(8 pages) **Reg. No. :** .....

Code No. : 5876 **Sub. Code : VMAC 21**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2026.

Second Semester

Mathematics – Core

RING THEORY AND LATTICES

(For those who joined in July 2024–2025 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. A ring homomorphism is a function between two rings that preserves ————————

(a) Only addition

(b) Only multiplication

(c) Both addition and multiplication

(d) None of the above

2. If I is an ideal of a ring R, the quotient ring R/I consists of ————————

(a) The elements of R that are multiple of I.

(b) The cosets of I in R under addition.

(c) The set of elements of R that commute with all elements of I.

(d) The set of all invertible elements of R.

3. The field of quotients exists for ————————.

(a) Any ring

(b) Any commutative ring with unity

(c) Any integral domain

(d) Any field

4. What is a module over a ring R?

(a) A group that is also a field

(b) An abelian group with a scalar multiplication by elements of R satisfying certain axioms

(c) A subgroup of a field

(d) A vector space over R

5. Which of the following is a unit in $\mathbb{Z}[x]$?

(a) x (b) $2x + 1$

(c) 1 (d) $x - 1$

6. Which of the following is an example of a Euclidean ring?

(a) $\mathbb{Z}$ (b) $\mathbb{Q}[x]$

(c) Any field (d) All of the above

7. The ring $\mathbb{Q}[x]$ consists of polynomials with coefficients from ————

(a) The set of integers $\mathbb{Z}$

(b) The set of rational number $\mathbb{Q}$

(c) The set of real numbers $\mathbb{R}$

(d) The set of complex numbers $\mathbb{C}$

8. A polynomial $f(x)$ in $\mathbb{Q}[x]$ is called irreducible if ————.

(a) It has no constant term

(b) It cannot be factored into two non-constant polynomials with coefficients in $\mathbb{Q}$

(c) It has at least one rational root

(d) It has a degree of at least 2.

9. A polynomial ring $R[x]$ over a commutative ring R is a unique factorization domain if ————.

(a) Every polynomial in $R[x]$ has a unique root

(b) Every polynomial in $R[x]$ can be factored uniquely

(c) Every polynomial has an inverse in $R[x]$

(d) $R[x]$ contains only irreducible pollynomials.

10. The Jacobson radicaI $J(R)$ of a ring R is ————

(a) The intersection of all prime ideals of R

(b) The intersection of all maximal ideals of R

(c) The set of all nilpotent elements of R

(d) The set of all idempotent elements of R

11. What is the Jacobson radical of a field?

(a) The entire field

(b) The set of nilpotent elements

(c) The zero ideal

(d) The set of all units

12. A ring R is semisimple if and only if ————

(a) Every module over R is irreducible

(b) Every module over R is projective and injective

(c) R has a unique maximal ideal

(d) R has no zero divisors

13. A set P with a relation $\leq$ is called a partially ordered set if $\leq$ is

(a) Reflexive, symmetric and transitive

(b) Reflexive, antisymmetric and transitive

(c) Symmetric and transitive only

(d) Antisymmetric and transitive only

14. The Jordon-Holder Theorem implies that

(a) Every finite group is simple

(b) Any two normal series of a finite group have the same number of factors

(c) The center of every group is trivial

(d) All composition factors are equal

15. Which of the following is an idempotent law in Boolean algebra?

(a) $A \cap A = A$ and $A \vee A = A$

(b) $A \wedge B = B \wedge A$

(c) $A \wedge (B \vee C) = (A \wedge B) \vee (A \wedge C)$

(d) $A \vee 0 = A$

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Prove that if ϕ is a homomorophism of R into R', then $\phi(0) = 0$ and $\phi(-a) = -\phi(a)$ for every $a \in R$.

Or

(b) Prove that if U is an ideal of the right R, then R/U is a ring and is a homomorphic image of R.

17. (a) Prove the if π is a prime element in the Euclidean ring R and $\pi \mid ab$ where $a, b \in R$ then π divides at least one of a or b.

Or

(b) Prove the if $a + bi$ is not a unit of $J[i]$, then $a^2 + b^2 > 1$.

18. (a) Prove that if R is an integral domain, then $R[x]$ is also a integral domain.

