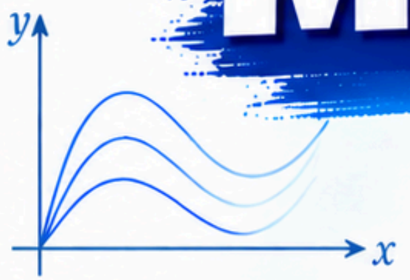
$\frac{dy}{dx} = f(x, y)$

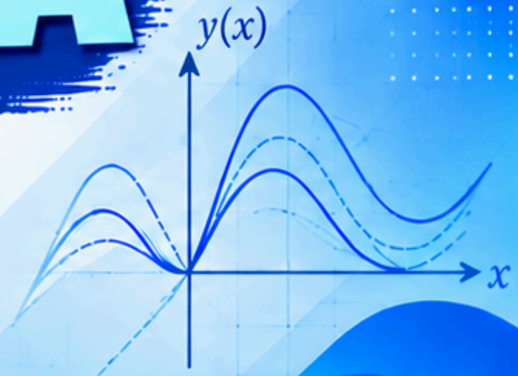
CSIR NET DEC 2026

MODERN ALGEBRA

TO-DO LIST

$y'' + p(x)y' + q(x)y = 0$





- Exam Weightage
- YouTube Video Links
- Short Notes
- Previous Year Questions (PYQs)
- Practice Plan
- Important Formulas & Key Concepts

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$Z_n = \{0, 1, 2, \cdots, n-1\}$

Modern Algebra

$\phi : G \to H$

$\phi(xy) = \phi(x)\phi(y)$

01 Fundamental theorem of arithmetic, divisibility in $\mathbb{Z}$, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots.

02 Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.

03 Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain.

04 Polynomial rings and irreducibility criteria.

05 Fields, finite fields, field extensions, Galois Theory.



$H \triangleleft G$

$F[x]$

Modern ALGEBRA

Topic	YouTube Videos [Click on the LINK to watch the video]
Groups	WATCH NOW
Subgroup	WATCH NOW
Normal Subgroups	WATCH NOW
Quotient Groups	WATCH NOW

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Topic	YouTube Videos [Click on the LINK to watch the video]
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Cyclic groups	WATCH NOW
Permutation Groups	WATCH NOW
Cayley's Theorem	WATCH NOW

Modern ALGEBRA

Topic	YouTube Videos [Click on the LINK to watch the video]
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Sylow Theorems	WATCH NOW
Field Extensions	WATCH NOW
Rings	WATCH NOW

Modern ALGEBRA

Topic	YouTube Videos [Click on the LINK to watch the video]
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Prime And Maximal ideals	WATCH NOW
Principal Ideal Domain	WATCH NOW
Euclidean Domain	WATCH NOW

PREVIOUS YEARS WEIGHTAGE

ANALYSIS OF CSIR-NET / JRF PREVIOUS YEAR PAPER

SUBJECTS	DEC. 2018			SUBJECTS	JUNE. 2019			SUBJECTS	DEC. 2019			SUBJECTS	26 NOV. 2020		
	JRF		LS		JRF		LS		JRF		LS		JRF		LS
	MARKS				MARKS				MARKS				MARKS		
SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL
UNIT - II	24	57	81	UNIT - II	24	66.5	90.5	UNIT - II	24	66.5	90.5	UNIT - II	24	52.3	76.3
MODERN ALGEBRA	9	28.5	37.5	MODERN ALGEBRA	9	28.5	37.5	MODERN ALGEBRA	9	28.5	37.5	MODERN ALGEBRA	9	28.5	37.5

SUBJECTS	30 NOV. 2020			SUBJECTS	16-Feb-22			SUBJECTS	JUNE. 23			SUBJECTS	DEC. 2023		
	JRF		LS		JRF		LS		JRF		LS		JRF		LS
	MARKS				MARKS				MARKS				MARKS		
SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL
UNIT - II	24	57	81	UNIT - II	21	61.8	82.8	UNIT - II	24	57	81	UNIT - II	24	66.5	90.5
MODERN ALGEBRA	9	28.5	37.5	MODERN ALGEBRA	9	28.5	37.5	MODERN ALGEBRA	12	19	31	MODERN ALGEBRA	15	19	34

