Time: 3 hrs

General Instructions: **M.M - 100**

1. All questions are compulsory.
2. The question paper consists of 26 questions divided into three sections A, B and C.
3. Section A consists of 6 questions of one mark each, section B comprises of 13 questions of four marks each and section C comprises of 7 questions of six marks each.
4. All question in section A are to be answered in one sentence or as per the exact requirement of the question.
5. There is no overall choice. However internal choice has been prepared.
6. Use of calculator is not permitted. You may ask for logarithmic tables, if required.

SECTION –A

1. Express i^{-2013} in form of a+ ib.
2. Solve: $\frac{3(x-2)}{5} \leq \frac{5(2-x)}{3}$.
3. Evaluate: $(99)^5$ using Binomial Theorem.
4. How many elements has P (A), if A=Φ?
5. How many digits can be formed by using the digit 1 to 9, if no digit is repeated?
6. In a triangle ABC, if $\cos A = \frac{\sin B}{2 \sin C}$, then prove that the triangle is isosceles

SECTION – B

7. For any non-empty sets A and B, if P (A) = P (B), then prove that A =B. **OR**
   State and prove De Morgan's law by definition.
8. If $\tan x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$, find the value of $\sin\frac{x}{2}, \cos\frac{x}{2}$ and $\tan\frac{x}{2}$.
9. Prove that: $\sin 3x + \sin 2x - \sin x = 4 \sin x \cos\frac{x}{2} \cos\frac{3x}{2}$.
10. Using PMI, Prove that:
    $$1 + \frac{1}{1+2} + \frac{1}{1+2+3} + \frac{1}{1+2+3+4} + \cdots + \frac{1}{1+2+\cdots+n} = \frac{2n}{n+1}$$
11. Using PMI, prove that $n^3 - 7n + 3$ is divisible by 3, for all natural numbers n.
12. Find real Ø such that $\frac{3+2i\sin\emptyset}{1-2i\sin\emptyset}$ is purely real. **OR**
    If $(x+iy)^3 = u+iv$, then show that: $\frac{u}{x} + \frac{v}{y} = 4(x^2-y^2)$
13. In triangle ABC, prove that : $\frac{b^2-c^2}{a^2}\sin 2A + \frac{c^2-a^2}{b^2}\sin 2B + \frac{a^2-b^2}{c^2}\sin 2C = 0$
14. Solve graphically: $3x + 2y \leq 150, x+4y \leq 80, x \geq 0, y \geq 0$.
15. How many numbers greater than 1000000 can be formed by using the digits 1, 2, 0, 2, 4, 2, 4?
16. If the fourth term in the expansion of $\left(ax + \frac{1}{x}\right)^n$ is $\frac{5}{2}$, then find the value of a and n.
17. Find the middle term in expansion of $\left(\frac{3x - x^3}{6}\right)^9$
18. The sum of the first four terms of an A.P. is 56. The sum of last four terms is 112. If its first term is 11, then find its ~~common ratio~~. no. of terms.
19. In how many ways can the letters of the words ASSASINATION be arranged so that all the S's are together? **OR**
    How many five-letter words containing 3 vowels and 2 consonants can be formed using the letters of the word EQUATION so that the two consonants occur together?

(vowels together)

SECTION C

20. In an university, out of 100 students 15 offered mathematics only, 12 offered statistics, 8 offered only physics, 40 offered only physics & statistics, 10 offered statistics & mathematics, 20 offered mathematics and physics, 55 offered physics, find the number of students who:

i. offered mathematics

ii. offered statistics

iii. did not offer any of three subjects

OR

(i) In a beauty contest, half the number of judges voted for Miss A, 2/3 of them voted for Miss B, 10 voted for both and 6 did not vote for either Miss A or Miss B. Find how many judges, in all, were present there?

(ii) If A and B are two sets such that $n(A-B) = 14+x$, $n(B-A) = 3x$ and $n(A \cap B) = x$. Draw a Venn Diagram to illustrate this information. If $n(A) = n(B)$, find (i) the value of x and (ii) $n(A \cup B)$

21. Solve: $\sin x \tan x - 1 = \tan x - \sin x$

OR

Show that $\cos^2 x + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) = \frac{3}{2}$

22. The sum of three numbers in G.P. is 56. If we subtract 1, 7, 21 from these numbers in that order, we obtain an arithmetic progression. Find the numbers.

23. Find the square root of the complex number $-7-24i$

OR

Find modulus and argument of the complex number $z = \frac{i-1}{\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}}$

24. A man has 7 relatives, 4 of them are ladies and 3 men, his wife also has 7 relatives, 3 of them are ladies and 4 men. In how many ways can they invite a dinner party of three ladies and 3 men so that there are 3 of men's relatives and 3 of wife's relatives? OR

A question paper contains 12 questions divided into two groups. Group I contains 7 questions and Group II contains 5 questions. In how many ways can a candidate attempt the question paper if he has to select 8 questions in all with the restriction of at least 3 questions from each group?

25. The second, third and fourth terms in the binomial expansion $(x+a)^n$ are 240, 720 and 1080, respectively. Find x, a and n.

26. Solve graphically: $x \le 10$, $x + 2y \le 10$, $x + y \ge 1$, $x - y \le 0$, $x \ge 0$, $y \ge 0$