GYAN BHARATI SCHOOL

Pre Board Examination (2022-2023)

Applied Mathematics (241)

SS2

Set-A

Time Allowed: 3 hrs Maximum Marks: 80

General Instructions:

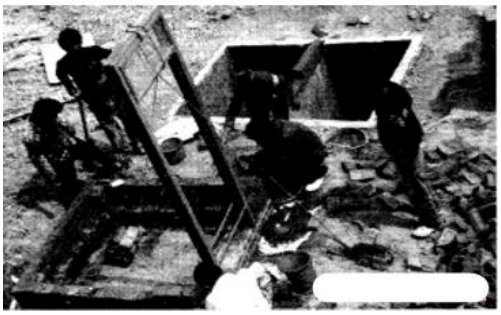
1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section – D carries 20 marks weightage and Section – E carries 3 case-based questions with total weightage of 12 marks.
3. Section A comprises of 18 MCQs and 2 Assertion- Reason based question of 1 mark each.
4. Section B comprises of 5 VSA type questions of 2 marks each.
5. Section C comprises of 6 SA type questions of 3 marks each.
6. Section D comprises of 4 LA type of questions of 5 marks each.
7. Section E 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. 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.

	SECTION –A	
Q1.	If $A=\begin{bmatrix}1 & 2 & x\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$ and $B=\begin{bmatrix}1 & -2 & y\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$ and $AB = I_3$, then $x + y$ equals (a) 0 (b) -1 (c) 2 (d) none of these	(1)
Q2.	If $A=\begin{bmatrix}1 & -1\\ 2 & -1\end{bmatrix}, B=\begin{bmatrix}a & 1\\ b & -1\end{bmatrix}$ and $(A + B)^2 = A^2 + B^2$,then values of a and b are (a) a = 4, b = 1 (b) a = 1, b = 4 (c) a = 0, b = 4 (d) a = 2, b = 4	(1)
Q3.	In a kilometre race, P, Q and R are three participants. A can give B a start of 50 m and C a start of 69 m. What start Q can allow R? (a) 16 m (b) 20 m (c) 24 m (d) 26 m	(1)
Q4.	If A is an invertible matrix, then $\det(A^{-1})$ is equal to (a) det(A) (b) $\frac{1}{\det(A)}$ (c) 1 (d) none of these	(1)
Q5.	If A is a matrix of order 3 and $\lvert A \rvert = 8$, then $\lvert \text{adj}A \rvert$ = (a) 1 (b) 2 (c) 2^3 (d) 2^6	(1)
Q6.	Kartika can row her boat at a speed of 5 km/h in still water. If it takes her 1 hour more to row the boat 5.25 km upstream than to return downstream, then the speed of the stream is: (a) 2 km/h (b) 3 km/h (c) 2 km/h (d) 2 km/h	(1)
Q7.	If $x = t^2$, $y = t^3$, then $\frac{d^2y}{dx^2}$ is: (a) 3/2 (b) 3/4t (c) $1/2t^2$ (d) 3/2t	(1)

