

o $\{(x, y) : 3x^2 + 2y^2 \leq 6\}$

a) $\{x : |x| = 5\}$

b) $\{(x, y) : x^2 + y^2 \leq 4\}$

c) $\{(x, y) : 2x + 5y < 7\}$

d) $\{(x, y) : 3x^2 + 2y^2 \leq 6\}$

5. What is x if $\begin{bmatrix} 1 & 4 \\ 2 & x \end{bmatrix}$ is a singular matrix? [1]

a) 7

b) 8

c) 5

d) 6

6. A coin is tossed 10 times. The probability of getting exactly six heads is [1]

a) $\frac{512}{513}$

b) ${}^{10}C_6$

c) $\frac{105}{512}$

d) $\frac{100}{153}$

7. If the variance of a Poisson distribution is 2, then $P(X = 2)$ is [1]

a) $\frac{4}{e^2}$

b) $\frac{2}{e^2}$

c) $4e^2$

d) $2e^2$

8. The differential equation $x \frac{dy}{dx} - y = x^2$, has the general solution: [1]

a) $y - x^3 = 2cx$

b) $2y - x^3 = cx$

c) $2y + x^2 = 2cx$

d) $y + x^2 = 2cx$

9. The speed of a boat in still water is 10 km/hr. It is can travel 26 km downstream and 14 km upstream in the same [1]
time, the speed of the stream, in km/hr, is

a) 2

b) 3

c) 4

d) $\frac{5}{2}$

10. . Let A be a square matrix of order 2×2 , then $|KA|$ is equal to: [1]

a) $K^3 |A|$

b) $K |A|$

c) $K^2 |A|$

d) $2K |A|$

11. (09 : 30 + 16 : 40) in 24 hours clock is [1]

a) 2 : 10

b) 26 : 10

c) 25 : 70

d) 03 : 10

12. If $|2x + 3| < 7$, $x \in \mathbb{R}$, then [1]

a) $x \in (-\infty, -5) \cup (2, \infty)$

b) $x \in (-5, 2)$

c) $x \in (-\infty, -5] \cup [2, \infty)$

d) $x \in (-5, 2]$

13. In a 400 m race, A gives B a start of 5 seconds and beats him by 15 m. In another race of 400 m, A beats B by 7 [1]
 $\frac{1}{7}$ seconds. Their respective speeds are:

a) 8 m/sec, 7 m/sec

b) 5 m/sec, 7 m/sec

c) 9 m/sec, 7 m/sec

d) 6 m/sec, 7 m/sec

14. If the number of available constraints is 3 and the number of parameters to be optimized is 4, then [1]

Ram purchased a laptop worth ₹80000. He paid ₹20,000 as cash down and balance in equal monthly installments in 2 years. If bank charges 9% p.a. compounded monthly. Calculate the EMI [Given $(1.0075)^{24} = 1.1964$]

23. Evaluate the definite integral: $\int_0^1 x(1-x)^5 dx$ [2]

24. If A is a square matrix of order 3 and $|A| = 7$, write the value of $|\text{adj } A|$. [2]

OR

If for any 2×2 square matrix A,

$$A(\text{adj } A) = \begin{bmatrix} 8 & 0 \\ 0 & 8 \end{bmatrix}, \text{ find the value of } |A|.$$

25. A Merchant lent out ₹ 10,000 in two parts, one at 8% and other at 10% interest. The yearly average comes out to be 9.2%. Find the amount lent in two parts. [2]

Section C

26. The rate of increase in the number of bacteria in a certain bacteria culture is proportional to the number present. Given the number triples in 5 hrs, find how many bacteria will be present after 10 hours. Also, find the time necessary for the number of bacteria to be 10 times the number of the initial present. [Given $\log_e 3 = 1.0986$, $e^{2.1972} = 9$] [3]

OR

The rate of increase of bacteria in a culture is proportional to the number of bacteria present and it is found that the number doubles in 6 hours. Prove that the bacteria becomes 8 times at the end of 18 hours.

27. A machine costing ₹ 30,000 is expected to have a useful life of 4 years and a final scrap value of ₹ 4000. Find the annual depreciation charge using the straight-line method. Prepare the depreciation schedule. [3]

28. The marginal cost of production of x units of a commodity is $30 + 2x$. It is known that fixed costs are ₹ 120. Find [3]

- i. the total cost of producing 100 units
- ii. the cost of increasing output from 100 to 200 units.