SUBJECTS	Jul-24			SUBJECTS	FEB. 2025			SUBJECTS	JULY. 2025			SUBJECTS	DEC. 2025		
	JRF		LS		JRF		LS		JRF		LS		JRF		LS
	MARKS				MARKS				MARKS				MARKS		
SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL	SECTIONS	PART B	PART C	TOTAL
UNIT - II	24	66.5	90.5	UNIT - II	12	47.5	59.5	UNIT - II	21	52.25	73.25	UNIT - II	24	47.5	71.5
MODERN ALGEBRA	12	14.3	25.3	MODERN ALGEBRA	6	28.5	34.5	MODERN ALGEBRA	9	33.25	42.25	MODERN ALGEBRA	15	28.5	43.5

GROUP THEORY — DECEMBER 2025

Topics	Question
Subgroups	1
Permutation Group	2
Groups (Properties)	2
Group Homomorphism	1
Total Questions	**6**

Total Marks: 23.25

RING THEORY – DECEMBER 2025

Topics	Question
Irreducible polynomial over $\mathbb{Q}[x]$ & $\mathbb{Z}[x]$	1
Ideals	1
Total Questions	**2**

Total Marks: 9.5

RING THEORY – JUNE 2025

Topics	Question
Ring Homomorphism	1
Irreducibility of Polynomial	1
Ideals	1
Subring	1
Total Questions	**4**

Total Marks: 15.5

GROUP THEORY – JUNE 2025

Topics	Question
Cosets	1
Automorphism	1
Quotient Groups	1
Total Questions	**3**

Total Marks: 14.25

GROUP THEORY - JULY 2026

Topics	Question
Number Theory	2
Sylow Theorem	1
Automorphism	1
Total Questions	**4**

Marks: 15.5

RING THEORY – JULY 2026

Topics	Question
Quotient Ring	1
Ring Theory (Units, Prime Element)	1
Polynomial Ring	1
Ring Homomorphism	1
Degree of Extension	1
Total Questions	**5**

Marks: 23.75

SHORT NOTES

Binary Composition or Binary Relation

Let S be a non-empty set. A binary relation * on S is a mapping * : S ×S→S defined as *(a, b) = a * b. i.e., if a ∈ S and b ∈ S, then a * b ∈ S.

Semigroup

An algebraic structure (G, *), where G is a non-empty set and '*' is a binary operation on G is said to be a semigroup if it satisfies the following associativity axiom :

$$a * (b * c) = (a * b) * c \quad \forall\ a, b, c \in G.$$

Monoid

An algebraic structure (G, *), where G is a non-empty set and '*' is a binary operation on G is said to be a monoid if it satisfies the following two axioms :

(i) $a * (b * c) = (a * b) * c \quad \forall\ a, b, c \in G$

(ii) $\exists e \in G$ such that $a * e = e * a = a, \forall a \in G$.
Here 'e' is called identity element of G.

Group

An algebraic structure (G, *), where G is a non-empty set and '*' a binary operation on G is said to be a group if it is satisfies the following axioms :

(i) $a * (b * c) = (a * b) * c \quad \forall\ a, b, c \in G$

(ii) $\exists e \in G$ such that $a * e = e * a = a \forall a \in G$. Here 'e' is called identity element of G.

(iii) $\forall a \in G, \exists\ b \in G$ such that $a * b = b * a = e$. Here b is called inverse of the element a and denoted by a^{-1}.

Order of Group

The number of elements in non-empty set G is called order of G.

Cyclic Group

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A group (G, .) is said to be a cyclic group if there exists and element a ∈ G such that every element of G is a power of a. If (G, +) is a cyclic group then G = {na ; n∈Z}.

Abelian group

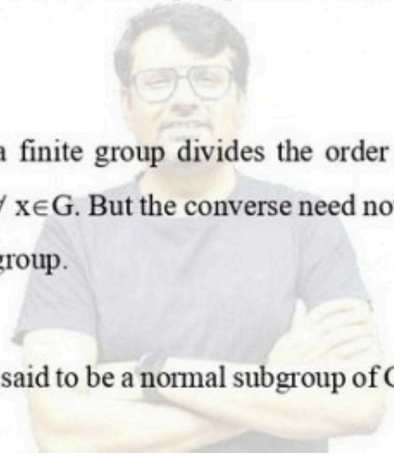
A group (G, *) is said to be abelian if it satisfies commutative property, i.e. , a*b = b*a ∀a, b ∈ G.

