THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

GRADE: XII Date:09/12/24	FIRST MODEL EXAMINATION 2024 APPLIED MATHEMATICS (241)	MARKS: 80 TIME: 3 HOURS

General Instructions :

1. This Question paper contains - **five sections** A,B,C,D and E. Each section is compulsory. However, there is some internal choice in some questions.
2. **Section A** has 18 **MCQ's and 02** Assertion Reason based questions of 1 mark each.
3. **Section B** has 5 **Very Short Answer(VSA)** questions of 2 marks each.
4. **Section C** has 6 **Short Answer(SA)** questions of 3 marks each.
5. **Section D** has 4 **Long Answer(LA)** questions of 5 marks each.
6. **Section E** has 3 **source based/case based/passage based/integrated units of assessment (**04 marks each**)** with sub parts.
7. Internal Choice is 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.**
8. Use of calculators is not allowed.

Q.No.	Questions	Mark
	SECTION A (Multiple Choice question) **Each question carries 1 mark**	
1	What is the least value of x that satisfies $x \equiv 27(mod\ 4)$, when $27 < x \leq 36$? (A) 27 (B) 30 (C) 31 (D) 35	**1**
2	The remainder when 5^{61} is divided by 7 is: (A)2 (B)1 (C) 5 (D) 4	**1**
3	A man can row 7.5 km/hr in still water. if the stream is flowing at the rate of 1.5 km/hr, it takes him 50mins to row to a place and return . how far is the place? (A) 3KM (B) 2KM (C) 4K (D)2.5 KM	**1**
4	The solution of $|x + 2| \leq 5$ is:	**1**

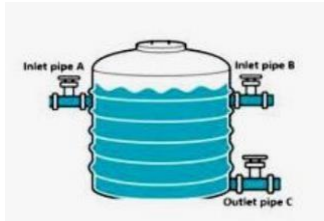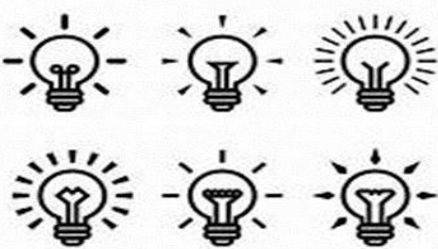|		
	(A)(-7,5)　　　(B)[-7,3]　　(C)[-5,5]　　　　(D)(-7,3)	
5	$\int x\sqrt{x+2}\,dx$ (A)$\frac{2}{5}(x+2)^{\frac{5}{2}}-\frac{2}{3}(x+2)^{\frac{3}{2}}+c$　　　　　　(B)$\frac{5}{2}(x+2)^{\frac{5}{2}}+\frac{3}{2}(x+2)^{\frac{3}{2}}+c$ (C)$\frac{2}{5}(x+2)^{\frac{5}{2}}-\frac{4}{3}(x+2)^{\frac{3}{2}}+c$　　　　　　(D)$\frac{2}{5}(x+2)^{\frac{5}{2}}+\frac{4}{3}(x+2)^{\frac{3}{2}}+c$	1
6	$\int_{1}^{3}(x^2+1)\,dx$ is equal to (A)$\frac{16}{3}$　　　　　(B)$\frac{22}{3}$　　　　　(C)$\frac{32}{3}$　　　　　(D)$\frac{34}{3}$	1
7	The present value of a sequence of payments of Rs 60 made at the end of each 6 months and continuing forever, if money is worth 4% p.a. compounded semi-annually is (A) RS 3,000　　　　　　　(B) RS 3,500 (C) RS 4,000　　　　　　　(D) RS 4,500	1
8	At 6% converted quarterly, find the present value of a perpetuity of Rs 600 payable at the beginning of each quarter. (A) Rs 30,400　　　　　(B) Rs 35,500 (C) Rs 40,600　　　　　(D) Rs 45,000	1
9	A machine costing Rs 50,000 has a useful life of 4 years. The estimated scarp value is Rs 10,000, then the annual depreciation is (A) Rs 20,000　　　　　　　(B) Rs 10,000 (C) Rs 5,000　　　　　　　(D) Rs 2,500	1
10	CAGR stands for (A) Compound Aggregate Growth Rate (B) Compound Annual Growth Rate (C) Computed Annual Growth Rate (D) Computed Aggregate Growth Rate	1
11.	A fire in a factory delaying production for some weeks is (A) Secular Trend (B) Cyclical Trend (C) Irregular Trend (D) Seasonal Trend	1

