Roll No.

MATHEMATICS
SET - B

Time allowed : 3 hr   **Maximum Marks : 100**

General Instructions:
- (i) All Question are compulsory.
- (ii) The question paper consists of 29 questions divided into three sections A, B, and C. Section A comprises of 10 questions of **one mark** each. Section B comprises of 12 questions of **four marks** each and Section C comprises of **7** questions of **six marks** each.
- (iii) All questions in Section A are to be answered in one word, one sentence or as per the exact requirement of the question..
- (iv) There is no overall choice. However, internal choice has been provided in 4 questions of four marks each and 2 questions of six marks each. You have to attempt only one of the alternatives in all such questions.

SECTION A

1   Find the value of k for which $\dfrac{-2}{7}, k, \dfrac{-7}{2}$ are in G.P.

2   Write the value of cot 15°

3   Express $(-5i)\left(\dfrac{1}{8}i\right)$ in the standard form.

4   If $2\cos\theta = a + \dfrac{1}{a}$ find the value of $2\cos 2\theta$

5   A box contains 6 red marbles numbered from 1 to 6 and 4 white numbered from 12 to 15. Find the probability that a marble drawn at random is white

6   Solve: $\dfrac{5-2x}{3} \le \dfrac{x}{6} - 5$

7   Write the equation of the line for which $\tan\theta = \dfrac{1}{2}$, where θ is the inclination of the line with the x-axis and y-intercept is $-\dfrac{3}{2}$

8   If $^{n+1}C_2 = 45$, find n

9   Find the equation of the straight line joining the point (a, b) and ((a + b), (a – b))

10 Find the real numbers x and y if (x – iy)(1 + i) is the conjugates of -3 – 2i.

SECTION B

11 If $z_1 = 2 - i$, $z_2 = 1 + i$, find $\left|\dfrac{z_1 + z_2 + 1}{z_1 - z_2 + i}\right|$ **OR**

    If $a + ib = \dfrac{(x+i)^2}{2x^2 + 1}$, prove that $a^2 + b^2 = \dfrac{(x^2+1)^2}{(2x^2+1)^2}$

12 Prove that using the principle of mathematical induction for all $n \in$ N:
    $$\dfrac{1}{1.2.3} + \dfrac{1}{2.3.4} + \dfrac{1}{3.4.5} + \dots + \dfrac{1}{n(n+1)(n+2)} = \dfrac{n(n+3)}{4(n+1)(n+2)}$$

13 (i) How many 6-digit numbers can be formed from the digits 0, 1,3, 5, 7 and 9 which are divisible by 10 and no digit is repeated?
    (ii) In how many ways can 5 girls and 3 boys be seated in a row so that no two boys are together?

14 A group consists of 4 girls and 7 boys. In how many ways can a team of 5 members be selected if the team has at least one boy and one girl.

15 Solve: $2\cos^2 x + 3\sin x = 0$

16 Prove that : $\cos 2\theta \cos\dfrac{\theta}{2} - \cos 3\theta \cos\dfrac{9\theta}{2} = \sin 5\theta \sin\dfrac{5\theta}{2}$

17 Find the equation of the lines through the point (3,2)which make an angle of 45° with the line x–2y= 3

OR

Find the equation of the circle passing through the points (-3, 4), (-2, 0) and (1, 5). Find the coordinates of the centre and radius of this circle.

18 P(a, b) is a mid-point of a line segment between axes. Show that equation of the line is $\frac{x}{a} + \frac{y}{b} = 2$.

19 Find the equation for the ellipse that satisfies the given conditions:
vertices$(0, \pm 13)$, foci $(0, \pm 5)$ **OR**
Find the lengths of the axes, the eccentricity, coordinates of foci and the equation of directrices of the ellipse $25x^2 + 16y^2 = 400$

20 Find domain and range of the real function f(x) defined by $f(x) = \begin{cases} 2-x & x < 0 \\ 1, & x = 0 \\ x-2 & x > 0 \end{cases}$ and draw its graph

21 If the origin is the centroid of the triangle PQR with vertices P(2a, 2, 6), Q(-4, 3b, -10) and R(8, 14, 2c), then find the value of a, b and c.

22 Two student A and B appeared in IIT examination. The probability that A will qualify the examination of 0.05 and that B will qualify the examination is 0.10. The probability that both will qualify the examination is 0.02. Find the probability that
(i) both A and B will not qualify the IIT examination
(ii) at least one of them will not qualify the IIT examination
(iii) only one of them will qualify the IIT examination

OR

A box contains 10 red marbles 20 blues marbles and 30 green marbles, 5 marbles are drawn from the box, what is the probability that (i) all will be blue (ii) at least one will be green

SECTION – C

23 In a survey it was found that 21 people liked product A, 26 liked product B and 29 liked C. If 14 people liked product A and B, 12 people liked product C and A, 14 people liked products B and C and 8 liked all the three products. Find how many liked (i) product C only (ii) products A and C but not product B (iii) at least one of three products.

24 Solve the following system graphically and name the vertices of the feasible region along with their coordinates: $3y - 2x \le 4$, $x + 3y > 3$, $x + y \ge 5$, $y < 4$.

25 Find the sum of n terms of the series $1^2 + (1^2 + 2^2) + (1^2 + 2^2 + 3^2) + \ldots\ldots\ldots$

OR

Between 1 and 31, m numbers have been inserted in such a way that the resulting sequence is an A.P. and the ratio of 7th and (m -1)th is 5:9 Find the value of m.

26 Find the coefficient of x^5 in the expansion of the product $(1 + 2x)^6 (1 - x)^7$

OR

(i) Show that the middle term in the expansion of $(1 + x)^{2n}$ is equal to sum of the coefficients of two middle terms in the expansion of $(1 + x)^{2n-1}$

(ii) Find rth term from the end in the expansion of $(x + a)^n$

27 (i) Find the Derivative of sin(x+1) from first principles

(ii) Evaluate $\lim_{x \to 0} \frac{\sin ax + bx}{ax + \sin bx}$ $a, b, a + b \ne 0$

28 Calculate the mean deviation about median age for the age distribution of 100 persons given below:

Age	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55
Number	5	6	12	14	26	12	16	9

29 Prove that $\frac{\sin A - \sin 5A + \sin 9A - \sin 13A}{\cos A - \cos 5A - \cos 9A + \cos 13A} = \cot 4A$

Best of Luck