Center of group

The center Z(G) of a group G is defined by Z(G) = {z ∈ G / zx = xz, ∀ x ∈ G}.

Subgroup

A non-empty subset H of G is said to be a subgroup of G if H itself is a group under same binary composition as that of G.



Lagrange's Theorem

The order of any subgroup of a finite group divides the order of the group. Also, Lagrange's theorem yields that O(x) |O(G) ∀ x∈G. But the converse need not be true.Converse of Lagrange's theorem is true for finite cyclic group.

Normal Subgroup

A subgroup H of a group (G, .)is said to be a normal subgroup of G is Ha = aH, ∀ a∈G and denoted by $H \lhd G$.

Quotient Group

Let (G, *) be a group and N be a normal subgroup of G then we define $\frac{G}{N} = \{N * a : a \in G\}$ and in '+' operation, G/N = {N + a : a ∈ G}G/N is quotient group of G under the operation defined as (Na)(Nb) = Nab for all Na, Nb∈ G/N and in '+' operation (N+a) + (N+b) = N+(a+b).

Conjugate elements in a group

Let G be a group, a ∈G and b ∈ G. Then b is said to be conjugate to a. If $b = xax^{-1}$ for some x ∈ G.

Class equation

Let G be a finite group of order n and $c_1, c_2, \ldots c_k$ be k-distinct conjugate classes of cardinality $n_1, n_2, \ldots, n_k$ then the expression $O(G) = O[Z(G)] + \sum_{a \notin Z(G)} \frac{O(G)}{O[N(a)]}$ is called class equation of G.

Homomorphism

Let G and G' be any two groups and let 'o' and '*' denote their respective binary operations. Then a mapping $f : G \to G'$ is called a homomorphism, if $f(a \circ b) = f(a) * f(b), \forall\ a, b \in G$.

Isomorphism

A homomorphism f from a group G to a group G' is called an isomorphism if *f* is a one-one and onto mapping.

Kernel of a Homomorphism

Let f be a homomorphism of a group G into a group G` then the kernel(f)=$\{x \in G \mid f(x) = e'\}$,where e` is the identity of G` We denote the kernel(f) by ker(f).

Fundamental Theorem of Homomorphism

Let $f : G \to G'$ is a onto homomorphism, then $\frac{G}{\ker(f)} \approx f(G) \approx G'$

Automorphism

Let G be a group, then the mapping $f : G \to G$ is called automorphism if

(i) f is one-one (ii) f is onto (iii) f is homomorphism

Sylow p-subgroup

Let p be a group s.t.p^n divides order of a group G and p^{n+1} does not divide it. Then a subgroup H of G s.t.$O(H) = p^n$ is called a Sylow p-subgroup of G and it is also called p-SSG of G.

Sylow's First Theorem

Let p be a prime and m be a positive integer s.t. p^m divides O(G), then ∃ a subgroup H of G s.t. $O(H) = p^m$.

Sylow Second Theorem

Any two p-SSG of a finite group G are conjugate in G.

Sylow Third Theorem

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The number of p-SSG of G is of the form 1 + kp where (1 + kp) | O(G), k being a non-negative integer.

Dihedral Group

Let $G = \{< a,b > | a^2 = e, b^n = e, ab = b^{-1}a\}$ be a group then this group is called dihedral group

Another type :

We can also written as $D_n = \begin{cases} a, a^2 = e \\ ab, ab^2, ab^3 ..... ab^{n-1} \\ b, b^2, b^3, ... b^{n-1} \end{cases}$

(1) Number of elements of order 1 = 1

(2) Number of elements of order 2 = $\begin{cases} n & if\ n\ is\ odd \\ n+1 & if\ n\ is\ even \end{cases}$

(3) Number of elements of order d = ϕ(d) if d|n& d $\notin$ {1, 2}

Centre of D_n

Let G = D_n be dihedral group then $Z(D_n) = \begin{cases} \{I\} & if\ n\ is\ odd \\ \{I, b^{n/2}\} & if\ n\ is\ even \end{cases}$

Subgroups od Dihedral group

Total subgroup of D_n = $\tau(n) + \sigma(n)$, where τ (n) is number of positive divisors of n and σ (n) is the sum of all positive divisors of n

Number of conjugacy classes in D_n are $\begin{cases} \frac{n+6}{2} & \text{if n is even} \\ \frac{n+2}{3} & \text{if n is odd} \end{cases}$

