SET-B

MOCK EXAMINATION I 2022-2023

APPLIED MATHEMATICS (241)

Exam No: _____ **Max. Marks: 80**

Std / Sec: XII-D **Time: 3 hrs.**

Date :

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 totalweightage of 12 marks.

Section – A:

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

Section – B:

4. It comprises of **5 VSA types questions of 2 marks** each.

Section – C:

5. It comprises of **6 SA types of questions of 3 marks** each.

Section – D:

6. It comprises of **4 LA types 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 questionsare of 1 mark** each and **1 SA type question is of 2 marks**. Internal choice is provided in **2 marks** questionin each case-study.
8. Internal choice is provided in **2 questions in Section - B**, **2 questions in Section – C,2questions in Section - D**. You have to attempt only one of the alternatives in all such questions.

- **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. (8×14) in 12 hours clock is

   (a) 4 O'clock (b) 8 O'clock (c) 6 O'clock (d) 2 O'clock

2. If $p > q$ and $r < 0$, then which of the following is true?

   (a) $pr < qr$ (b) $p - r < q - r$ (c) $p + r < q + r$ (d) none of these

3. An observed set of the population that has been selected for analysis is called

   (a) a sample (b) a process (c) a forecast (d) a parameter

4. A sample of 4 students from a school was taken to see how many pens were they carrying **2,3,5,6.** What is the point estimate of the population mean?

   (a) 6 (b) 4 (c) 5 (d) 16

5. A man can row at 8 km/h in still water. If the speed of current is 2 km/h and he takes 4 hours to row to a place and return back, how far is the place?

   (a) 10 km (b) 12 km (c) 15 km (d) 9 km

6. A statement made about a population parameter for testing purpose is called

   (a) Statistic (b) parameter (c) hypothesis (d) level of significance

7. In a 500m race, A reaches the finish point in 20 seconds and B reaches in 25 seconds. By how much distance A beats B?

   (a) 50m (b) 100m (c) 110m (d) 150m

8. Mr. X takes a loan of 2,00,000 with 10% annual interest rate for 5 years. Find EMI?

   (a) ₹3000 (b) ₹5000 (c) ₹2000 (d) ₹3500

9. The marginal cost of production is $30+2x$, it is known that fixed cost is ₹200, then the cost of increasing output from 100 to 200 units is

   (a) ₹3300 (b) ₹33000 (c) ₹3500 (d) ₹35000

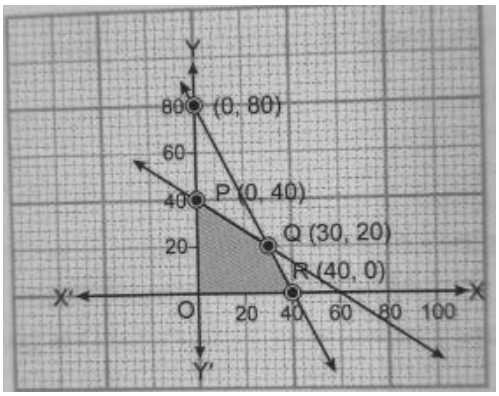
10. A factory production is delayed for three weeks due to breakdown of a machine and unavailability of spare parts. Under which trend oscillation does this situation fall under?

    (a) Seasonal (b) Cyclical (c) Secular (d) Irregular

11. A vehicle costing ₹125000 has scrap value ₹25000. If annual depreciation charge is ₹12500, then useful life of the vehicle is

    (a) 4 years (b) 6 years (c) 8 years (d) 10 years

12. For an LPP the objective function is $Z=4x+3y$ and feasible region determined by a set of constraints (linear inequations) is shown in the graph.



   Which of the following statements is true?

   (a) Maximum value of Z is at R (c) Value of Z at R is less than the value at P

   (b) Maximum value of Z is at Q (d) The value of Z at Q is less than the value at R

13. Integrating factor of $x\frac{dy}{dx}-y=x^4$ is

    (a) x (b) $\log x$ (c) $\frac{1}{x}$ (d) $-x$

14. ₹100 shares of a company are selling at ₹80. If the company is paying a dividend of 12%, then the rate of return is

    (a) 10% (b) 12% (c) 15% (d) 18%

15. A container contains 40L milk. From this container 4L milk was taken out and replaced with water. This process was repeated further two more times. How many milk is there in the container now? (Approx)

(a) 9L (b) 19L (c) 29L (d) 39L

16. _____ the population is divided into subgroups based on the relevant characteristics, then the members from each subgroup are selected using sampling methods

(a) Systematic sampling (c) Stratified sampling

(b) Snowball sampling (d) Cluster Sampling

17. The equation of trend line can be written as $y_t = a + bx$, the values of a and b can be obtained by solving the equations $\sum y = na + \sum x$ and $\sum xy = a\sum x + b\sum x^2$. What is the equation called as?