Or

(b) Prove that if $f(x)$ and $g(x)$ are primitive polynomials, then $f(x)g(x)$ is a primitive polynomial.

19. (a) Prove that every nil ideal of R is contained in *rad R*.

Or

(b) Prove that for any ring R, the quotient ring $R/Rad\ R$ is without prime radical.

20. (a) Prove that a bijective map of a lattice L onto a lattice L' is a lattice isomorphism if and only if it and its inverse are order preserving.

Or

(b) Prove that the lattice of normal subgroups of a group is modular and the lattice of sub modules of a module is modular.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Prove that for a commutative ring R with unit element whose only ideals are (0) and R itself then R is a field.

Or

(b) Prove that the if K is any field with contain D then K contains a subfield isomorphic to F.

22. (a) State and prove Unique Factorization theorem.

Or

(b) Prove that $J[i]$ is a Euclidean ring.

23. (a) Prove that $F[x]$ is a principal ideal ring.

Or

(b) Prove that if R is a unique factorization domain, then $R[x]$ is also a unique factorization domain.

24. (a) Prove that for an ideal I of the ring R, then $I \subseteq rad\ R$ if and only if each element of the coset $1+I$ has an inverse in R.

Or

(b) Prove for an ideal I of the ring R, if the subset $S \subseteq R$ is closed under multiplication and disjoint from I, then there exists an ideal P which is maximal in the set of ideals which contain I and do not meet S any such ideal is necessarily prime.

25. (a) Prove that a lattice L is modular if and only if whenever $a \geq b$ and $a \wedge c = b \wedge c$ and $a \vee c = b \vee c$ for some c in L, then $a = b$.

Or

(b) State and prove the theorem of Jordan-Hölder-Dedekind.

———————

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M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2026

Second Semester

Mathematics – Core

REAL ANALYSIS – II

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. The value of $m^*(A)$ _____ $m^*(B)$ if $A \subseteq B$.

(a) =

(b) <

(c) >

(d) ≤

2. The outer measure of a set is given by $m^*(A) =$ _____ where the inf is taken over all finite or uncountable collections of intervals $[I_n]$ such that $A \subseteq UI_n$

(a) $\inf \Sigma l(I_n)$ (b) $\inf \Sigma(m_n)$

(c) $\inf \Sigma f(I_n)$ (d) $\inf \Sigma(I_n)$

3. The set E is _____ if for each set $m^*(A) = m^*(A \cap B) + m^*(A \cap CE)$.

(a) empty (b) differentiable

(c) measurable (d) 0

4. If E is a measurable set and f is a measurable function and $\chi_E f$ is integrable and $\chi_E f$ is integrable then f is _____over E.

(a) Integrable (b) Measurable

(c) Borel (d) Complete

5. The value of $|f| =$ _____, $f^+, f^- \geq 0$.

(a) $f^+ - f^-$ (b) f^+, f^-

(c) $f^+ + f^-$ (d) $f^+ * f^-$

6. If for each a and b, f is bounded and $\mathcal{R}$ is integrable on $[a,b]$ and $\lim_{a\to\infty b\to-\infty} \int_a^b f dx$ exists then f is said to be _____ on $(-\infty,\infty)$.

(a) Imaginary (b) Ideal

(c) Riemann integrable (d) Negative

7. If the collection of functions of $L^2(I), S = \{\varphi_0\varphi_1....\}$ of $(\varphi_n\varphi_m) = 0$ whenever $n \neq m$ the collection is called as _____ system on I.

(a) Parallel

(b) Equal

(c) Orthogonal

(d) None

8. The series $f(x) \sim \sum_{n=0}^{\infty} C_n\varphi_n(x)$ is called _____ with $\varphi_0\varphi_1...$ be orthogonal on I and $f \in L^2(I)$.

(a) Fourier (b) Real

(c) Complex (d) Constant

9. A function f is said to be _____ with period $p \neq 0$ if f is defined on R and if $f(x + p) = f(x)$ for all x.

(a) complex (b) real

(c) periodic (d) length

10. The Dirichlet kernel $D_{rk}f = D_r D_k(f) =$ _____.

(a) $\dfrac{\partial^2 f}{\partial x_r \partial x_k}$ (b) $\dfrac{\partial^3 fs}{\partial x_r \partial x_k}$

(c) $-\dfrac{\partial^2 fk}{\partial x_r \partial x_k}$ (d) $\dfrac{\partial^2 frk}{\partial x_r \partial x_k}$

11. If $D_r f$ and $D_k f$ exist on n ball $B(c)$ and if both $D_{r,k}f$ and $D_{k,r}f$ are continuous at c then $D_{r,k}f(x) =$ _____.