Number of normal subgroup in D_n are $\begin{cases} \tau(n)+1 & \text{if n is odd} \\ \tau(n)+3 & \text{if n is even} \end{cases}$

Symmetric Group

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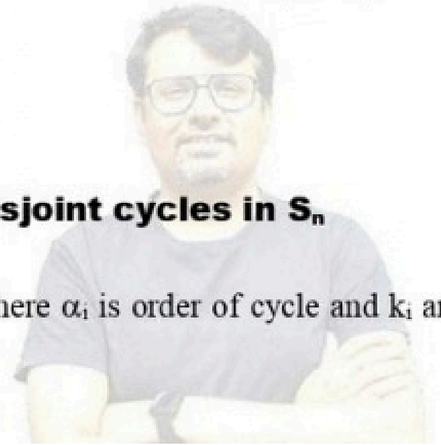
A collection of all permutations on the set S = {1, 2, 3, ..., n} is define a group under composition of function and denoted by S_n. It is called a symmetric group.

Order of symmetric group

The order of symmetric group S_n is n!.

Number of r-cycles in S_n

Number of cycles of length r in S_n are ${}^nC_r\,(r-1)! = \frac{n!}{r(n-r)!}$.



Number of product of disjoint cycles in S_n

$= \frac{n!}{\alpha_1^{k_1}.\alpha_2^{k_2}.....\alpha_i^{k_i}.\,k_1!\,k_2!....k_i!}$ where α_i is order of cycle and k_i are repeated number of cycles of order α_i.

Alternating Group

The group of all even permutation of S_n under composition of function is called alternating group and denoted by A_n.

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Normal subgroup in symmetric Group are $\begin{cases} I, K_4, A_4, S_4 & \text{if } n = 4 \\ I, A_n, S_n & \text{if } n \neq 4 \end{cases}$

SHORT NOTES

Definition

A ring (R, +, .) is a non-empty set R equipped with two binary operation denoted by +(addition) and . (multiplication) defined on R such that the following conditions are satisfied

(a) R is abelian group for additive operation.

(b) R is semi group for multiplication operation.

(c) Multiplication is distributive over addition

Some important definition

(1) Unity : Multiplicative identity of a ring is called unity of ring.

(2) Unit : Let (R, +, .) be a ring and a $\in$ R , a is called unit if 'a' has multiplicative inverse.

(3) Zero Divisor : Let R be a ring and if a & b are two non-zero elements of R such that a.b = 0,Then a is zero divisor from left and b is zero divisor from right.

(4) Commutative ring :

Let (R, +, .) be a ring then R is said to be commutative if R is commutative under multiplication. i.e. a.b = b.a for all a, b $\in$ R

(5) Characteristic of Ring :

The smallest positive integer n is said to be characteristic of a ring R.

If na = 0; for all a $\in$ R

i.e. if $a + a + a + \ldots\ldots + a = 0$

n-times

Note : If no such positive integer exists, then characteristic of a ring is 0 and it is denoted by Char R or Ch R.

(6) Nilpotent element : Let a $\in$ R then a is said to be a nilpotent element if $\exists$ n $\in$N s.t. $a^n = 0$ i.e. a.a.a. ….. a = 0 (n-times)

The smallest such n is called index.

(7) Idempotent element : Let a $\in$ R then a is said to idempotent element if $a^2 = a$

(8) Irreducible element : A non-unit, non-zero element 'a' in a commutative ring with unity ring R is said to be irreducible element if a = b.c where either b is unit or c is unit

(9) Prime element : Let R be commutative ring with unity then non-zero, non-unit element of R is said to be prime if p|ab $\Rightarrow$ p|a or p | b

Integral Domain

A commutative ring with unity without zero divisors is called an integral domain.

Subring

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A non-empty subset S of a ring R is said to be a subring of R if S forms a ring under the binary composition of R.

One-Step Test

A non-empty subset of S of a ring R is a subring of R, iff a,b$\in$ S

$\Rightarrow$ ab$\in$ S and a – b $\in$ S.

Ideal Test :A non empty subset I of a ring R is an ideal of R if

(i) a – b $\in$ I whenever a, b $\in$ I.

(ii) ra & ar $\in$ I, whenever a $\in$I, r $\in$R.

