MOCK EXAMINATION - I   2023 - 2024
APPLIED MATHEMATICS

Name : _____   **Marks : 80**

Std / Sec : XII

Date   : 16.12.2023   **Time   : 3hrs.**

General Instructions:

1. This question paper contains five sections A, B, C, D and E and total of **38 questions**. 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 questions no **1-18 MCQs and 19 & 20 are Assertion-Reason based questions of 1 mark** each.

Section – B:

4. It comprises of questions no **21-25 VSA types questions of 2 marks** each.

Section – C:

5. It comprises of questions no **26-31 SA types of questions of 3 marks** each.

Section – D:

6. It comprises of questions no **32-35 LA types of questions of 5 marks** each.

Section – E:

7. It has **3 case studies** questions no **36-38**. 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**. Internal choice is provided in **2 marks** question in each case-study.

8. Internal choice is provided in **2 questions in Section - B**, **2 questions in Section – C**, **2 questions in Section - D**. You have to attempt only one of the alternatives in all such questions.

9. **Use of Calculator not permitted.**

Section –A

(Each question (1-20) carries 1 mark each, all questions are compulsory. No internal choice in this section)

1. If $100 \equiv x(\mod 7)$, then the least positive value of x is

   (a) 2   (b) 3   (c) 6   (d) 4

2. The solution of the inequation $|x+2| \le 5$ is

   (a) (-7,5)   (b) [-7,3]   (c) [-5,5]   (d) (-7,3)

3. Which of the following statements are true?

   I: The mean of a population is denoted by $\bar{x}$.

   II: The population mean is a statistic.

   (a) I only   (b) II only   (c) Both I and II   (d) none

4. Suppose company A has its branches in 15 cities. You want to select a sample of 100 employees. It is difficult to select members from each branch. So first select any 5 branches and then select 20 members from each selected branch. It is related to

   (a) Simple random sampling   (c) Stratified Sampling

   (b) Systematic Sampling   (d) Cluster Sampling

5. Two athletes Vijay and Samuel finish 100 meters race in 12 seconds and 16 seconds respectively. By how many meters does Vijay defeat Samuel?

   (a) 10.2 m   (b) 15 m   (c) 25 m   (d) 33.3 m

6. A coin is tossed 4 times. The probability of getting atleast one head is

   (a) $\dfrac{1}{16}$ (b) $\dfrac{1}{8}$ (c) $\dfrac{1}{7}$ (d) $\dfrac{15}{16}$

7. It is currently 08:00 A.M. What time (A.M. or P.M.) will be in next 500 hours?

   (a) 08:00 A.M.   (b) 04:00 A.M.   (c) 04:00 P.M.   (d) 08:00 P.M.

8. At what rate of interest will the present value of a perpetuity of ₹300 payable at the end of each quarter ₹24000

   (a) 4%   (b) 5%   (c) 6%   (d) 8%

9. If $\displaystyle\int_{0}^{40} \dfrac{dx}{2x+1} = \log k$, then the value of k is

   (a) 3   (b) $\dfrac{9}{2}$ (c) 9   (d) 81

10. Increase in the number of patients in the hospital due to heat stroke is

    (a) Secular Trend   (c) Seasonal Variation

    (b) Irregular Variation   (d) Cyclical Variation

11. The annual depreciation of a car is ₹30000, if the scrap value of the car after 15 year is ₹50000, then original cost of tr, when depreciation is linear.

    (a) ₹500000   (b) ₹450000   (c) ₹600000   (d) ₹650000

12. Navisha has an initial investment of ₹200000 in an investment plan. After 6 years, it has grown to ₹250000 then rate of return is

    (a) 25%   (b) 55%   (c) 75%   (d) 80%

13. Interest paid in kth payment

    (a) $\dfrac{EMI\left(1+i\right)^{n-k+1}-1}{\left(1+i\right)^{n-k+1}}$ (c) $\dfrac{EMI\left(1+i\right)^{n+k-1}-1}{\left(1+i\right)^{n+k-1}}$

    (b) $\dfrac{EMI\left(1+i\right)^{n-k+1}-1}{i}$ (d) $\dfrac{EMI\left(1+i\right)^{n-k+1}-1}{i\left(1+i\right)^{n-k+1}}$

14. The order and the degree of the differential equation $\left(1+3\dfrac{dy}{dx}\right)^{\frac{2}{3}} = 4\dfrac{d^3y}{dx^3}$, respectively, are