(a) $D_{k,r}f(c)$ (b) $D_{k,r}f(cf)$

(c) $D_{k,k}f''(c)$ (d) $D_{r,r}f'(c)$

12. The function f is said to be _____ at c if there exists a linear function $T_c : R^n \to R^m$ such that $f(c+v) = f(c) + T_c(v) + \|v\| E_c(v)$.

(a) Integrable (b) Parallel

(c) Differentiable (d) Orthogonal

13. If f is differentiable at a and if $\nabla f(a) = 0$ then the point a is called a _____ point of f.

(a) stationary (b) inverse

(c) derivative (d) complement

14. A stationary point f is called _____ point if every n-ball B(a) contain points x such that $f(x) > f(a)$ and other point such that $f(x) < f(a)$

(a) saddle (b) parallel

(c) orthogonal (d) none

15. If $D_j f_i$ denotes the partial derivative of f_i with respect to the j^{th} coordinate x_j then $D_j f_i(x,t) =$ _____.

(a) $a_{ij} = u + iv$ (b) $u - iv$

(c) $c + d = b_{ij}$ (d) 0

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Show that for any set A and any $\in > 0$ there is an open set O containing A and such that $m^*(O) \leq m^*(A) + \in$.

Or

(b) Prove that there exists uncountable sets of zero measure.

17. (a) Show that $\int_1^\infty \frac{dx}{x} = \infty$.

Or

(b) Show that if f is non negative measurable function then $f = 0$ a.e. if and only if $\int f dx = 0$.

18. (a) Assume that $f \in L(I)$, prove that for each real β, $\lim_{\alpha \to +\infty} \int_t f(t) \sin(\alpha t + \beta) dt = 0$.

Or

(b) Let f be a real valued and continuous on a compact interval $[a, b]$. Then prove that for every $\in > 0$ there is a polynomial p such that $|f(x) - p(x)| < \in$.

19. (a) State and prove Taylor's formula.

Or

(b) Assume that g is differentiable at a with total derivative $g'(a)$. Let $b = g(a)$ and assume that f is differentiable at b with total derivative $f'(b)$. Then prove that the composite function $h = f \circ g$ is differentiable at a and the total derivative $h'(a)$ is given by $h'(a) = f'(b) \circ g'(a)$ the composition of the linear functions $f'(b)$ and $g'(a)$.

20. (a) Let A be an open set of R^n and assume $f : A \to R^n$ is continuous and has finite partial derivatives $D_j f_i$. If f is one to one on A and if $J_F(x) \neq 0$ for each x in A then prove that $f(A)$ is open.

Or

(b) State and prove second derivative test for extrema.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Let C be any real number and let f and g be real valued measurable function defined on the same measurable set E. Then prove that $f + c, cf, f - g$ and fg are also measurable.

Or

(b) Prove that the outer measure of an interval equals its length.

22. (a) Let f be a bounded function defined on the finite interval $[a, b]$ then prove that f is Riemann integrable over $[a, b]$ if and only if it is continuous a.e.

Or

(b) State and prove Fatou's lemma.

23. (a) State and prove Riesz Fischer theorem.

Or

(b) If g is bounded variation on $[0, \delta]$ then prove that $\lim_{\alpha \to +\infty} \frac{2}{\pi} \int_0^{\delta} \frac{\sin \alpha t}{t} dt = g(0^+)$.

24. (a) If both derivatives $D_r f$ and $D_k f$ exist in an n ball $B(c : \delta)$ and if both differentiable at c then prove that $D_{r,k} f(c) = D_{kr} f(c)$.

Or

(b) State and prove mean value theorem.

25. (a) State and prove implicit function theorem.

Or

(b) State and prove inverse function theorem.

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Code No. : 5877 **Sub. Code : VMAC 23**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2026.

