Second Semester B.Sc., Degree Examinations

MAY/JUNE 2026

(NEP Syllabus)

MATHEMATICS

Paper: NSB 0240: ALGEBRA – II AND CALCULUS – II

Time: 2 hrs] *[Max. Marks: 60*

Instructions to Students:

1. ***The Students should legibly write Section number along with question numbers within the margin ONLY.***
2. ***The answer without Section number and question numbers will not be valued.***
3. ***Draw neat and labelled diagram wherever necessary.***
4. ***Use of Scientific non programmed calculator is permitted.***
5. ***Section – I multiple Choice Questions should be answered in the first page of main answer book and same questions shall not be answered repeatedly.***
6. ***Any identifications like marking, ticking, dots etc., in the options of MCQ (Section – I) on the question paper is strictly prohibited. Do not write anything (except register number) on the question paper.***

SECTION – I

Select the most appropriate answer from the options provided: 10 × 1 = 10

I - 1) Which of the following set is a uncountable set?

a) Set of Real numbers b) Set irrational numbers

c) $[a, b]$ d) Set rational numbers

I - 2) If a and b are two real numbers such that $a < b$ then the set $S = \{x / a < x < b\}$ is called

a) Open interval b) Closed intervals

c) Semi closed interval d) Semi open interval

I - 3) Arbitrary union of open sets is

a) open b) closed c) Both (a) and (b) d) None of these

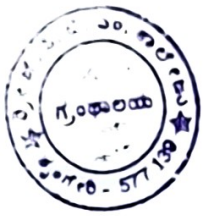
I - 4) Every cyclic group is

a) Abelian group b) Subgroup c) Not Abelian group d) None of these

Contd..... 2

I - 5) $a * H$ is a set of _____ coset.

a) Right b) Left c) Semi d) Sub



I - 6) If $u = y^x$ then u_x is

a) y^x b) xy^{x-1}

c) $y^x \log y$ d) $y^x \log x$

I - 7) Which of the following is homogeneous function?

a) $\frac{x^2+y}{x+y}$ b) $\frac{x^2+y^2}{x+y}$

c) $\frac{x^2+xy-y}{x-y}$ d) $\frac{x^2-2x+y^2}{x-y}$

I - 8) The value of $\int_0^1 e^x dx$ is

a) 2.71 b) 1.71 c) 3.71 d) None

I - 9) Surface area of the sphere $z = f(x, y)$ in $XY-$plane is

a) $\iint_A \sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1}\, dx\, dy$ b) $\iint_A \sqrt{\left(\frac{\partial x}{\partial y}\right)^2 + \left(\frac{\partial x}{\partial z}\right)^2 + 1}\, dy\, dz$

c) $\iint_A \sqrt{\left(\frac{\partial y}{\partial z}\right)^2 + \left(\frac{\partial y}{\partial x}\right)^2 + 1}\, dz\, dx$ d) None

I - 10) The volume of the region D in space is

a) $\iint_D dxdy$ b) $\iiint_D dx\, dy\, dz$

c) $\int_D dx\, dy$ d) None

SECTION – II

Answer any FIVE of the following: 5 × 3 = 15

II - 1) Give an example to show that every infinite set need not be bounded.

II - 2) Show that the set $S = \{x / 0 < x < 1,\ x \in \mathbb{R}\}$ is open but not closed.

II - 3) Prove that if every element of a group G has its own inverse then G is abelian.

Contd..... 3

II - 4) Find the order of each element of the group $(Z_4, +_4)$

II - 5) If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 1$



II - 6) Show that $u = e^x \sin y$, $v = e^x \cos y$ are not functionally dependent.

II - 7) Show that $\int_C y^2 dx + 2xy dy$ is independent of the path joining $(0,1)$ and $(1,3)$ and hence evaluate.

II - 8) Evaluate $\int_0^1 \int_0^2 \int_1^2 x^2 yz \, dx dy dz$

SECTION – III

Answer any THREE of the following: 3 × 5 = 15

III - 1) Show that the set A is closed if and only if it's compliment is open.

III - 2) Find all the right cosets of the subgroup $H = \{0,4,8\}$ of the group $\{Z_{12}, +_{12}\}$

III - 3) If 'a' is generator of cyclic group G then show that $0(a) = 0(G)$.

III - 4) Examine the function $f(x,y) = x^2 + y^2 + 6x + 12$ for extreme values.

III - 5) Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing into polar co-ordinates.

SECTION – IV

Answer the following: 2 × 10 = 20

IV - 1) a) State and prove Bolzano Weierstrass theorem.

b) Prove that the subset of a finite set is finite. (6 + 4)

OR

c) State and prove Langrange's theorem for finite group.

d) Let G be a group and $a \in G$. if $0(a) = n$ and $\langle m, n \rangle = 1$ then prove that $0(a^m) = n$. (6 + 4)

IV - 2) a) If $u = f(r)$ and $x = r\cos\theta$, $y = r\sin\theta$ then prove that

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r)$$

Contd..... 4

b) Verify Euler's theorem for the function $u = x^n \sin\left(\frac{y}{x}\right)$ (5 + 5)

OR

c) Find the volume common to the cylinder $x^2 + y^2 = a^2$ and $x^2 + z^2 = a^2$.

d) Evaluate $\int_0^1 \frac{x^a - 1}{\log x} dx$, where a is a parameter by using Leibnitz's rule.

(5 + 5)

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