

**WEST CHENNAI SAHODAYA CLUSTER EXAMINATION 2022-23**

**CLASS XII**

**APPLIED MATHEMATICS**

**SUBJECT CODE -241**

**TIME: 3 Hours**

**MAXIMUM MARKS: 80**

**General Instructions:**

1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section - D carries 20 marks weightage and Section - E carries 3 case-based with total weightage of 12 marks.

Section – A:

3. It comprises of 20 MCQs of 1 mark each.

Section – B:

4. It comprises of 5 VSA type questions of 2 marks each.

Section – C:

5. It comprises of 6 SA type of questions of 3 marks each.

Section – D:

6. It comprises of 4 LA type of questions of 5 marks each.

Section – E:

7. It has 3 case studies. Each case study comprises of 3 case-based questions, where 2 VSA type questions are of 1 mark each and 1 SA type question is of 2 marks.

**SECTION A**

**Answer all the questions each question carries 1 mark**

1. The value of  $5 \odot_8 11$ , where  $\odot$  is multiplication modulo is

(a) -1                                      (b) 0                                      (c) 7                                      (d) 9

2. What effective rate is equivalent to a nominal rate of 8% converted quarterly?

(a) 8.24%                                      (b) 8.25%                                      (c) 8.27%                                      (d) 8.30%

3. In what ratio shall I add water to the liquid detergent costing ₹ 480 per litre to get resulting mixture worth ₹ 300 per litre?

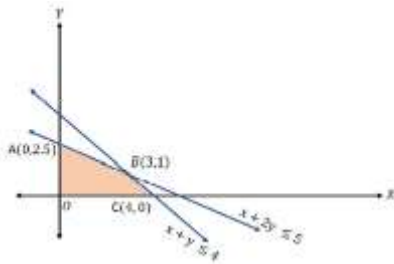
(a) 5:3                                      (b) 3:8                                      (c) 3:5                                      (d) 5:8

4. The number of all possible matrix of order  $3 \times 3$  with each entry 0 or 1 is

(a) 27                                      (b) 18                                      (c) 81                                      (d) 512

5. The slope of the tangent at a point (2,6) to the curve  $y = x^3 - x$   
 (a) -11 (b) 11 (c) 1/11 (d) -1/11
6. An automatic machine produces 20000 pins per day. On rare occasion it produces a perfect pin whose chance is 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
7. The total area under the normal distributed curve above the base line i.e.,  $\int_{-\infty}^{\infty} f(x)dx$  is  
 (a) 0 (b) 0.5 (c) 0.75 (d) 1
8. How many components does Time series data have ?  
 (a) 3 (b) 4 (c) 5 (d) 6
9. The function  $y = |x|$  is  
 (a) Neither differentiable nor continuous at  $x = 0$   
 (b) Differentiable and continuous at  $x = 0$   
 (c) Continuous but not differentiable at  $x = 0$   
 (d) Differentiable but not continuous at  $x = 0$
10. At 6% converted quarterly, find the present value of a perpetuity of Rs 600 payable at the end of each quarter.  
 (a) 40000 (b) 45000 (c) 50000 (d) 60000
11. In a Poisson distribution, if mean is 2, what is the variance?  
 (a) 4 (b) 8 (c) 2 (d) 16
12. A Candidate claim 70% of the people in her constituency would vote for her. If 120000 valid votes are polled, then the number of votes she expects from her constituency is  
 (a) 100000 (b) 84000 (c) 56000 (d) 36000
13. If Let A be a square matrix of order  $2 \times 2$ , then  $|KA|$  is equal to  
 (a)  $K|A|$  (b)  $K^2|A|$  (c)  $K^3|A|$  (d)  $2K|A|$ .
14. The matrix  $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$   
 (a) a unit matrix (b) a symmetric matrix  
 (c) a skew symmetric matrix (d) a diagonal matrix

15. In the given figure, what is the LPP shaded region known as?



- (a) Feasible region (b) Infeasible solution (c) Optimal region (d) Objective region