Second Semester

Mathematics — Core

PROBABILITY THEORY

(For those who joined in July 2024–2025 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. The difference of events E-A is called the

(a) Intersection (b) Union

(c) Complement (d) Borel

2. The probability of the sure event equals

(a) zero (b) one

(c) $-\infty$ (d) ∞

3. Suppose that the random variable X can take on two values $x_1 = -1$ with probability $p_1 = 0.1$ and $x_2 = +1$ with probability $p_2 = 0.9$ Then $E(X) =$

(a) 0.6 (b) 1

(c) 0 (d) 0.8

4. The square root of the variance is called the

(a) Coefficient

(b) Central moments

(c) Standard deviation

(d) Mean

5. The function defined by the formula, where $-1 \leq S \leq$ is called the probability generating function of X

(a) $\psi(s) = -\sum_k P_k S^k$

(b) $\psi(s) = \sum_{k\to\infty} P_k S^k$

(c) $\psi(s) = \sum_{k=0} P_k S^k$

(d) $\psi(s) = \sum_k P_k S^k$

6. The characteristic function of the random variable (X, Y) or of the distribution function $F(x, y)$ is defined by the

(a) $\phi(t,u) = -E\left[e^{i(X+uY)}\right]$

(b) $\phi(t,u) = E\left[e^{i(X+uY)}\right]$

(c) $\phi(t,u) = -E\left[e^{-i(X+uY)}\right]$

(d) $\phi(t,u) = -E\left[e^{i(iX+uY)}\right]$

7. The random variable X has a one point distribution if there exists a point x_0 such that

(a) $P(X=x_0)=1$ (b) $P(X=x_1)=1$

(c) $P(X=x_0)=0$ (d) $P(X=x_1)=0$

8. The random variable X has a normal distribution if its density function is given by the formula

(a) $f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{x-m^2}{2\sigma^2}\right)$

(b) $f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{x-m^2}{2\sigma^2}\right)$

(c) $f(x) = -\frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{x-m^2}{2\sigma^2}\right)$

(d) $f(x) = -\frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{x-m^2}{2\sigma^2}\right)$

9. The distribution function $F(x)$ is called the

(a) limit distribution (b) convergent

(c) discontinuity (d) limit

10. The sequences X_k, and $X_k^*(k=1,2,\cdots)$ are equivalent in the sense of Khintchin if

(a) $\sum_{k=1}^{\infty} P\left(X_k = X_k^*\right) < \infty$

(b) $\sum_{k=1}^{-\infty} P\left(X_k \neq X_k^*\right) < \infty$

(c) $\sum_{k=1}^{-\infty} P\left(X_k = X_k^*\right) < \infty$

(d) $\sum_{k=1}^{\infty} P\left(X_k \neq X_k^*\right) < \infty$

11. The set Z of random events contains as an element the ————

(a) empty set (b) one

(c) $-\infty$ (d) ∞

12. The determinant $|M|$ is called the ————

(a) variance

(b) mean

(c) generalized variance

(d) degenerate

13. The random variable X has a binomial distribution ————

(a) $P_k = \binom{n}{k} p^k (1-p)^{n+k}$

(b) $P_k = \binom{n}{k} p^{-k} (1-p)^{n+k}$

(c) $P_k = -\binom{n}{k} p^k (1+p)^{n-k}$

(d) $P_k = \binom{n}{k} p^k (1-p)^{n-k}$

14. The random variable X has a Cauchy distribution if its density is given by the formula

(a) $f(x) = \frac{1}{\pi} + \frac{\lambda}{\lambda^2 + (x-\mu)^2}$

(b) $f(x) = \frac{1}{\pi} \cdot \frac{\lambda}{\lambda + (x-\mu)}$

(c) $f(x) = \frac{1}{\pi} \cdot \frac{\lambda}{\lambda^2 + (x-\mu)^2}$

(d) $f(x) = \frac{1}{\pi} \cdot \frac{\lambda}{\lambda^2 + (x \times \mu)^2}$

15. The least upper bound of the values of T is called the _____ of the function $F(x)$ in the interval $[a, b]$

(a) total absolute variation

(b) bounded variation

(c) variation

(d) absolute variation

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Prove the relations:

$$A_2A_2 = A_1 - (A_1 - A_2)$$

$$A_1 + A_2 = A_1 + (A_2 - A_1)$$

$$A_1 - A_2 = A_1 - A_1A_2$$

Or

(b) Explain Marginal distribution.