Ring Homomorphism

Let (R, +, .) & (R', $\oplus$, Θ) two rings then a map ϕ:R $\rightarrow$R' is defined as ring homomorphism if

(i) $\phi(a+b) = \phi(a)\oplus\phi(b); \forall a,b\in R$

(ii) $\phi(a.b) = \phi(a)\Theta\phi(b); \forall a.b\in R$

Ring of Polynomials

Let Rbe a ring, then the set $R[x]=\{a_nx^n+a_{n-1}x^{n-1}....+a_1x+a_0: a_i\in R, n \in N\cup \{0\}\}$ forms a ring with respect to addition and multiplication of polynomials.

Irreducibility Tests

(i) If a polynomial f(x) is ofdegree >1 and f(a)= 0 for some a$\in$ F. Then f(x) isreducibleoverF ,where F is a field

(ii) **Reducibility Test for degree 2 and 3:** Let F be a field if f(x)$\in$F[x] and degf(x)=2 or 3. Then f(x) is reducible over Fif and only if f(x) has a zero in F.

(iii) Let f(x)$\in$Z[x], if f(x) is reducible over Z, then it is reducible over Q.

(iv) **Mod p irreducibility Test:** Let p be a prime and suppose that f(x)$\in$Z[x] with degf$\geq$1. Let f(x) be the polynomial in $Z_p[x]$ obtained from f(x) by reducing all the coefficientsof f(x) modulopiff(x)is irreducible over $Z_p$and degf(x)=deg $f_p(x)$ then f(x) is irreducible over Q.

(v) **Eisenstein's Criterion:** Let $f(x)=a_nx^n + a_{n-1}x^{n-1} + ... + a_0\in Z[x]$. If $\exists$a prime p such that $p|a_0.p|a_2,....p|a_{n-1}$and $p^2\nmid a_0$, $p\nmid a_n$, then f(x) is irreducible over Q.

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Principal Ideal Domain

An integral domain R is said to be principal ideal domain if each ideal I of R is Principal ideal.

Euclidean Domain

Let R be an integral domain if ∃ a norm on R s.t.

(i) $N(a.b) \geq N(a) \quad \forall\ a, b \neq 0 \in R$

(ii) For any $a, 0 \neq b \in R \quad \exists\ q, r \in R$ s.t. $a = bq + r, r = 0$ or $N(r) < N(b)$ then R is said to be Euclidean domain.

Unique Factorization Domain (UFD)

An I.D. is called UFD if it satisfy the properties.

(i) Each non-zero element of R is either unit or can be expressed as a product of finite number of irreducible element of R.

Field Extension

If F is a subfield of a field E; then " E is called an 'extension field ofF" or simply an extension of F.

Minimal Polynomial

Let Fbe a field and let E be an extension field of F such that $\alpha \in E$then the monic irreducible polynomial of least degree $p(x) \in F[x]$ such that $p(\alpha)=0$ is called the Minimal Polynomial of α over F.

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Splitting Field

Let f(x) be a polynomial in F[x] of degree ≥ 1. Then an extension Kof F is called a splitting field of f(x) over F If

(i) f(x) factors into linear factors in K[x]i.e., $f(x)=c(x - x_1)...(x - \alpha_n)$;$\alpha_i \in K$.

(ii) K is generated over F by the roots $\alpha_1, ..., \alpha_n$of f (x) in K.

-:Previous Year Questions :-

NOTE:- click on abovetextyoucanrefertolinkofvideosolution of questions

1. Let G a group, H a subgroup of G and $T = \{gH \mid g \in G\}$, the set of all left coset of H in G. Let S_T be the set of all permutations of T and $\pi : G \to S_T$ be the map defined by $\pi(g)(g_1H) = gg_1H$. For a prime number P, let F_P denote the field with Placements. In which of the following cases is Ker π trivial? **CSIR NET JULY 2025**

(a) $G = GL_2(F_P)$ and H is a subgroup of order P.

(b) $G = SL_2(F_P)$ and H is a subgroup of order P.

(c) $P \equiv 3 \pmod 4$, $G = GL_2(F_P) / SL_2(F_P)$ and H is a subgroup of order 2.

(d) $P \equiv 1 \pmod 4$, $G = GL_2(F_P) / SL_2(F_P)$ and H is subgroup of order 2.

2. For a Group G, let Aut(G) denote the group (under composition) of all bijective Group homomorphism from G onto itself. Which of the following statements are True? **CSIR NET JULY 2025**

(a) If G_1, G_2 are two groups such that Aut (G_1) is ismorphic to Aut (G_2), then G_1 is isomorphic to G_2.