29. Five defective bolts are accidentally mixed with twenty good ones. If four bolts are drawn at random from this lot, find the probability distribution of the number of defective bolts. [3]

OR

The probability distribution of a random variable X is given as under:

$$P(X = x) = \begin{cases} kx^2 & \text{for } x = 1, 2, 3 \\ 2kx & \text{for } x = 4, 5, 6; \text{ where } k \text{ is a constant.} \\ 0 & \text{otherwise} \end{cases}$$

Find:

- i. $P(X \geq 4)$
- ii. $E(X)$
- iii. $E(3X)^2$

30. The profit of a paper bag manufacturing company (in lakhs of rupees) during each month of a year are: [3]

Month	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Profit	1.2	0.8	1.4	1.6	2.0	2.4	3.6	4.8	3.4	1.8	0.8	1.2

Plot the given data on a graph sheet. Calculate the four monthly moving averages and plot these on the same graph sheet.

31. Consider the following hypothesis test: [3]

$$H_0 : \mu \leq 12$$

$$H_a : \mu > 12$$

A sample of 25 provided a sample mean $\bar{x} = 14$ and a sample standard deviation $S = 4.32$

- i. Compute the value of the test statistic.
- ii. Use the t-distribution table to compute a range for the p-value.
- iii. At $\alpha = 0.05$, what is your conclusion?
- iv. What is the rejection rule using the critical value? What is your conclusion?

Section D

32. Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain at least 8 units of vitamin A and 11 units of vitamin B. Food P costs ₹ 60 kg and Food Q costs ₹ 80 kg. Food P contains 3 units/kg of Vitamin A and 5 units/kg of Vitamin B while food Q contains 4 units/kg of Vitamin A and 2 units/kg of vitamin B. Determine the minimum cost of the mixture. [5]

OR

A company manufactures two types of novelty Souvenirs made of plywood. Souvenirs of type A require 5 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours 20 minutes available for cutting and 4 hours available for assembling. The profit is 50 paise each for type A and 60 paise each for type B souvenirs. How many souvenirs of each type should the company manufacture in order to maximize the profit?

33. Solve the following system of inequalities graphically: [5]

$$3y - 2x < 4, x + 3y > 3 \text{ and } x + y \leq 5.$$

34. In a certain factory turning out razor blades, there is a small chance $\frac{1}{500}$ for any blade to be defective. The blades are supplied in a packet of 10. Use Poisson distribution to calculate the approximate number of packets containing [5]

- i. no defective,
- ii. one defective,
- iii. two defective
- iv. 3 defective blades, in a consignment of 10,000 packets.

OR

Two cards are drawn successively with replacement from a well-shuffled deck of 52 cards. Compute the variance of the number of aces.

35. A machine costing ₹50,000 depreciates at a constant rate of 8%. What is the depreciation charge for the 8th year. [5] If the estimated useful life of the machine is 10 years, determine its scrap value.

Section E

36. **Read the text carefully and answer the questions:** [4]

Rohit's father wants to construct a rectangular garden using a brick wall on one side of the garden and wire fencing for the other three sides as shown in the figure. He has 200 ft of wire fencing.



- (i) To construct a garden using 200 ft of fencing, what should we need to maximize?
- (ii) If x denotes the length of the side of the garden perpendicular to a brick wall and y denotes the length of the side parallel to a brick wall, then find the relation representing the total amount of fencing wire?
- (iii) Area of the garden as a function of x , say $A(x)$, how it can be represented?

OR

At what value of x , Maximum value of $A(x)$ occurs?

37. **Read the text carefully and answer the questions:**

[4]

EMI or equated monthly installment, as the name suggests, is one part of the equally divided monthly outgoes to clear off an outstanding loan within a stipulated time frame. The EMI is dependent on multiple factors, such as:

- Principal borrowed
- Rate of interest
- Tenure of the loan
- Monthly/annual resting period

For a fixed interest rate loan, the EMI remains fixed for the entire tenure of the loan, provided there is no default or part-payment in between. The EMI is used to pay off both the principal and interest components of an outstanding loan.

Example:

A person amortizes a loan of ₹1500000 for renovation of his house by 8 years mortgage at the rate of 12% p.a. compounded monthly.

(Given $(1.01)^{96} = 2.5993$, $(1.01)^{57} = 1.7633$)

- (i) Find the equated monthly installment.
- (ii) Find the principal outstanding at the beginning of 40th month.
- (iii) Find the interest paid in 40th payment.

OR

Find the principal contained in 40th payment.

38. An amount of ₹5000 is put into three investments at the rate of interest of 6%, 7% and 8% per annum

[4]

respectively. The total annual income is ₹358. If the combined income from the first two investments is ₹70 more than the income from the third, find the amount of each investment by matrix method.

OR

A two industries input-output relationship states that industry I require 20 paise worth of its own output and 50 paise worth of industry II for producing output of ₹1. Industry II requires 30 paise worth of its own output and 40 paise worth of industry I for producing an output of ₹1.

- i. Write the technology coefficient matrix.
- ii. Determine the gross output required to satisfy the economy's demand of ₹180 crores and ₹270 crores respectively.
- iii. Give the interpretation of its row sum and column sum, if any.