17. (a) Show that the equality $\rho^2 = 1$ is a necessary and sufficient condition for the relation $P(Y = aX + b) = 1$ to hold.

Or

(b) The random variable X has the normal distribution with density $f(x) = \left(\frac{1}{\sqrt{2\pi}}\right)e^{-}\left(\frac{x^2}{2}\right)$. Find $E(X^2)$.

18. (a) Prove that the characteristic function of the sum of an arbitrary finite number of independent random variable equals the product of their characteristic functions.

Or

(b) The random variable X has a Poisson distribution, that is $P_k = e^{-}\lambda\frac{\lambda^k}{k!}$ $(k = 0, 1, 2, \cdots)$. then prove that

$$\psi(s) = \sum_{k=0}^{\infty} e^{-\lambda}\frac{(\lambda s)^k}{k!} = e^{-\lambda}e^{\lambda s} = e^{-\lambda(1-s)}$$

19. (a) If for $N = 1,2,\ldots$ equality is satisfied and $\lim_{N\to\infty} \alpha = 0$, then prove that the probability function of the random variable X with the poly distribution tends to the probability function of the binomial distribution as $N \to \infty$.

Or

(b) Explain the gamma distribution.

20. (a) State and prove the Chebyshev theorem.

Or

(b) We throw a coin n=100 times. We assign the number 1 to the appearance of heads and the number 0 to the appearance of tails. The probability of each of these events is equal to $p = q = 0.5$ What is the probability that heads wills appear more than 50 times and 60 times?

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Prove that the normal distribution of the sum, difference, product and ratio of two independent random variable X and Y.

Or

(b) State and prove the Bayes theorem.

22. (a) Show that for a random variable X the absolute moment of order n exists, for arbitrary $k(k=1,2,\ldots,n-1)$ the following inequality is then true $\beta_k^k \le \beta_{k+1}^{(k+1)}$

Or

(b) Prove that the variance of the sum of an arbitrary finite number of independent random variables, whose variances exist, equals the sum of their variances.

23. (a) Prove that the 11th moment m_i of a random variable exists, it is expressed $m_i = \frac{\phi^{(i)}(0)}{u^i}$ where $\phi^{(l)}(0)$ is the 1th derivative of the characteristic function $\phi(t)$) of this random variable at $t = 0$.

Or

(b) State and prove the Cramer-Wold theorem.

24. (a) Explain the Cauchy and Laplace distribution.

Or

(b) If for $N = 1,2,\ldots$ equality $P = \frac{b}{N} = \text{constant}$ is satisfied and $\lim_{N\to\infty} \alpha = 0$, then prove the probability function of the random variable X with the polya distribution tends to zero the probability function of the binomial distribution as $N \to \infty$.

25. (a) State and Prove the De Moivre laplace theorem.

Or

(b) If $X_1, X_2, \cdots$ independent random variables with the same distribution, whose standard deviation sigma $\sigma \neq 0$ exists, then prove the sequence $F_n(z)$ of distribution functions of the random variables Z_n, given by formulas

$Z_n = \frac{Y_n - mn}{\sigma\sqrt{n}}$ and $Y_n = X_1 + X_2 + \cdots + X_n$

satisfies, for every, the equality and

$\lim_{n\to\infty} F_n(z) = \frac{1}{\sqrt{z\pi}} \int_{-\infty}^{z} e^{-\frac{z^2}{2}} dz$.

(7 pages) **Reg. No. :** .....

Code No. : 5881 **Sub. Code : VMASE 21**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2026.

Second Semester

Mathematics

Skill Enhancement Course — MATHEMATICAL DOCUMENTATION USING LATEX

(For those who joined in July 2024–2025 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL the questions.

Choose the correct answer :

1. An environment is initiated with the command _____

(a) \begin {name} (b) \end {name}

(c) \begin (d) \end

2. _____ length can be stretched or shrunk by a certain amount.

(a) blank (b) rubber

(c) eraser (d) fined

3. Which of the following is used for compound words?

(a) \ (b) –

(c) $ (d) {

4. Which of the following is used for the amount of indentation for the first line of a paragraph?

(a) \parskip (b) \baseline

(c) \parindent (d) \parind

5. Which of the following is used to format a page into two columns?

(a) two co⌉umn (b) two co⌈umn

(c) two column (d) two

6. _____ is used to make both head and footlines as empty.