(a) Linear general equations (b) Method of least squares

(c) Normal Equation (d) Normal Curve analysis

18. Critical value approach to reject H_0 for an upper tail test of hypothesis test about population mean(σ unknown) is

(a) $t \le t_\alpha$ (b) $t \ge t_\alpha$ (c) $t \ge -t_\alpha$ (d) $t \le -t_\alpha$

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:** In a Binomial Distribution, if $p = q$, then $P(X = x)$ is given by ${}^nC_x(0.5)^n$

Reason: The probability of r success in n trails, denoted by $P(X = r)$ is given by $P(X = r) = {}^nC_r p^r q^{n-r}, r = 0,1,2,.....n$ where p denotes success and q denotes failure in each trail.

20. **Assertion:** The decrease in the value of the assets such as building machinery and equipment of all kinds is called depreciation.

Reason: The difference between the original cost and the scrap value is called total depreciation.

Section – B

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

21. At what rate of interest will the present value of perpetuity of ₹500 payable at the end of each quarter be ₹35000?

22. Solve the equation for $x, y, x \& t$, if $2\begin{bmatrix} x & z \\ y & t \end{bmatrix} + 3\begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix} = 3\begin{bmatrix} 3 & 5 \\ 4 & 6 \end{bmatrix}$

(OR)

If $A = \begin{vmatrix} 2 & 3 & -1 \\ 4 & 1 & 0 \\ 3 & 3 & 2 \end{vmatrix}$, find $M_{12} \times M_{21} + C_{21} \times C_{12}$ when M_{ij} is called minor and C_{ij} is called cofactors of A.

23. A motor boat takes 3 hours to cover a certain distance upstream and returns back the same distance downstream in 1 hour 15 minutes. If the speed of the stream is 7 km/h, find the speed of boat in still water.

(OR)

In a flat race, A beats B by 15 m and C by 29 m. When B and C run over the course together B wins by 15 m. Find the length of the race course.

24. A factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftsman's time in its making while a cricket bat takes 3 hours of machine time and 1 hour of craftsman's time. In a day, the factory has the availability of not more than 42 hours of machine time and 24 hours of craftsmen's time. If the profit on a racket and on a bat is 20 and 10 respectively.Formulate this as a linear programming problem to maximize its profit.

25. Find the effective interest rate corresponding to a nominal rate of interest of 8.5% per year compounded monthly. [Given $(1.00708)^{12}=1.0884$]

SECTION – C

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

26. To promote the making of toilets for women, as organization tried to generate awareness through (i) house calls (ii) letters and (iii) announcements. The cost for each mode per attempt is given below: (i) ₹50 (ii) ₹20 (iii) ₹40

The number of attempts made in three villages X, Y and Z and given below:

	(i)	**(ii)**	**(iii)**
X	400	300	100
Y	300	250	75
Z	500	400	150

Find the total cost incurred by the organization for the three villages separately, using matrices

27. Find the point on the curve $y = x^3 - 11x + 5$ at which the equation of tangent is $y = x - 11$.

28. Evaluate: $\int \frac{e^{2x} - e^{-2x}}{e^{2x} + e^{-2x}} dx$

(OR)

Evaluate: $\int \frac{dx}{2x^2 + 4x - 3}$

29. A cake is removed from an oven at 250^0F and left to cool at room temperature which is 70^0F. After 30 minutes the temperature of the cake is 150^0F. After how much time will it be 100^0F? [Given log 6=0.7782, log 4=0.6021, log 9=0.9542]

(OR)

The demand function p for maximizing a profit monopolist is given by $p = 274 - x^2$ while the marginal cost is $4 + x$, for x units of the commodity. Using integrals, find the consumer surplus.

30. Rohan has completed his M.B.A. and now he wants to start a new business. So, he approaches to many banks. One bank is agreed to give loan to Rohan. So, Rohan has borrowed ₹5 lakhs from a bank on the interest rate of 12% for 10 years.

(i) Calculate monthly installment using $(1.01)^{120} = 3.300$

(ii) Find the amount of interest paid by Rohan.

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 ₹200000. 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. Assume that the probability that a bomb dropped from an aero plane will strike a certain target is $\frac{1}{5}$. If 6 bombs are dropped, find the probability that

(i) Exactly two will strike the target

(ii) Atleast 2 will strike the target

Given: $e^{-1.2} = 0.301$

(OR)

(i) There are 5% defective items in a large bulk of items. What is the probability that a sample of 10 items will not include more than 1 defective item?

(ii) In 3 trails of a binomial distribution, the probability of 2 successes is 9 times the probability of 3 successes. Find the probability of success in each trial.

33. A steel plant is capable of producing x tonnes per day of low-grade steel and y tonnes per day of a high-grade steel, where $y = \frac{32-5x}{10-x}$. If the fixed price of low-grade steel is half that of high-grade steel, find the quantity of low-grade steel that should be produced per day for maximum receipts.

