Q.1 Four possible answers to each statement are given below. Tick (✓) the correct answer.

- (1) The property $\forall\, a \in R;\ a = a$ is called:
  (a) Reflexive (b) Symmetric
  (c) Transitive (d) Commutative

- (2) The multiplicative inverse of complex number $(0,-1)$ is:
  (a) $(1,0)$ (b) $(0,1)$
  (c) $(-1,0)$ (d) $(0,0)$

- (3) A function which is on to is called:
  (a) Objective (b) Injective
  (c) Bijective (d) Surjective

- (4) The contra positive of $p \to q$ *is*:
  (a) $\sim p \to \sim q$ (b) $\sim q \to \sim p$
  (c) $q \to p$ (d) $p \to q$

- (5) If A is a matrix of order 3×2 then order of $A^tA =$ _____ :
  (a) 3×3 (b) 2×3
  (c) 2×2 (d) 3×2

- (6) If ω is the imaginary cube root of unity then $\omega^2 =$ _____ :
  (a) 1 (b) -1
  (c) ω^{-1} (d) ω^{-2}

- (7) Partial fraction of $\dfrac{(x-a)(x-b)}{(x-c)(x-d)}$ is of the form:
  (a) $\dfrac{A}{x-c}+\dfrac{B}{x-d}$ (b) $1+\dfrac{A}{x-a}+\dfrac{B}{x-b}$
  (c) $\dfrac{A}{x-a}+\dfrac{B}{x-b}$ (d) $1+\dfrac{B}{x-c}+\dfrac{A}{x-d}$

- (8) $1^3+2^3+3^3+------+n^3 =:$
  (a) $\left(\dfrac{n(n+1)}{2}\right)^3$ (b) $\dfrac{n(n+1)(2n+1)}{6}$
  (c) $\dfrac{n(n+1)(2n+1)}{3}$ (d) $\dfrac{n^2(n+1)^2}{4}$

- (9) Arithmetic Mean (A.M) between $\sqrt{2}$ and $3\sqrt{2}$ is:
  (a) ± 6 (b) $\dfrac{3}{\sqrt{2}}$
  (c) $\sqrt{8}$ (d) $4\sqrt{2}$

- (10) Numbers of ways in which 5 persons can be seated at a round table are:
  (a) 120 (b) 24
  (c) 60 (d) 12

- (11) If E is an event then probability of non-occurrence of E is:
  (a) $1-p(\overline{E})$ (b) $p(\overline{E})-1$
  (c) $1-p(E)$ (d) $p(E)-1$

- (12)The sum of odd coefficients in the expansion of $(1+x)^5$ is :

  (a) 16 (b) 32
  (c) 25 (d) 5

- (13) The expansion of $(3-5x)^{\frac{-1}{2}}$ is valid only if:

  (a) $|x|<5$ (b) $|x|<\frac{5}{3}$
  (c) $|x|<\frac{3}{5}$ (d) $|x|<\frac{1}{2}$

- (14) $2^n-1<n!$ is true for:

  (a) $n\geq 1$ (b) $n\geq 2$
  (c) $n\geq 3$ (d) $n\geq 4$

- (15) $1-\sec^2\theta=$

  (a) $\tan^2\theta$ (b) $-\tan^2\theta$
  (c) $\tan^2\theta-1$ (d) $1-\tan^2\theta$

- (16) $2\cos 5\theta\sin 3\theta$:

  (a) $\sin 8\theta-\sin 2\theta$ (b) $\sin 8\theta+\sin 2\theta$
  (c) $\cos 8\theta+\cos 2\theta$ (d) $\sin 4\theta-\sin\theta$

- (17) The range of $y=\cos x$ is:

  (a) $-1\leq x\leq 1$ (b) $-\infty\leq x\leq+\infty$
  (c) $-1\leq y\leq 1$ (d) $-\infty\leq y\leq+\infty$

- (18) The in-radius of the in-circle is:

  (a) $\frac{abc}{4\Delta}$ (b) $\frac{\Delta}{s}$
  (c) $\frac{\Delta}{s-a}$ (d) $\frac{s}{\Delta}$

- (19) $Tan^{-1}\left(-\sqrt{3}\right)=$:

  (a) $\frac{2\pi}{3}$ (b) $\frac{-2\pi}{3}$
  (c) $\frac{-\pi}{6}$ (d) $\frac{-\pi}{3}$

- (20)The equation $Cos^2x=\frac{3}{4}$ has solution:

  (a) One (b) Two
  (c) Four (d) Infinite

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Section – I

Note: *All questions are to be attempted on answer book.*

Q # 2: Write any TWENTY-FIVE short answers of the following questions:

(i) Show that $s = \{1, -1\}$, is closed under multiplication.

(ii) Simplify $(a - bi)^3$.

(iii) Under what condition on sets A and B that the statement A – B = A, is true?

(iv) Construct the truth table of $(p \to q) \wedge p$.