(a) /empty (b) \empty

(c) ϕ (d) empty

7. Which of the following is used to make the smallest size?

(a) \script size (b) \small

(c) \large (d) \tiny

8. The individual entries are indicated with a _____

(a) black dot (b) big dot

(c) small dot (d) double dot

9. Every infinite set of bounded points possesses atleast one maximum point. The result is known as _____ theorem.

(a) Taylor's

(b) Balzano-Weierstrass

(c) Euler's

(d) Lagrange's

10. _____ is a piece of tent that TEX treats as a unit, like a single character.

(a) table (b) box

(c) paragraph (d) word

11. \par box [pos] {width} {text} is used to put paragraphs into separate _____

(a) vertical boxes (b) horizontal boxes

(c) boxes (d) circular boxes

12. Which of the following is the column formatting argument?

(a) column (b) columns

(c) cols (d) colus

13. How to represent Δ in Latex?

(a) \triangle (b) \triang

(c) \tri (d) \tangle

14. Which of the following command produces a structure that looks like a fraction without dividing the lien?

(a) /choose (b) \up

(c) /down (d) \choose

15. Roots are printed with the command _____

(a) \sqrt (b) \sqrt [n] {arg}

(c) \sqrt {arg} (d) /sqrt [n] {arg}

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Describe the Euro symbol.

Or

(b) Explain the fined lengths in Latex.

17. (a) How to print the table of contents?

Or

(b) How to select font size and paper size?

18. (a) Write a short note on theorem-like declarations.

Or

(b) Explain about lists.

19. (a) Discuss about standard and non-standard foot notes.

Or

(b) Illustrate table style parameters.

20. (a) List out the binary operators.

Or

(b) Describe constants and variables.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

21. (a) Discuss various types of special characters.

Or

(b) Explain about command names and arguments.

22. (a) What are the parts of the documents? Explain them.

Or

(b) Discuss about standard class options.

23. (a) Explain centering and identing in detail.

Or

(b) Discuss various style parameters uses for formatting lists.

24. (a) How to construct tables? Illustrate.

Or

(b) Discuss various types of boxes.

25. (a) Explain about fractions, roots, sums and integrals in detail.

Or

(b) Discuss the following :

(i) Arrows

(ii) Pointers

(iii) Symbols with two sizes

Reg. No. : .....

Code No. : 5404 **Sub. Code : WMAE 25/ VMAE 25**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2026.

Second Semester

Mathematics — Core

Elective IV — OPERATIONS RESEARCH

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. A transportation problem is said to be unbalanced if the total supply is not equal to the total ————————

(a) demand (b) cost

(c) optimization (d) dummy demand

2. A general transportation model with m sources as n destinations has _____ constraint equations.

(a) m (b) n

(c) $m+n$ (d) $m-n$

3. Which of the following is true?

(a) Vogel method yields the best basic solution

(b) North west corner method yields the worst

(c) Both (a) and (b)

(d) Neither (a) not (b)

4. Completion of an activity on CPM network diagram is known as

(a) evend (b) node

(c) connector (d) all the above

5. _____ algorithm is designed to determine the shortest routes between the source node and every other node in the network.

(a) Dijkstra's

(b) Floyd's

(c) Shortest route

(d) Branch and bound

6. An activity is said to be _____ when there is no 'lee way' in determining its start and finish times.

(a) non critical (b) critical

(c) network (d) event

7. In _____ problem, a person desires to determine the shortest four for visiting n cities, with each city visited exactly once.

(a) Chinese post man

(b) Integer Value

(c) Traveling salesman

(d) Fixed Charge

8. In solving ILP, _____ method is more successful than the cutting plane method.

(a) Vogel method

(b) Branch and bound

(c) TORA

(d) MODI

9. The cutting plane algorithm starts by solving the _____ problem.

(a) Continuous LP (b) ILP

(c) Continuous ILP (d) TSP

10. _____ represents the cost of maintaining the inventory in stock.

