Roll No. _____ **NLCS/11/Applied Mathematics(241) /10**

Half Yearly Examination 2024 – 2025

Time - 3:00 Hrs. **M.M. 80**

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. You have to attempt only one alternative in all such questions.

Section – A

Multiple Choice Questions (MCQs) and Assertion-Reason (20 marks)

Q.1 Convert the binary number $(10101)_2$ to its decimal equivalent.

(a) 20 (b) 21 (c) 22 (d) 23

Q.2 The logarithm of 1000 to the base 10 is :

(a) 2 (b) 3 (c) 4 (d) 10

Q.3 Which of the following is an example of a null set?

(a) {0} (b) ϕ (c) {1} (d) {a, b}

Q.4 The sum of the first 10 terms of the arithmetic progression 2, 4, 6, 8, ... is:

(a) 55 (b) 110 (c) 220 (d) 330

Q.5 If $\log_a b = c$, then a^c is equal to:

(a) b (b) c (c) 1 (d) 0

Q.6 The union of sets A and B is denoted by:

(a) $A \cup B$ (b) $A \cap B$ (c) $A - B$ (d) AB

Q.7 If a clock shows 3:15, the angle between the hour and minute hands is:

(a) 7.5 degrees (b) 30 degrees (c) 37.5 degrees (d) 52.5 degrees

Q.8 A man can do a piece of work in 5 days, and another man can do the same work in 10 days. Working together, they can complete the work in:

(a) 2 days (b) $\frac{10}{3}$ days (c) 3 days (d) 4 days

Q.9 The average of 5, 10, 15, and 20 is:

(a) 10 (b) 12.5 (c) 15 (d) 20

Q.10 The 5th term of the geometric progression 2, 4, 8, 16, ... is:

(a) 16 (b) 32 (c) 64 (d) 128

Q.11 The intersection of sets A and B is:

(a) $A \cup B$ (b) $A \cap B$ (c) $(A - B)$ (d) AB

Q.12 The decimal equivalent of the binary number 1101 is:

(a) 10 (b) 11 (c) 12 (d) 13

Q.13 If $\log_{\sqrt{2}} 5 = x$ than $\sqrt{2}$ is the :

(a) Base (b) Exponent (c) Logarithm (d) Argument

Q.14 The formula for the area of a rectangle is:

(a) L×B (b) L+B (c) $\frac{1}{2}\times$ (B+L) (d) 2 (L+B)

Q.15 The sum of the first n terms of an arithmetic progression is given by:

(a) $\frac{n}{2}\left[2a+(n-1)\right]d$ (b) $n(a+d)$ (c) $\frac{n}{2}(2a+L)$ (d) $n\left[2a+(n-1)d\right]$

Q.16 The binary system is based on:

(a) Base 2 (b) Base 8 (c) Base 10 (d) Base 16

Q.17 The difference between two sets A and B is denoted by:

(a) $(A \cap B)$ (b) $(A \cup B)$ (c) $(A - B)$ (d) AB

Q.18 The 7th term of the arithmetic progression 1, 3, 5, 7, ... is:

(a) 11 (b) 13 (c) 15 (d) 17

Q.19 Assertion-Reason Questions:

Assertion (A) : The binary number system is used in computers.

Reason (R) : The binary number system is a base-10 system.

(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.

Q.20 Assertion-Reason Questions :

Assertion (A) : The sum of an arithmetic progression can be found using the formula

$$S_n = \frac{n}{2}\left[2a+(n-1)d\right].$$

Reason (R) : This formula gives the sum of the first n terms of an arithmetic progression.

(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.

Section – B

Very Short Answer (VSA) Questions (10 marks)

Q.21 If $a = b^{2x}, b = c^{2y}$ and $c = a^{2z}$ find xyz.

OR

If $(13)^{\sqrt{x}} = 4^4 - 3^4 - 6$ find value of x.

Q.22 Define a null set and give an example.

OR

Calculate the average of 8, 12, 20, 24, 25, 30, 37 39, 43.

Q.23 If the first term of an arithmetic progression is 5 and the common difference is 3, find the sum of 51^{th} term.