(v) For the set A = {1, 2, 3, 4} state domain and range of relation {(x, y) | x + y>5}

(vi) Define surjective function.

(vii) If $A = \begin{bmatrix} 1 & 2 \\ a & b \end{bmatrix}$ *and* $A^2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ find values of a and b.

(viii) Show that $(A^{-1})^{-1} = A$ where A is non singular matrix.

(ix) If A is any square matrix of order 3, show that $(A + A^t)$ is symmetric.

(x) Define radical equation.

(xi) Show that $1 + \omega + \omega^2 = 0$.

(xii) If α *and* β are roots of the equation $3x^2 - 2x + 4 = 0$, find values of $\alpha^3 + \beta^3$.

(xiii) The sum of a positive number and its reciprocal is $\frac{26}{5}$. find the number.

(xiv) Find the 13th term of the sequence x, 1, 2 – x , …

(xv) If $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in G.P show that common ratio is $\pm\sqrt{\frac{a}{c}}$

(xvi) If $y = \frac{2}{3}x + \frac{4}{9}x^2 + \frac{8}{27}x^3 + \ldots$ if $0 < x < \frac{3}{2}$ then show that $x = \frac{3y}{2(1+y)}$

(xvii) Find the 9th term of the sequence $\frac{-1}{5}, \frac{-1}{3}, -1, \ldots$

(xviii) Prove that ${}^nP_r = n \cdot {}^{n-1}P_{r-1}$

(xix) Find the number of ways in which 5 men and 5 women can be seated at a round table in such a way that no two persons of the same sex are together.

(xx) Pakistan and India play a cricket match. Find the probability that Pakistan wins

(xxi) A box contains 10 red, 30 white and 20 black marbles. A marble is drawn at random. Find the probability that it is either red or white.

(xxii) State principle of mathematical induction.

(xxiii) State any four points of observation in the expansion of $(a + x)^n$

(xxiv) Find the general term in the expansion of $(1 + x)^{-3}$ when $|x| < 1$

(xxv) Using binomial theorem, find the value of $\sqrt{99}$ to the three places of decimal.

(xxvi) Express $\frac{19\pi}{32}$ in to the measure of sexagesimal system.

(xxvii) Find x if $\tan^2(45^0) - \cos^2(60^0) = x\sin(45^0)\cos(45^0)\tan(60^0)$

(xxviii) Prove that $\tan(45^0 + A)\tan(45^0 - A) = 1$

(xxix) Find value of $\sin(2\alpha)$ *if* $\cos(\alpha) = \frac{3}{5}$ *where* $0 < \alpha < \frac{\pi}{2}$

(xxx) Express $\cos 12^0 + \cos 48^0$ as product.

(xxxi) Write the domain and range of $y = \cos ec(x)$

(xxxii) Find the period of $\cos(2x)$

(xxxiii) In the right triangle ABC in which $\gamma = 90^0, a = 8, b = 8, Find\ \alpha.$

(xxxiv) Write the law of Sine

(xxxv) Show that $r_2 = s\tan\frac{\beta}{2}$

(xxxvi) Solve trigonometric equation $\cos(x) = \sin(2x)\ in\ [0, \pi]$

(xxxvii) Find the solution of $\sin x = -\frac{\sqrt{3}}{2} in [0, 2\pi]$

Section - II

***Note:** Attempt any THREE questions.*

Q # 3 (a) Solve the system of linear equations. 5

$$2x + 2y + z = 3$$
$$3x - 2y - 2z = 1$$
$$5x + y - 3z = 2$$

(b) Show that roots of $x^2 + (mx + c)^2 = a^2$ will be equal if $c^2 = a^2(1 + m^2)$ 5

Q # 4 (a) Resolve in to partial fractions $\frac{x^3}{(x-1)^3(x+1)}$ 5

(b) For what value of n, $\frac{a^n + b^n}{a^{n-1} + b^{n-1}}$ is harmonic mean between a and b. 5

Q # 5 (a) Find the values of n and r when ${}^nC_r = 35\ and\ {}^nP_r = 210$ 5

(b) If x is very nearly equal to 1 then prove that $P x^p - q x^q = (p - q) x^{p+q}$ 5

Q # 6 (a) Show that $\sin^6(\theta) + \cos^6(\theta) = 1 - 3\sin^2\theta\cos^2\theta$ 5

(b) If α, β, γ are angles of a triangle ABC, then show that

$$\cot\frac{\alpha}{2} + \cot\frac{\beta}{2} + \cot\frac{\gamma}{2} = \cot\frac{\alpha}{2} \cdot \cot\frac{\beta}{2} \cdot \cot\frac{\gamma}{2}$$ 5

Q # 7 (a) The sides of a triangle are $x^2 + x + 1, 2x + 1, and\ x^2 - 1$, prove that the greatest angle of the triangle is 120^0. 5

(b) Prove that $\tan^{-1}\frac{3}{4} + \tan^{-1}\frac{3}{5} - \tan^{-1}\frac{8}{19} = \frac{\pi}{4}$ 5

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