit, Singh mobiles sold 20 units every month and when price dropped to ₹10000 per unit, Singh mobiles sold 80 units every month. When the price was ₹16000 per unit, 155 mobiles were available per month for sale and when the price was only ₹10000 per unit, 35 mobiles remained. Find the demand function and supply function. Also find the producer surplus.

33. (a) Fit a straight-line trend by the method of least squares to the following data and find the trend values.

Year	2010	2012	2013	2014	2015	2016	2019
Sales(in lakh)	65	68	70	72	75	67	73

OR

33. (b) From the following data, calculate the three yearly moving averages:

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Sales(in lakh)	30	25	35	20	24	25	28	26	28	32

34. (a) The sum of three numbers is 6. If we multiply third number by 3 and add second number to it we get 11. By adding first and third numbers, we get double of the second number. Represent it algebraically and find the numbers using matrix method.

OR

34. (b) The sum of three numbers is 20. If we multiply the first number by 2 and add the second number to the result and subtract the third number, we get 23. By adding second and third numbers to three times the first number, we get 46. Represent the given problem algebraically and use Cramer's rule to find the numbers.

35. Adithya bought a mobile phone for which he makes a down payment of ₹5000. The balance is to be paid in 3 years by monthly instalments of ₹1673 each. The interest rate charged by the financer is 6% p.a. Find the actual price of the mobile phone.

[Given $\left(\frac{201}{200}\right)^{-36}$ = 0.83564492]

SECTION-E [4 x 3 = 12]

(This section comprises of 3 case-study/passage-based questions of 4 marks each with sub parts. The 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)

36. **Case Study-1**

The cost function of a firm is given by the equation $C = 300x - 10x^2 + \frac{1}{3}x^3$, where C stands for cost and x for output.

Based on the above information, answer the following questions.

(i) Find the marginal cost. **[1]**

(ii) Calculate the output at which marginal cost is equal to average cost. **[1]**

(iii) (a) Find the output at which marginal cost is minimum. **[2]**

OR

(iii) (b) Find the output at which average cost is minimum. **[2]**

37. **Case Study-2**

A machine costing ₹ 200000 has effective life of 7 years and its scrap value is ₹30000. It is assumed to cost ₹300000 after 7 years. The prevailing interest rate is 5% per annum.

Based on the above information, answer the following questions.

(i) Find the amount required to purchase the new machine after 7 years. **[1]**

(ii) Find the amount needed to be put in the sinking fund to replace the machine after its useful life. **[1]**

(iii) (a) Find the present value of a perpetuity which pays at the end of the year an amount equal to that obtained in part (ii). **[2]**

OR

(iii) (b) If the owner is keeping aside ₹ 40000 at the end of every year, then find the time in which he would have required funds to buy a new machine. **[2]**

38. **Case Study-3**

In a mid-day meal programme, an NGO wants to provide a vitamin rich diet to the students of an MCD school. The dietician of the NGO, wishes to mix two types of food in such a way that vitamin contents of the mixture contains at least 8 units of vitamin A and 10 units of vitamin C. Food 1 contains 2 unit per kg of vitamin A and 1 unit per kg of vitamin C. Food 2 contains 1 unit per kg of vitamin A and 2 units per kg of vitamin C. It costs ₹50 per kg to purchase food 1 and ₹ 70 per kg to purchase food 2.

Based on the above information, answer the following questions:

(i) Formulate the objective function and the constraints of the above Linear programming problem. **[2]**

(ii) Find the minimum cost of mixture by using iso-cost method. **[2]**