(b) If $|G| = 2$, then Aut $(G \times G)$ is abelian.

(c) If G is the group of complex numbers under addition, then Aut (G) is abelian.

(d) If G is finite, then Aut (G) is finite.

3. Let G_1 and G_2 be subgroups of a group G. Which of the following statements are true? **CSIR NET JULY 2025**

(a) If G_1 is normal in G, then $(G_2 G_1) / G_1 \cong G_2 \mid (G_2 \cap G_1)$

(b) If H_1 and H_2 are normal subgroup of G_1 and G_2 respectively, Then $(G_1 \times G_2) / (H_1 \times H_2) \cong (G_1 / H_1) \times (G_2 / H_2)$

(c) If G_1 is normal in G_2 and G_2 is normal in G then G_1 is normal in G.

(d) Every subgroup of prime index in G is normal

4. Which of the following statements are true? **CSIR NET FEB 2025**

(a) The value of the Euler ϕ-function is even for all integer $n \geq 3$

(b) Let G be a finite group and S a subset of G with $|S| > \frac{|G|}{2}$. Then $\{ab : a, b \in S\} = G$.

(c) The polynomial ring $R[x_1, ..., x_n]$ is a Euclidean domain for all integers $n \geq 1$

(d) The subset $\{f \in C[0, 1]); f(1/2) = 0\}$ of the ring $C([0, 2])$ of continuous functions from [0, 1] to R is a prime ideal.

5. For integer $n > 1$, let $G(n)$ denote the number of groups of order n, up to isomorphism, i.e. $G(n)$ is the number of isomorphism classes to group of order n. Which of the following statement is true? **CSIR NET FEB 2025**

(a) If $G(n) = 1$. Then n is prime.

(b) $G(8) = 2$

(c) If $\gcd(n, \phi(n)) > 1$, then $G(n) > 1$ (Here ϕ denote the Euler-ϕ function)

(d) $\limsup_{n\to\infty} G(n) = 2$

6. We say that a group G has property (A) if every non-trivial homomorphism from G to any group is injective. Which of the following groups has property (A)? **CSIR NET FEB 2025**

(a) The cyclic group of order 6

(b) The symmetric group of S_5

(c) The alternating group A_5

(d) The dihedral group with ten element

7. Let R be a non-zero ring with unity such that $r^2 = r$ for all $r \in R$.

Which of the following statements are true? **CSIR NET FEB 2025**

(a) R is never an integral domain

(b) $r = -r$ for all $r \in R$

(c) Every non-zero prime ideal of R is maximal

(d) R must be a commutative ring

8. Let $f \in R[x]$ be a product of distinct monic irreducible polynomial $p_1, p_2, \ldots p_n$, where $n \geq 2$, let (f) denote the ideal generated by f in the ring R[x], where R is set of real number. Which of the following statement are true? **CSIR NET FEB 2025**

(a) R[x] / (f) is a field.

(b) R[x]/(f) is a finite dimensional R-vector space.

(c) R[x]/(f) is a direct sum of fields, each of which is isomorphic to R or C

(d) There are no non-zero elements $u \in R[x]/(f)$ such that $u^m = 0$ for some $m \geq 1$

9. Consider the polynomial $f(x) = x^{2025} - 1$ over F_5, where F_5 is the field with five elements. Let S be the set of all roots of f in an algebraic closure of the field F_5. Which of the following statement are true?

CSIR NET FEB 2025

(a) S is a cyclic group

(b) S has $\phi(2025)$ element, where ϕ denote the Euler ϕ-function

(c) S has $\phi(2025)$ generators, where ϕ denote the Euler ϕ function

(d) S has 81 elements

10. Let C[x, y] be the polynomial ring in two variable over C. For which of the following ideals I, the quotient C[x, y] / I is not an integral domain

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(a) $I = \langle x, y \rangle$