Q8.	If the supply function for a commodity is p = 2x+10 and the market price is 4, then producer's surplus is (a) 3 (b) 10/3 (c) 10 (d) None of the above	(1)
Q9.	Suppose that two cards are drawn at random from a deck of cards. Let X be the number of aces obtained. Then, the value of E(X) is: (a) 37/22 (b) 5/13 (c) 1/13 (d) 2/13	(1)
Q10.	If a random variable X has the following probability distribution: X: 0 1 2 3 4 5 6 7 8 P(X): a 3a 5a 7a 9a 11a 13a 15a 17a then the value of a is (a) $\frac{7}{81}$ (b) $\frac{5}{81}$ (c) $\frac{2}{81}$ (d) $\frac{1}{81}$	(1)
Q11.	If in a binomial distribution n = 4, P (X = 0) = $\frac{16}{81}$, then P (X = 4) equals (a) $\frac{1}{16}$ (b) $\frac{1}{81}$ (c) $\frac{1}{27}$ (d) $\frac{1}{8}$	(1)
Q12.	In one sample t-test, the estimation for the population mean is: (a) $\frac{\bar{x}-\mu}{s\sqrt{n}}$ (b) $\frac{\bar{x}-\mu}{2s\sqrt{n}}$ (c) $\frac{\bar{x}-\mu}{s^2\sqrt{n}}$ (d) $\frac{\bar{x}-\mu}{s\sqrt{2n}}$	(1)
Q13.	The marks obtained were found normally distribution with mean 75 and variance 100. The percentage of students who scored more than 75 marks is (a) 25% (b) 50% (c) 75% (d) 100%	(1)
Q14.	If we reject the null hypothesis when it is true, we might be making (a) Type – I error (b) Type — III error (c) a correct decision (d) a wrong decision	(1)
Q15.	At what rate of Interest will the present value of a perpetuity of ₹ 500 payable at the end of every 6 months be ₹ 10,000? (a) 6% (b) 8% (c) 10% (d) 12%	(1)
Q16.	The comer points of the feasible region determined by the following system of linear inequalities are (0,0), (5, 0), (3, 4) and (0, 5): $2x + y \leq 10$, $x + 3y \leq 15$, $x, y \geq 0$ Let Z = px+ qy, where p, q > 0 Condition on p and q so that the maximum of Z occurs at both (3, 4) and (0, 5) is: (a) p = q (b) p = 2q (c) p = 3q (d) q = 3p	(1)
Q17.	Time series analysis helps to (a) understand the behaviour of a variable (b) predict the future behaviour of a variable (c) plan future operations (d) all of these	(1)
Q18.	The assumed hypothesis which is tested for rejection considering it to be true is called: (a) true hypothesis (b) alternative hypothesis (c) simple hypothesis (d) null hypothesis	(1)
	Assertion- Reason Based Question: 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 (a), (b), (c) and (d) as given below: (a) Both A and R are true and R is the correct explanation of the assertion (b) Both A and R are true but R is not the correct explanation of the assertion (c) A is true, but R is false	

	(d) A is false, but R is true	
Q19.	Assertion (A): The slope of the normal to the curve $y = x^2 + 3x - 5$ at $x = 0$ is -13 Reason (R): The Slope of the normal of the curve is $(- dx/dy)$	(1)
Q20.	In binomial distribution $n = 200$, $p = 0.04$. Taking poisson distribution as an approximation to the binomial distribution. Assertion (A): Mean of poison distribution = 8. Reason (R): In a Poisson distribution, $P(X = 4) = 512/3e^8$	(1)
	SECTION – B	
Q21.	A boat can row upstream at 15 km/h and downstream at 25 km/h. Find the speed of the boat in still water and the speed of the stream.	(2)
Q22.	A salesman wants to know the average number of units he sells per sales call. He checks his past sales records and comes up with the following probabilities: Sales(in Units) | 0 | 1 | 2 | 3 | 4 | 5 Probability | 0.15 | 0.20 | 0.10 | 0.05 | 0.30 | 0.20 OR In a binomial distribution B(n, p = 1/4) if the probability of at least one success is greater than or equal to 9/10, then find the value of n	(2)
Q23.	Suppose that a 95% confidence interval states that population mean is greater than 100 and less than 300. How would you interpret this statement? OR Distinguish between a point Estimation and Interval Estimation.	(2)
Q24.	Find the EMI of a loan of ₹10,00,000 for 15 years at 11% per annum [Given $(1.0092)^{180} = 5.19876$]	(2)
Q25.	Two tailors A and B earn Rs 150 and Rs 200 per day respectively. A can stitch 6 shirts and 4 pants per day while B can stitch 10 shirts and 4 pants per day. Form a linear programming problem to minimize the labour cost to produce at least 60 shirts and atleast 32 pants.	(2)
	SECTION – C	
Q26.	If $-2\frac{1}{2} \leq \frac{x}{2} - 1\frac{1}{3} < \frac{1}{6}$ then find the values of x when (A) x is an integer (B) x is a natural number OR If $a^2 + b^2 = 1$ and $c^2 + d^2 = 1$, then show that $1 \geq ac + bd$.	(3)
Q27.	Show that $A = \begin{bmatrix} 2 & -3 \\ 3 & 4 \end{bmatrix}$ satisfies the equation $x^2 - 6x + 17 = 0$. Hence, find A^{-1}.	(3)
Q28.	A company produces three products every day. Their production on a certain day is 45 tons. It is found that the production of third product exceeds the production of first product by 8 tons while the total production of first and third product is twice the production of second product. Determine the production level of each product using Cramer's Rule.	(3)
Q29.	Find the intervals in which the function f(x) is (i) increasing, (ii) decreasing : $f(x) = 2x^3 - 9x^2 + 12x + 15$ OR Determine the intervals in which the function $f(x) = x^4 - 8x^3 + 22x^2 - 24x + 21$ is	(3)