    (a) $3, \dfrac{2}{3}$ (b) $3, 1$ (c) $3, 2$ (d) $3, 3$

15. For the following feasible region, the linear constraints are
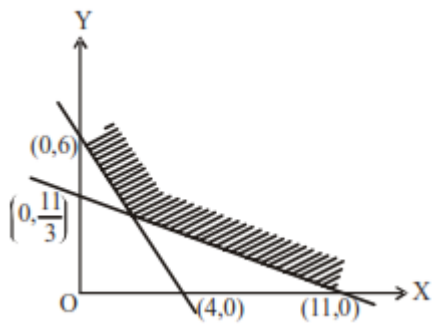
    (a) $x \geq 0,\ y \geq 0,\ 3x + 2y \geq 12,\ x + 3y \geq 11$

    (b) $x \geq 0,\ y \geq 0,\ 3x + 2y \leq 12,\ x + 3y \geq 11$

    (c) $x \geq 0,\ y \geq 0,\ 3x + 2y \leq 12,\ x + 3y \leq 11$

    (d) None of these

16. In a binomial distribution, the probability of getting a success is $\dfrac{1}{4}$ and the standard deviation is 3. Then its mean is

(a) 6   (b) 8   (c) 12   (d) 48

17. Which of the following is an example of time series problems?

   (i) Estimating numbers of hotel rooms booking in next 6 months.

   (ii) Estimating the total sales in next 3 years of an insurance company.

   (iii) Estimating the number of calls for next one week.

(a) Only (iii)   (b) (i) and (ii)   (c) (i), (ii), & (iii)   (d) (ii) & (iii)

18. Given that mean of a normal variable X is 12 and standard deviation is 4, then find the data point if its Z-score is -2.

(a) 2   (b) 4   (c) 20   (d) 32

Directions (19-20)the below given questions are of the type Assertion and Reason. Each question contains Assertion and Reason. Each question has 4 choices (a), (b), (c) and (d)out of which ONLY ONE is correct. So select the correct choice.

(a) Both the Assertion and Reason is true, and the reason is correct explanation for assertion.

(b) Both the Assertion and Reason is true, and the reason is not correct explanation for assertion.

(c) Assertion is true, reason is false

(d) Assertion is false, reason is true

19. **Assertion:** The total cost and the total revenue of a company that produces and sells x units of particular product are respectively $C(x) = 5x + 350$ and $R(x) = 50x - x^2$. The breakeven value are 10 or 30.
    Reason: $P(x) = R(x) - C(x)$

20. **Assertion:** The area under the standard normal curve which lies right of $Z = -0.48$ is $F(0.48)$.
    Reason: If Z is a standard normal variable, then $F(z)$ represents the entire area which is left of the line $Z = z$.

(Each question (21-25) carries 2mark each, all questions are compulsory. In case of internal choice attempt only one question)

21. What effective rate is equivalent to a nominal rate of 8% per annum compounded quarterly?
    [Given $(1.02)^4 = 1.0824$]

22. If A is a square matrix $\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$ such that $A^2 = pA$, then the value of p.

    (OR)

    If A, B are symmetric matrices of same order, prove that AB-BA is a skew-symmetric matrix.

23. Two tailors A and B earn 300 and 400 per day, respectively. A can stitch 6 shirts and 4 pairs of trousers while B can stitch 10 shirts and 4 pairs of trousers per day. To find how many days should each of them work and if it is desired to produce at least 60 shirts and 32 pairs of trousers at a minimum labour cost. Formulate this problem as LPP.

24. Three varieties A, B and C of tea are mixed together in the ratio 1:1:3 respectively. The price of tea A is ₹127 per kg and that of tea B is ₹135 per kg. If the price of the mixture is ₹152 per kg, the find the price per kg of tea C.

    (OR)

    In a one-kilometer race, A beats B by 30 seconds and B eats by 15 seconds. If A beats C by 180 meters, then find the time taken by A to run 1 kilometer.