(b) $I = \langle x + y \rangle$

(c) $I = \langle x^2 + y^2 \rangle$

(d) $I = \langle xy - 1 \rangle$

11. For which of the following values of q, does a finite field of order q have exactly 6 sub fields ds

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(a) $q = 2^{18}$

(b) $q = 2^{32}$

(c) $q = 2^{12}$

(d) $q = 2^{243}$

12. Which of the following numbers are order of some element of the symmetric group S_5 is **CSIR NET JUNE 2024**

(a) 2

(b) 3

(c) 4

(d) 5

13. The no. of group homeomorphisms from $Z/150$ to $Z/90$ is

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(a) 30 (b) 60

(c) 45 (d) 10

14. Consider the ring $R = \left\{ \sum_{n \in z} a_n x^n \middle| a_n \in Z;\ \text{and } a_n \neq 0 \text{ only for finitely many } n \in Z \right\}$

where addition and multiplication are given by $\sum_{n \in z} a_n x^n + \sum_{n \in z} b_n x^n = \sum_{n \in z} (a_n + b_n) x^n$

$$\left(\sum_{n \in z} a_n x^n \right) \left(\sum_{m \in z} b_m x^m \right) = \sum_{k \in z} \left(\sum_{n+m=k} a_n b_m \right) x^k$$

Which of the following statement is true? **CSIR NET JUNE 2024**

(a) R is not commutative

(b) The ideal $(x - 1)$ is a maximal ideal in R

(c) The ideal $(x - 1, 2)$ is a prime ideal in R

(d) The ideal $(x, 5)$ is a maximal ideal in R

15. For two indeterminates x, y. Let $R = F_3[x]$ and $S = R[y]$

Which of the following statements are true? **CSIR NET JUNE 2024**

(a) S is a principal ideal domain

(b) $S/(y^2 + x^2)$ is a unique factorization domain

(c) S is a unique factorization domain

(d) S(x) is a principal ideal domain

16. Let R and S be non-zero commutative rings with multiplicative identities 1_R, 1_S, respectively. Let $f : R \to S$ be a ring Homomorphism with $f(1_R) \to 1_S$. Which of the following statements are true? **CSIR NET JUNE 2024**

(a) If f(a) is a unit in S for every non-zero element $a \in R$, then S is a field

(b) If f(a) is a unit in S for every non-zero element $a \in R$, then f(R) is a field

(c) If R is a field then f(a) is a unit in S for every non-zero element $a \in R$

(d) If a is a unit in R, then f(a) is a unit in S

17. Let I be an ideal of the ring $F_2[t]/t^2(1- t)^2$.

Which of the following are the possible values for the cardinality of I?

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(a) 1 (b) 8

(c) 16 (d) 24

18. Let R be a principal ideal domain with a unique maximal ideal.

Which of the following statements are necessarily true?

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(a) Every quotient ring of R is a principal ideal domain

(b) There exists a quotient ring S of R and an ideal $I \subseteq S$ which is not principal

(c) R has countably many ideals.

(d) Every quotient ring $S(\neq \{0\})$ of R has a unique maximal ideal which is principal

Answer Key

1	2	3	4	5	6	7	8	9	10
a,b	d	b	a,b,d	c	c	b,c,d	b,c ,d	a,c	c
11	12	13	14	15	16	17	18		
a,b,c,d	a,b,c,d	a	c	c,d	c,d	a,b,c	b,c ,d		