16. For the purpose of t-test of significance, a random sample of size  $(n)32$  is drawn from a normal population, then the degree of freedom ( $\nu$ ) is –

- (a) 32 (b) 31 (c) 34 (d) 35

17. Find the value of  $5^6 \pmod{4}$ .

- a) 1 (b) 2 (c) 3 (d) 4

18. General solution of differential equation:  $y \log y \, dx - x \, dy = 0$  is

- (a)  $y = \log |Cx|$  (b)  $y = e^{Cx}$  (c)  $y = e^{-Cx}$  (d)  $\log y = |C + x|$

For questions 19 and 20, two statements are given – one labelled Assertion(A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (i), (ii), (iii) and (iv) as given below:

- (i) Both A and R are true and R is the correct explanation of the assertion  
 (ii) Both A and R are true but R is not the correct explanation of the assertion  
 (iii) A is true, but R is false  
 (iv) A is false, but R is true

19. **Assertion (A)** : It is given that at  $x=1$  the function  $x^4 - 62x^2 + ax + 9$  attains its maximum value on the interval  $[0, 2]$ . Then the value of  $a$  is 120

**Reason (R)** : To find the value of  $a$  put  $f'(x) = 0$

- a) (i) (b) (ii) (c) (iii) (d) (iv)

20. **Assertion (A)**: Feasible region is the set of points which satisfy all of the given constraints.

**Reason (R)**: The optimal value of the objective function is attained at the points on X axis only

- a) (i) (b) (ii) (c) (iii) (d) (iv)

## SECTION B

Answer all the questions each question carries 2 marks

21. In what ratio must a grocer mix two varieties of pulses costing Rs.15 and Rs.20 per kg respectively so as to get a mixture worth Rs.16.50 kg?

OR

In a 200-metre race, Anuj can beat Param by 5 metre or 3 seconds. How much time did Anuj take to complete the race?

22. The supply function for a commodity is  $p = \frac{(x+20)^2}{100}$ . Find the producer's surplus when the market price is 25.

OR

Evaluate:  $\int x e^x dx$

23. A sampling distribution of the sample means  $X$  is formed from a population with mean weight  $\mu = 60kg$  and standard deviation  $\sigma = 9kg$ . What is the expected value and standard deviation of  $X$ , if sample size is 36?

24. Mitul invested ₹ 3,50,000 in a fund. At the end of the year the value of the fund is ₹ 4,37,500. What is the nominal rate of interest, if the market price is same at the end of the year?

25. Find the trend values using 3 yearly moving average for the loans sanctioned to farmers by a particular branch of a bank in a village.

Year	2016	2017	2018	2019	2020	2021
Amount (in ₹ lakh)	25	30	32	40	45	50

## SECTION C

Answer all the questions each question carries 3 marks

26. A manufacturer produces two products A and B. Both the products are processed on two different machines. The available capacity of first machine is 12 hours and that of second machine is 9 hours per day. Each unit of product A requires 3 hours on both machines and each unit of product B requires 2 hours on first machine and 1 hour on second machine. Each

unit of product A is sold at Rs7 profit and that of B at a profit of Rs 4. Find the production level per day for maximum profit graphically

27. Calculate four yearly moving averages of number of students studying in a higher secondary school in a particular city from the following data.

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of Students	124	120	135	140	145	158	162	170	175

28. A container contains 40litre milk. From this container 4 litre milk was taken out and replaced with water. This process was repeated further two more times. How much milk is there in the container now?

29. Evaluate  $\int x \log(1 - x^2) dx$

**OR**

Evaluate:  $\int \frac{dx}{x(x^2 + 1)}$ .

