

**First Year B.Sc (MRT) Degree Supplementary Examinations
September 2024**

Mathematics

Time: 3 Hours

Total Marks: 100

- Answer all questions to the point neatly and legibly • Do not leave any blank pages between answers • Indicate the question number correctly for the answer in the margin space
- Answer all parts of a single question together • Leave sufficient space between answers
- Draw table/diagrams/flow charts wherever necessary.
- The use of a simple calculator is allowed, but using scientific calculator or sharing any calculator is strictly prohibited under any circumstance.

Essay**(2x20=40)**

1. a) Calculate the regression coefficients and obtain the lines of regression for the following data

X	1	2	3	4	5	6	7
Y	9	8	10	12	11	13	14

- b) Using mathematical induction show that

$$1.2.3 + 2.3.4 + \cdots + n.(n+1).(n+2) = \frac{n.(n+1).(n+2).(n+3)}{4}$$

2. a) Find the Laplace transform of $f(t) = te^{2t} \sin 3t$.

- b) Evaluate the integral

$$\int x\sqrt{x+1} dx$$

- c) Use De Moivre's theorem to prove

$$\cos 3\theta = \cos^3 \theta - 3 \cos \theta \sin^2 \theta.$$

Short notes:**(8x5=40)**

3. Find $\text{curl}(\vec{F})$ and $\text{div}(\vec{F})$ if $\vec{F} = \frac{1}{r}(x\hat{i} + y\hat{j} + z\hat{k})$ where $r^2 = x^2 + y^2 + z^2$

4. If $\phi = \tan^{-1}xy$, find $\text{grad}(\phi)$.

5. Show that

$$\frac{\sin 5x - 2 \sin 3x + \sin x}{\cos 5x - \cos x} = \tan x$$

6. If $\sin x = \frac{3}{5}$, $\cos y = -\frac{12}{13}$, where x and y both lie in second quadrant, find the value of $\sin(x+y)$.

7. If $\left(\frac{1+i}{1-i}\right)^m = 1$, find the possible values for m .

8. An unbiased coin is tossed eight times what is the probability of obtaining more than five heads?

9. A committee of 5 people is to be chosen from a group of 6 men and 4 women. How many ways can we form such a committee if there must be a majority of women?

10. Find the solution $y(x)$ of the differential equation

$$xy \frac{dy}{dx} = (x+2)(y+2)$$

such that $y(1) = -1$.

(P.T.O)

Answer briefly:

(10x2=20)

11. Find the value of x , if $\log(x + 5) + \log(x - 5) = 4\log 2 + 2\log 3$

12. Convert $40^\circ 20'$ into radian measure

13. Find

$$\lim_{x \rightarrow 9} \frac{x - 3}{x^2 - 9}.$$

14. Find $\hat{i} \times (\hat{j} \times \hat{k}) + \hat{j} \times (\hat{k} \times \hat{i})$.

15. Find a vector perpendicular to both $3\hat{i} + 4\hat{j} - \hat{k}$ and $2\hat{i} - \hat{j} + \hat{k}$.

16. Find the modulus and amplitude of the complex number

$$\frac{(1 + 2i)(1 + 3i)}{1 - i}.$$

17. Three dice are rolled together. What is the probability of getting at least two sixes.

18. Prove the linearity property of Fourier Transform.

19. Define Sievert integral.

20. Evaluate

$$\int_0^1 x \cos\left(\frac{\pi x^2}{2}\right) dx.$$