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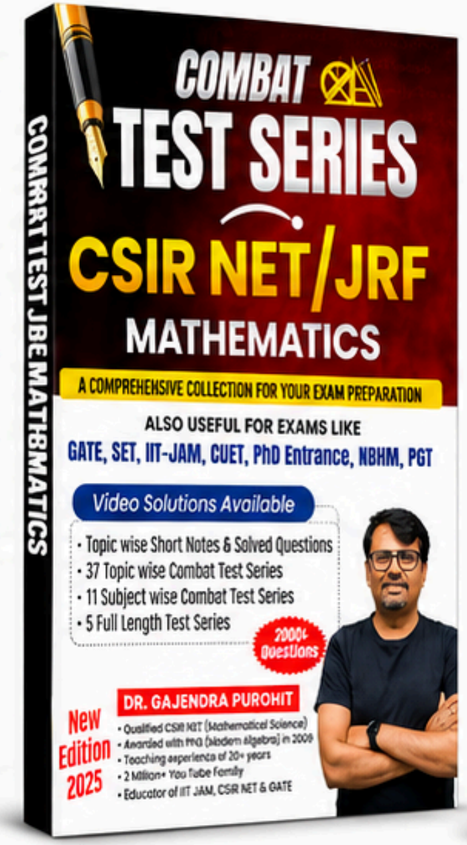
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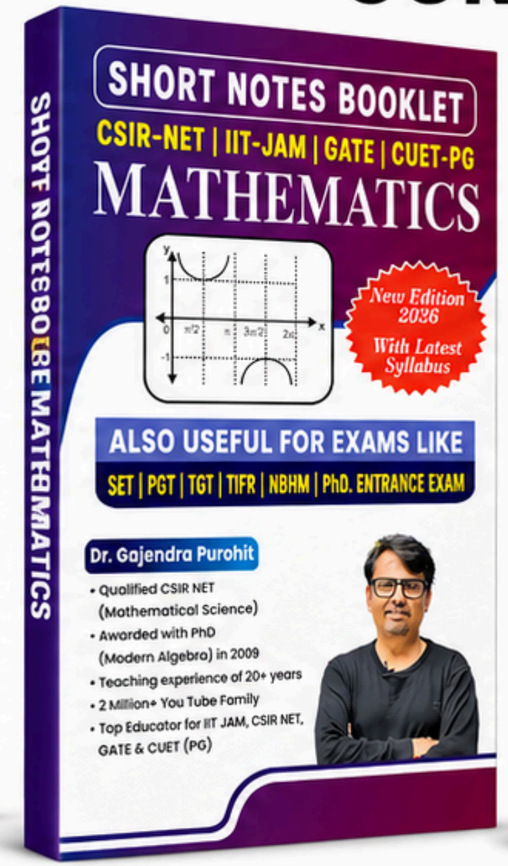
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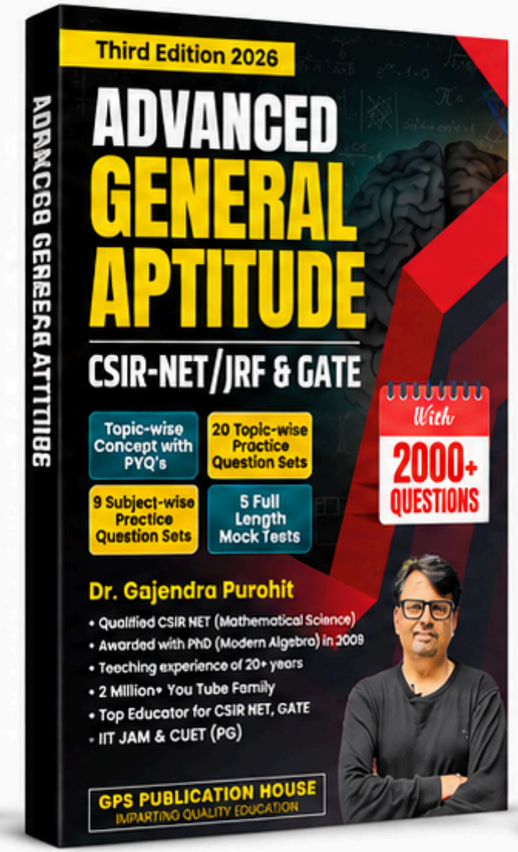
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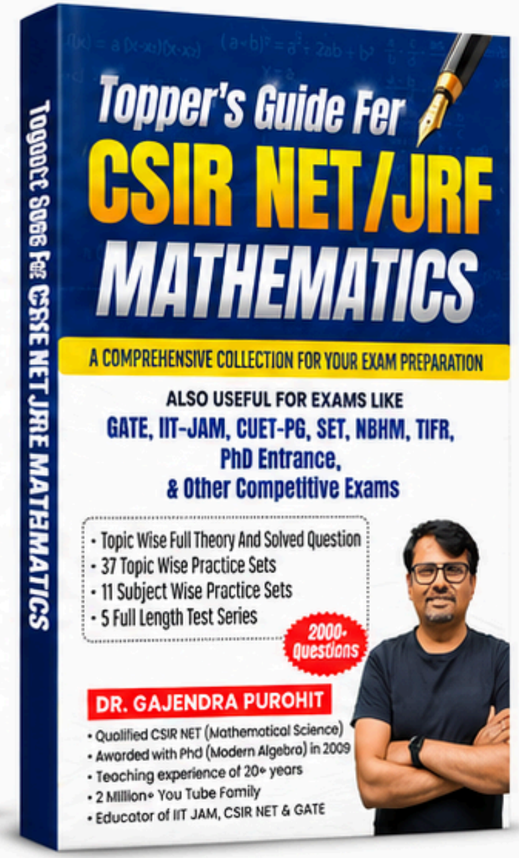
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