	decreasing or increasing.	
Q30.	4000 students appeared for an examination. The mean marks were 49 and S.D. was 6. Assuming the marks to be normally distributed, what percent of students scored more than 55 marks?	(3)
Q31.	Mr. X plans to set his son for higher studies abroad for 10 years. He expects the cost of the studies to be ₹ 2,00,000. How much must he set aside at the end of each quarter for 10 years to accumulate this amount, if money is worth 6% p.a. compounded annually. [Given $(1.015)^{40} = 1.8140$]	(3)
	SECTION- D	
Q32.	The rate of growth of a population is proportional to the number present at any instant, If the population of a city doubled in the past 25 years and the present population is 1,00,000, when will the city have a population of 5,00,000? OR The rate at which radioactive substances decay is known to be proportional to the number of such nuclei that are present at the time in a given sample. In a certain sample, 10% of the original number of radioactive nuclei have undergone disintegration in a period of 100 years. Find what percentage of the original radioactive nuclei will remain after 1000 years.	(5)
Q33.	Compute the trend for the following data using method of least squares. Find out an estimate of the year 2014. Year: 2005, 2006, 2007, 2008, 2009, 2010 Value: 80, 90, 92, 83, 94, 99 OR Calculate 5 – yearly moving averages for the following data of the number of commercial and industrial failures in a country from 1992 to 2007: Year: 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999 Number of failures: 23, 26, 28, 32, 20, 12, 12, 10 Year: 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007 Number of failures: 9, 13, 11, 14, 12, 9, 3, 1	(5)
Q34.	A machine costing $ 50,000 depreciates at rate of 8%. What is the depreciation amount for the 8th year. If the estimated useful life of the machine is 10 years, determine its scrap vale.	(5)
Q35.	A dietician wished to mix together two kinds of food X and Y in such a way that the mixture contains at least 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. The vitamin contents of one kg food is given below: Food X: Vitamin A 1, Vitamin B 2, Vitamin C 3 Food Y: Vitamin A 2, Vitamin B 2, Vitamin C 1 One kg of food X costs ₹ 16 and one kg of food Y costs ₹ 20. Find the least cost of the mixture which will produce the required diet?	(5)

	SECTION- E	
Q36.	The coordinated efforts of the local community and district administration have transformed the poor hygiene and diseases driven village. In continuation, to get rid of sewage and waste water, the local department wish to construct an underground septic tank with a square base whichcan hold a given quantity V of water andsludge with a metal sheet in minimum cost.Assume the side of the square be x and height of thetank be 'h'.  Based on the given information, answer the following question:	
a)	What is the relation among x, h and V?	(1)
b)	What is the surface area S(x) of the tank?	(1)
c)	What will be the relation between x and h for which the cost of construction will be the least? OR (for (c) part) If V = 13500, find the value of x?	(2)
Q37.	In mathematics, modular arithmetic is a system of arithmetic for integers, where numbers "wrap around" when reaching a certain value, called modulus. A familiar use of modular arithmetic is in the 12- hour clock, in which the day is divided into two 12- hour periods. If the time is 7: 00 now, then 8 hours later it will be 3: 00. Simple addition would result in 7 + 8 = 15, but clocks "wrap around" every 12 hours. Because the hour number starts over after it reaches 12, this is arithmetic modulo 12. In terms of the definition, 15 is congruent to 3 modulo 12, so "15:00″ on a 24- hour clock is displayed "3: 00″ on a 12- hour clock. Based on the above concept of " modulo arithmetic" answer the following questions:	
a)	Evaluate 3^6 (mod 4)	(1)
b)	What is the least possible value of x for which 100 = x (mod 7)?	(1)
c)	Evaluate (137 + 995) (mod 12). OR (for (c) part) Find the last digit of 12^{12}.	(2)
Q38.	In the year 2020, Mrs. Rennu took a home loan of ₹ 30,00,000 from Axis Bank at 9% per annum compounded monthly for 10 years on reducing balance method. Based on the given information, answer the following question:  {Use: $(1.0075)^{120} = 2.4514$}	
a)	What is the EMI paid by Sudha?	(1)
b)	What is the total interest paid over the 10 years by Sudha?	(1)
c)	What is the outstanding amount at the end of 1st year? OR (for (c) part) Find principal contained in 10th payment?	(2)