25. Consider the following hypothesis test

    $H_o : \mu \leq 12$
    $H_a : \mu > 12$

    A sample of 25 provided a sample mean of 14, the sample standard deviation is 4.32. What is the rejection rule using critical value approach? What is your conclusion? ($\alpha = 0.05$)

SECTION – C

(Each question (26-31) carries 3 marks each, all questions are compulsory. In case of internal choice attempt only one question)

26. (a) Evaluate: $\int x \log(1+x^2)dx$

    (OR)

    (b) Evaluate: $\int_{1}^{3} |x^2 - 2x| dx$

27. Two badminton teams A and B are staying in the same hotel. Team A has 2 male and 3 female players accompanied by 1 coach. Team B comprises of 1 male, 2 female players and 2 coaches. The daily diet requirement (calories and protein) for each person is as given below:

	Calories	Protein
Male Player	2500	65 g
Female Player	1900	50 g
Coach	2000	54 g

Use matrix algebra to calculate the total diet requirement of calories and protein for each team.

28. At what points will the tangent to the curve $y = 2x^3 - 15x^2 + 36x - 21$ be parallel to x-axis. Also, find the equation of tangents at those points.

29. (a) The marginal revenue function of a commodity is $MR = 7 - \dfrac{6}{(x+2)^2}$, find the revenue function. Also, find the revenue obtained on selling 4 units of the product.

(OR)

(b) The demand and supply function of a commodity are $p_d = 18 - 2x - x^2$ and $p_s = 2x - 3$. Find the producer's surplus at equilibrium price

30. Mr. Bharti wishes to purchase a flat for ₹6000000 with a down payment of ₹1000000 and balance in equal monthly payments for 20 years. If bank charges 7.5% p.a. compounded monthly, calculate the EMI.

(Given $(1.00625)^{240}$ = 4.4608)

31. Mr X plans to save amount for higher studies of his son, required after 10 years. He expects the cost of these studies to be ₹100000. How much should he save at the beginning of each year to accumulate this amount at the end of 10 years, if the interest rate is 12% compounded annually? [Given $(1.12)^{11} = 3.477$]

SECTION – D

(Each question (32-35) carries 5 marks each, all questions are compulsory. In case of internal choice attempt only one question)

32. (a) The probability of a shooter hitting a target is $\dfrac{3}{4}$. How many minimum number of times must he fire so that the probability of hitting the target atleast once is more than 0.99?

(OR)

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

    (i) more than the mean score?

    (ii) between 30 and 50?

33. Suppose every gram of wheat provides 0.1 g of proteins and 0.25 g of carbohydrates, and the corresponding values for rice are 0.05 g and 0.5 g respectively. Wheat costs ₹20 and rice ₹30 per kilogram. The minimum daily requirement of an average man for proteins and carbohydrates is 50 g and 200 g respectively. Find what quantities of wheat and rice be mixed in the daily diet to provide the minimum daily requirements of proteins and carbohydrates at minimum cost and also find the minimum cost? Form an L.P.P. and solve it graphically using iso-profit/iso-cost method.

34. (a) An open topped box is to be made by removing equal squares from each corner of a 3 m by 8 m rectangle sheet of aluminum and by folding up the side. Find the volume of the largest such box.

(OR)

(c) The demand x of a commodity in terms of price p is given by $x = (245 - 7p)$. The average cost is 20 per unit. Find in terms of p:

    (i)   The cost function

    (ii)   The revenue function

    (iii)   The profit function

    (iv)   The price and level of output at which profit is zero

35. 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 above problem algebraically and use Cramer's rule to find the numbers from these equations.

SECTION – E

(All the questions (36-38) are compulsory. In case of internal choice attempt only one question)

36. Case Study I:

A, B, C, D are the four contestants 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 questions:

(a) Find the ratio of speed A: D   .   **[1m]**

(b) Which contestant win the race without any start?   **[1m]**

(c) If C gives a start of 40 m to B and still beat him by how much seconds?   **[2m]**

                    (OR)

   Find the B's time over the course.   **[2m]**

37. Case Study II:

In a game, a man wins ₹8 for getting a number greater than 3 and loses ₹23 otherwise, when a fair die is thrown. The man decided to throw a die 4 times but to quit as and when he gets a number greater than 3.

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

(a) If X denotes the amount which the man wins or loses, then find all the possible values of X.

                                                                                                                                         [1m]

(b) Find the probability distribution of X.   **[1m]**

(c) Find the expected value of X.   **[2m]**

                    (OR)

   Find the variance of X.   **[2m]**

38. Case Study III:

In an influenza epidemic the number of cases diagnosed were

Date (March)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Numbers	2	0	5	12	20	27	46	30	31	18	11	5	0	1

Based on the above information, answer the following questions.

Show steps to support your answers.

(a)   Calculate 3-day moving average   **[2m]**

(b)   Display new and original figures on the same graph.   **[2m]**

**********************All the best******************