30. A person invested ₹15000 in a mutual fund and the value of investment at the time of redemption was ₹25000. If CAGR for this investment is 8.88%, calculate the time period for which the amount was invested? [Given  $\log(1.667) = 0.2219$  &  $\log(1.089) = 0.037$ ]

**OR**

Find the equation of the tangent to the curve  $x^2 + 3y - 3 = 0$ , which is parallel to the line  $y = 4x - 5$

31. Surjeet purchased a new house, costing ₹ 40,00,000 and made a certain amount of down payment so that he can pay the balance by taking a home loan from XYZ Bank. If his equated monthly instalment is ₹ 30,000, at 9% interest compounded monthly (reducing balance method) and payable for 25 years, then what is the initial down payment made by him? [Use  $(1.0075)^{-300} = 0.1062$ ]

## SECTION D

**Answer all the questions each question carries 5 marks**

32. It is known that 3% of plastic buckets manufactured in a factory are defective. Using the Poisson distribution on a sample of 100 buckets, find the probability of:

(i) Zero defective buckets

(ii) At most one bucket is defective [Use  $e^{-3} = 0.049$ ]

**OR**

In a math aptitude test, student scores are found to be normally distributed having mean as 45 and standard deviation 5. What percentages of students have scores -

(i) More than the mean score? Between 30 and 50?

(ii) Between 30 and 50?

**33.** Use the second derivative test to find the local maxima and minima of

$$f(x) = \frac{4}{3}x^3 + 6x^2 + 8x + 7$$

**OR**

To manufacture 'x' number of dolls, a company's total cost function  $C(x)$  is given by

$$C(x) = 100 + 0.025x^2 \text{ and the total revenue function } R(x) \text{ is described as } R(x) = 5x.$$

Given that  $C(x)$  and  $R(x)$  are in thousand rupees, what number of dolls shall be manufactured to maximise the profit of the company? What is the maximum profit?

**34.** Solve the following system of equation using matrix method

$$3x + x + z = 10,$$

$$2x - y - z = 0,$$

$$x - y + 2z = 1$$

**35.** In a certain culture of bacteria, the rate of increase of bacteria is proportional to the number present. It is found that there are 10,000 bacteria at the end of 3 hours and 40,000 bacteria at the end of 5 hours. Determine the number of bacteria present in the beginning.

### **CASE STUDY QUESTIONS**

**36.** An overhead water tank has three pipes A, B and C attached to it. The inlet pipes A and B can fill the empty tank independently in 15 hours and 12 hours respectively. The outlet pipe C alone can empty a full tank in 20 hours.

Based on the above information, answer the following questions. Show steps to support your answers.

(i) For a routine cleaning of the tank, the tank needs to be emptied. If pipes A and B are closed at the time when the tank is filled to two-fifth of its total capacity, how long will pipe C take to empty the tank completely? (1 mark)

- (ii) How long will it take for the empty tank to fill completely, if all the three pipes are opened simultaneously? (1 mark)
- (iii) On a given day, pipes A, B and C are opened (in order) at 5 am, 8 am and 9 am respectively, to fill the empty tank. In how many hours will the tank be filled completely? (2 mark)

**OR**

Given that the tank is half-full, only pipe C is opened at 6 AM, to empty the tank. After closing the pipe C and an hour's cleaning time, tank is filled completely by pipe A and B together. What is the total time taken in the whole process? (2 mark)

**37. CASE STUDY:** Four friends Rohan, Rohit, Roshan, and Raman have few doubts in the topic binomial distribution, so they decided for group study at Rohan's place. They are trying to solve a question in which a pair of dice is thrown 7 times. If getting a total 7 is considered a success, then answer the following questions.

- i. If X denote the number of success in 7 throws of a pair of dice, then find X binomial variate with parameter? (1 mark)
- ii. What is the probability of no success? (1 mark)
- iii. What is the probability of at least 6 success? (2 mark)

**OR**

What is the probability of at most 6 success? (2 mark)

**38. CASE STUDY:**

In a factory A machine costing Rs.50000 depreciates at a constant rate of 8%.

- (i) What is the book value at the end of the 7th year?( 1mark)
- (ii) What is the book value at the end of the 8th year? ( 1mark)
- (iii) What is the depreciation charge for the 8th year? ( 2mark)

**OR**

If the estimated useful life of the machine is 10 years, determine its scrap value. (2mark)