(a) purchasing cost

(b) setup cost

(c) holding cost

(d) shortage cost

11. In classic EOQ model, $y^* =$ _____

(a) $\sqrt{\frac{2KD}{h}}$ (b) $\frac{-KD}{y^2} + \frac{h}{2}$

(c) $\frac{y}{2}$ (d) $\sqrt{\frac{2k}{h}}$

12. The cost of insurance and taxes are included in

(a) Cost of ordering

(b) Inventory carrying cost

(c) Set up cost

(d) Cost of shortages

13. The mean and standard deviation of the exponential distribution are _____

(a) equal (b) unequal

(c) ∞ (d) zero

14. In a single server queue model, $W_s =$ _____

(a) L_s (b) $\frac{L_s}{\lambda}$

(c) $\frac{\lambda}{L_s}$ (d) λL_s

15. In ((M/M/C): $(G_D/\infty/\infty)$ model , $L_q =$ _____

(a) $\sum_{n=1}^{\infty}(n-c)P_n$

(b) $\sum_{n=1}^{\infty}(c-n)P_n$

(c) $\sum_{n=c}^{\infty}(n-c)P_n$

(d) $\frac{\lambda}{\mu}$

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

16. (a) Explain Northwest - Corner method.

Or

(b) Explain Vogel approximation method.

17. (a) Explain CPM and PERT in detail.

Or

(b) Write the Red- Flagging rule.

18. (a) Maximize $Z = x_1 + 2x_2 + 5x_3$ subject to

$$|-x_1 + 10x_2 - 3x_3| \geq 15$$

$$2x_1 + x_2 + x_3 \leq 10$$

$$x_1, x_2, x_3 \geq 0$$

Or

(b) Solve by the additive algorithm.

Maximize $Z = 3x_1 + x_2 + 3x_3$

Subject to $-x_1 + 2x_2 + x_3 \leq 4$

$$4x_2 - 3x_3 \leq 2$$

$$x_1 - 3x_2 + 2x_3 \leq 3$$

$$x_1, x_2, x_3 = (0, 1)$$

19. (a) Neon lights on the U and A Campus are replaced at the rate of 100 units per day. The physical plant orders the neon lights periodically. It costs \$100 to initiate a purchase order. A neon light kept in storage is estimated to cost about \$.02 per day. The lead time between placing and receiving an order is 12 days. Determine the optimal inventory policy for ordering the neon lights.

Or

(b) Explain the classic EOQ model.

20. (a) Explain pure birth model.

Or

(b) In (M/M/1):($G_D/\infty/\infty$) model, find L_s, W_s, W_q, L_q.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

21. (a) Compare the starting solutions obtained by the northwest corner, least cost and Vogel methods for the following model.

0	2	1	6
2	1	5	7
2	4	3	7
5	5	10	

Or

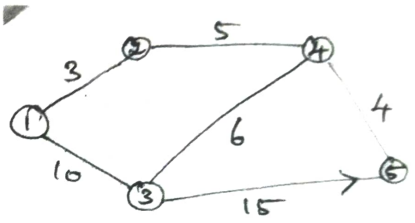
(b) Solve the assignment model in the following table

3	8	2	10	3
8	7	2	9	7
6	4	2	7	5
8	4	2	3	5
9	10	6	9	10

22. (a) Explain maximal flow algorithm.

Or

(b) Find the shortest routes between every two nodes for the following network.



23. (a) Describe Branch and Bound algorithm.

Or

(b) Explain Zero-One implicit enumeration algorithm.

24. (a) Describe EOQ with price breaks.

Or

(b) Lube car specializes in fast automobile oil change. The garage buys car oil in bulk at \$3 per gallon. A price discount of \$2.50 per gallon is available if Lube Car purchases more than 1000 gallons. The garage services

approximately 150 cars per day and each oil change requires 1.25 gallons. Lube car stores bulk oil at the cost of $.02 per gallon per day. Also the cost of placing an order for bulk oil is $20. There is a 2-day lead time for delivery. Determine the optional inventory policy.

25. (a) Explain (M/M/1) (GD/N/∞) Model.

Or

(b) Write a short note about steady state measures of performance in queuing system.

(8 pages) **Reg. No. : .....**

Code No. : 5878 **Sub. Code : VMAE 21**

M.Sc.(CBCS) DEGREE EXAMINATION, APRIL 2026.