(OR)

The volume of a closed metal box with a square base is 4096 cm^3. The cost of polishing the outer surface of the box is ₹4 per cm^2. Find the dimensions of the box for the minimum cost of polishing it.

34. A farmer has a supply of chemical fertilizer of type A which contains 10% nitrogen and 6% phosphoric acid and of type B which contains 5% nitrogen and 10% phosphoric acid. After soil test, it is found that atleast 7 kg of nitrogen and same quantity of phosphoric acid is required for a good crop. The fertilizer of type A costs ₹5 per kg and the type B cost ₹18 per kg. Using linear programming, find how many kilograms of each type of the fertilizer should be bought to meet the requirement and for the cost to be minimum. Find the feasible region in the graph.

35. Check consistency and solve equations using Cramer's rule:

$2x + y - 2z = 4$
$x - 2y + z = -2$
$5x - 5y + z = -2$

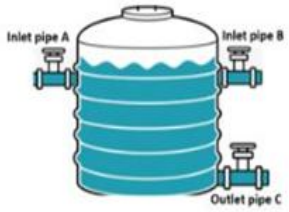
SECTION – E

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

36. **CASE I:**

A pipe is connected to tank or cistern. It is used to fill or empty the cistern. The amount of work down by a pipe is a part of the tank filled or emptied in unit time.

An overhead water tank has three pipes A, B and C attached to it (as shown in figure). The inlet pipes A and B can fill the empty tank independently in 6 hours and 8 hours respectively. The outlet pipe C alone can empty a full tank in 15 hours.



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

(a) If pipes A and C are opened together, then how much time will be taken to fill the tank? **[1]**

(b) If all three pipes A,B and C are opened together, what is the time taken to fill the empty tank? **[1]**

(c) If pipes A and B are opened together for some time and then pipe B is turned off. If the tank is filled in 5 hours, then find how much time the pipe B is turned off? **[2]**

(OR)

If all three pipes are opened together, then the tank is filled in 24 hours. If pipe C can empty the tank at the rate of 20 litres/hours, then find the capacity of the tank. **[2]**

37. **Case II:**

When observed over a long period of time, a time series data can predict trend that can forecast increase or decrease or stagnation of a variable under consideration. Such analytical studies can benefit a business for forecasting or prediction of future estimated sales or production. Mathematically, for finding a line of best-fit to represent a trend, many methods are available. Methods like moving-averages and least-squares squares are some of the techniques to predict such trends.

Mrs. Zahir Hasan runs a steel industry and workers welfare expenses (in lakhs) for the period of 2001- 2005 are as follows:

Year	**2001**	**2002**	**2003**	**2004**	**2005**
workers welfare expenses (in lakhs)	160	185	220	300	510

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

(a) By taking year 2003 as origin, use method of least-squares to find the best-fit trend line equation for Mrs Zahir Hasan runs a steel industry. Show the steps of your working. **[2]**

(OR)

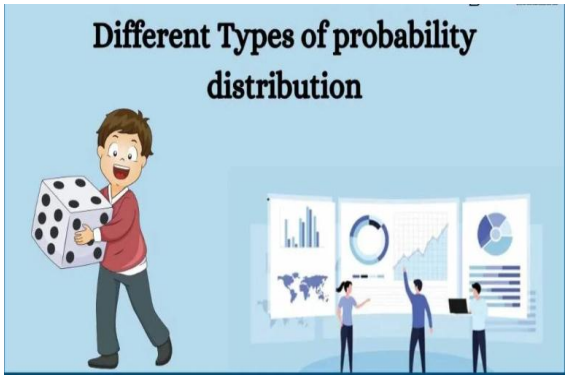
Demonstrate the technique to fit the best-suited straight-line trend by the method of 3-years moving averages. Also draw the trend line. **[2]**

(b) Estimate the likely workers welfare expenses of steel factory during 2006? **[1]**

(c) Mrs Zahir Hasan wishes to check when the workers welfare expenses reach of 805 lakhs. In which year will he be able to reach her target? **[1]**

38. **Case III:**

Let X denotes the number of hours a person watches television during a randomly selected day. The probability that X can take the values x_i has the following form, where k is some unknown constant.



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

$$P(X=x_i)=\begin{cases}0.2, & x_i=0\\ kx_i, & x_i=1,x_i=2\\ k(5-x_i), & x_i=3\\ 0, & otherwise\end{cases}$$

(a) Find the value of k. **[1]**

(b) What is the probability that the person watches two hours of television on a selected day? **[1]**

(c) What is the probability that the person watches atmost two hours of television on a selected day? **[2]**

(OR)

Calculate mathematical expectation and variance of a random variable X. **[2]**

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