Q.24 The length and breadth of a rectangle increased by 30% and decreased by 20% respectively. Determine the percentage increased in its area.

Internal Choice :

Q.25 Draw a Venn diagram to represent the union of two sets A and B.

Section – C

Short Answer Questions (18 marks)

Q.26 Explain the properties of logarithms.

OR

Solve the equation $\frac{(42.87)^{\frac{1}{2}} \times 84.9}{0.234}$ *if*

$$\log 42.87 = 1.6321$$
$$\log 84.9 = 1.9289$$
$$\log 0.234 = \bar{1}.3692.$$
$$\text{anti}\log 3.3758 = 2375$$

Q.27 A clock shows 9:00. What is the angle between the hour and minute hands?

Q.28 If a man can do a piece of work in 6 days and another man can do the same work in 8 days, how long will they take to complete the work together?

OR

Define an arithmetic progression. Give an example and find the sum of its first 5 terms.

Q.29 Sum of first 4 terms of an A.P. is 56. The sum of the last 4 terms is 112. If first term is 11, then find the number of terms.

Q.30 Divide $(111011101)_2$ by $(1101)_2$.

Q.31 Find the common difference of a geometric progression whose 5th term is 14 and 10th term is 29.

Section – D

Long Answer (LA) Questions (20 marks)

Q.32 Explain the laws of logarithms with examples.

Q.33 A geometric progression.Sum $3, \frac{3}{2}, \frac{3}{4}$--------- are needed to give $\frac{3069}{512}$.

Q.34 Using Venn diagrams, explain the different types of sets and their operations.

OR

A person travels a distance of 120 km at a speed of 40 km/h and returns at a speed of 60 km/h. Calculate the average speed for the entire journey.

Q.35 If the radius of a sphere is doubled then what is the ratio of their volumes?

OR

If the heights of two cylinders are in the ratio of 3 : 4 and their radii are in the ratio of 4 : 3. Find the ratio of their volumes?

Section – E

Q.36 Binary numbers are fundamental to computer systems. The binary number system uses only two digits: 0 and 1. Each digit in a binary number represents a power of 2, starting with 2° at the rightmost digit. For example, the binary number $(1101)_2$ can be converted to its decimal equivalent by calculating $\frac{1}{2^3}+\frac{1}{2^2}+\frac{0}{2^1}+\frac{1}{2^0}=8+4+0+1$.

(i) Convert the binary number $(10110)_2$ to its decimal equivalent. 1

(ii) What is the decimal equivalent of the binary number $(1001)_2$? 1

(iii) Add $(110111)_2$ and $(100110)_2$. 2

OR

Multiply $(1011)_2$ by $(110)_2$.

Q.37 Logarithms are used in many fields such as science, engineering, and finance. They are particularly useful in dealing with exponential growth or decay. For example, the pH level of a solution, which measures its acidity or alkalinity, is calculated as the negative logarithm of the hydrogen ion concentration. Similarly, in finance, logarithms are used to calculate compound interest.

(i) If $\log 2.378=0.3762$ find $\log 237.8$.

(ii) If $\log 6832=3.8345$ find $\log 0.06832$.

(iii) If $\log 0.0009236=\bar{4}.9653$ and $\log x=4.9653$.

OR

If $\log 712.5=2.8528$ and $\log x=\bar{3}.8528$ then find x.

Q.38 Arithmetic progressions (AP) are sequences in which the difference between consecutive terms is constant. Aps are commonly found in various real-life situations, such as in the scheduling of events, distribution of resources, and financial planning. For instance, if you save a fixed amount of money every month, the total savings over time forms an arithmetic progression.

(i) If you save $200 every month, how much will you have saved in 12 months? (2 marks)

(ii) The first term of an AP is 5, and the common difference is 3. Find the 10^{th} term of the AP. (2 marks)

(iii) If a = 5 and d = 3 find sum of 20^{th} term.

OR

If $a=\frac{1}{5}$ and $d=\frac{1}{3}$ find sum of 20^{th} term.

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