12.	A time series consist of (A) Short-term variations (B) Long-term variations (C) Irregular variations (D) All the above	**1**
13	Corner points of the feasible region for an LPP are (0, 2), (3, 0), (6, 0), (6, 8) and (0, 5). Let F = 4x+ 6y be the objective function. The Minimum value of F occurs at .... (A) only (0, 2) (B) only (3, 0) (C) the mid-point of the line segment joining the points (0, 2) and (3, 0) only (D) any point on the line segment joining the points (0, 2) and (3, 0).	**1**
14	In a Poisson Distribution, if 'n' is the number of trials and 'p' is probability of success, then the mean value is given by? (A) m = np (B) m = 2np (C) m = np(1-p) (D) m = p	**1**
15.	For a standard normal variate, the value of mean is? (A)0 (B) 1 (C)∞ (D) not defined	**1**
16.	The shape of the Normal Curve is (A) Bell Shaped (B) Flat (C) Circular (D) Spiked	**1**
17.	Which of the following statement are true? I: The mean of the 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) III only	**1**
18	An observed set of population that has been selected for analysis is called (A) a sample (B) a process (C) a forecast (D) a parameter	**1**

	ASSERTION-REASON BASED QUESTIONS	
	In the following questions(19&20), a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices. (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):**If the mean of a Poisson distribution is 2.56 then standard deviation is 1.6 **Reason (R):** The Poisson distribution has only one parameter, λ (lambda), which is the mean number of events.In Poisson distribution is Mean = Variance = λ.	**1**
20	**Assertion (A):** The maximum profit that a company makes if profit function is given by P(x) = 41 + 24x − 8x ^2 ; where 'x' is the number of units and P is the profit is 59. **Reason (R) :** The profit is maximum at x = a if $P'(a) = 0$ $and\ P''(a) > 0$	**1**
	SECTION B **(This section comprises of very short answer type-questions(VSA) of 2 marks each)**	
21	Solve the following inequality and graph the solution on the number line: $$2x - 5 \le x + 2 \le 3x + 8$$ **OR** A woman can swim 8 km/h in still water. If the speed of the stream is 4 km/h, then find the time taken by the woman to cover the distance of 16 km upstream.	**2**
22	If $\begin{bmatrix} 5 & 3x \\ 2y & z \end{bmatrix} = \begin{bmatrix} 5 & 12 \\ 6 & 4 \end{bmatrix}$ then find the value of x, y, z	**2**

23	The present value of a perpetual income of x at the end of each six months is 40000. Find the value of x if money is worth 6% compounded semi-annually.	**2**
24	A die is rolled. If a random variable X is defined as the number on the upper face , then find its probability distribution. **OR** In a certain village some families are strictly limited to two children. The probability distribution of number of children is given below. Find the mean number of children. <table><tr><td>No of children</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Probabilty</td><td>1/10</td><td>1/2</td><td>2/5</td></tr></table>	**2**
25	A machine produces washers of thickness 0.50 mm. To determine whether the machine is in proper working order, a sample of 10 washers is chosen for which the mean thickness is 0.53 mm and the standard deviation is o.03 mm. Test the hypothesis at 5% level of significance that the machine isworking in proper order. (Given t0.025 = 2.262 at 9 degree of freedom).	**2**

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SECTION C
(This section comprises of short answer type questions (SA) of3 marks each)