Second Semester

Mathematics

Elective III — RESEARCH METHODOLOGY

(For those who joined in July 2024–2025 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. Which writing style is generally preferred in academic assignments?
   (a) Informal and conversational
   (b) Formal and objective
   (c) Emotional and subjective
   (d) Poetic and abstract

2. In academic writing, what does 'finding your own voice' refer to?
   (a) Using colloquial language to express ideas
   (b) Developing a unique argument or perspective
   (c) Mimicking the writing style of published authors
   (d) Avoiding the use of external sources

3. A thing that differentiate academic writing from other types of writing is
   (a) Level of formality
   (b) Register
   (c) Neutral language
   (d) Both (a) and (b)

4. Written sources of information is
   (a) Seminars
   (b) Lectures
   (c) Conference presentations
   (d) Journals

5. Why is it important to adhere to the specified formatting guidelines in academic writing

(a) To make the document look more colourful

(b) To ensure consistency and meet institutional standards

(c) To fill up space in the assignment

(d) To showcase creative design skills

6. To avoid plagiarism, which practice should be followed when incorporating sources your writing?

(a) Using synonyms to change a few words

(b) Paraphrasing without citation

(c) Quoting directly and providing proper citations

(d) Rearranging the order of sentences

7. What is a primary difference between a dissertation and a thesis?

(a) A dissertation is shorter than a thesis

(b) A thesis involves original research, while a dissertation does not

(c) A dissertation is typically required for a doctoral degree, while a thesis is for a master's degree

(d) There is no difference, the terms are interchangeable

8. Which component is essential in a research proposal?

(a) Detailed findings and conclusions

(b) A comprehensive literature review

(c) A budget plan for the research

(d) An abstract summarizing the entire research

9. In research ethics, obtaining informed consent from participants ensures that:

(a) Participants are compensated for their time

(b) Participants are aware of and agree to the research procedures and potential risks

(c) The research complies with institutional funding requirements

(d) The data collected will be statistically significant

10. The 'Title' of a research project should:

(a) Be as long as possible to include all details

(b) Be concise yet descriptive of the main focus of the research

(c) Include complex terminology to showcase expertise

(d) Be decided upon after completing the research

11. Which component of a research project lists all the sources cited throughout the work?
(a) Appendices
(b) Abstract
(c) References or Bibliography
(d) Footnotes

12. Which section of a research project provides a critical evaluation of existing research related to the topic?
(a) Methodology (b) Introduction
(c) Literature Review (d) Conclusion

13. What is the primary purpose of publishing your research?
(a) To fulfill academic requirements
(b) To share findings with the broader academic community
(c) To increase personal recognition
(d) To secure funding for future projects

14. When delivering an oral presentation, which practice is recommended?
(a) Reading directly from your slides
(b) Engaging with the audience through eye contact
(c) Avoiding any visual aids
(d) Speaking in a monotone voice

15. What is a common reason for manuscript rejection by journals?
(a) Excessive use of technical jargon
(b) Lack of novelty or significance
(c) Too many visual aids
(d) Overuse of citations

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

16. (a) Write a short note on the sentence combining in the research methodology

Or

(b) Explain about how to read other research project.

17. (a) Discuss that how to decide on your writing approach in research project.

Or

(b) Explain about the electronic source of information.

18. (a) Write a short note on the basic requirement of a research project.

Or

(b) How to write proposal in research Project

19. (a) Explain how to choose the title page in the research project.

Or

(b) Write a short note on Style of presentation in the research project.

20. (a) Write a short note on Journal articles.

Or

(b) Discuss about conference presentation in publishing and presenting your research topic.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

21. (a) Explain briefly about how to write clearly and concisely in research project.

Or

(b) Discuss about the Level of formality and gender-neutral language

22. (a) Explain in detail about the sourcing and selecting information.

Or

(b) Discuss about the Recording information(or) making notes.

23. (a) Differentiate between a dissertation and a thesis in research project.

Or

(b) Explain about the Ethical consideration in research project.

24. (a) Explain about Abstract Acknowledgement and List of contents.

Or

(b) Explain how to write literature review in your research project.

25. (a) Explain how to publish your book.

Or

(b) Explain briefly about the punctuation use.

———————