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26	The quarterly profits of a small-scale industry (₹ in thousands)	**3**
	<table><tr><td>Year</td><td>Quarter 1</td><td>Quarter 2</td><td>Quarter 3</td><td>Quarter 4</td></tr><tr><td>2020</td><td>39</td><td>47</td><td>20</td><td>56</td></tr><tr><td>2021</td><td>68</td><td>59</td><td>66</td><td>72</td></tr><tr><td>2022</td><td>88</td><td>60</td><td>60</td><td>67</td></tr></table> are as follows._____ Calculate 4-quarterly moving averages	
27	Evaluate: $\int x^2 e^x \, dx$ **OR** Evaluate: $\frac{3x+1}{(x-1)^2(x+3)}$	**3**

28	Find the equation of the normal to the curve $x^2 + y^2 - 4x - 6y + 8 = 0$ at the point where x= 2. **OR** The total revenue received from the sale of x units of a product is given by $R(x) = 200 + \frac{x^2}{5}$ Find (a) The average revenue (b) The marginal revenue (c) The marginal revenue when $x = 25$.	3
29	The supply function for a commodity is $100p = (x + 20)^2$.Find the producer's surplus when the market price is Rs 25.	**3**
30	Ram takes a loan of R.S 2,00,000 with 10% annual interest rate for 5 years. Calculate EMI under Flat Rate system.	**3**
31	**a)** If the sum of mean and variance of a binomial distribution is 4.8 for 5 trials, find the distribution. **OR** **b)** Obtain the binomial distribution whose mean is 10 and standard deviation is $2\sqrt{2}$	**3**
	SECTION D **(This section comprises of long answer-type questions (LA) of5 marks each)**	
32	Solve the following system of equations: $x + y + z = 6$ $x - y + z = 2$ $2x + y - z = 1$	**5**
33	Find the absolute maximum and absolute minimum values of the function $f(x) = 3x^4 - 2x^3 - 6x^2 + 6x + 1$ on $[0,2]$. **OR**	**5**

	Find the intervals in which $f(x) = (x-1)^3(x-2)^2$ is strictlyincreasing or strictly decreasing.	
34	Solve the following linear programming problem graphically: Maximize Z = 4x + y subject to the constraints: x + y ≤ 50 3x + y ≤ 90 x ≥ 0, y ≥ 0	**5**
35	Find the Probability distribution of the number of Successes of two tosses of a die. Where a Success is defined as "the number greater than 4". Also find the Mean. Variance and Standard deviation of the distribution. **OR** 2000 students appeared in an examination.Distribution of marks is assumed to be normal with mean 30 and standard deviation 6.25.How many students are expected to get marks (1) Between 20 and 40 (2) Less than 25 (Given: $P(0 \le Z \le 1.60) = 0.8904$, $P(0 \le Z \le 0.8)$	**5**
	SECTION E **(This section comprises of 3 case study/passage – based questions of 4 marks each with two sub parts. First two case study questions have 3 sub – parts (i), (ii), (iii) of marks 1,1,2respectively)**	
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 20hours.	

	Based on the above information , answer the following questions:	
	i)For a routine cleaning of the tank, the tank needs to emptied. If pipes A and B are closed at the time when the the tank is filled to two-fifth of its total capacity , how long will pipe C take to empty the tank completely?	1
	ii) How long will it take for the empty tank to fill completely, if all the three pipes are opened simultaneously?	1
	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
	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?	
37	A factory produces bulbs, of which 6% are defective bulbs in a large bulk of bulbs. Based on the above information, answer the following questions :	
	(i) Find the probability that in a sample of 100 bulbs selected at random none of the bulbs are defective (Use $e^{-6} = 0.0024$)	1
	(ii) Find the probability that the sample of 100 bulbs has exactly two defective bulbs.	1
	(iii) Find the probability that the sample of 100 bulbs will include not more than one defective bulb.	
	OR	2

	Find the Mean and Variance of the distribution of number of defective bulbs in a sample of 100 bulbs		
38	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 The table below shows the welfare expenses(in lakh) of Steel Industry during 2001-2005.		

Year	2001	2002	2003	2004	2005
Welfare expenses	160	185	220	300	510

(i) Fit a straight line trend by the method of least squares .

(ii) Find the trend values.

2

2

OR

Estimate the trend for the year 2008 and 2010

*****END*****