

This question paper contains 4 printed pages]

Your Roll No.

5283

B.A. (Hons.) Programme/II J
DISCIPLINE CENTRED CONCURRENT
COURSE

(Maths other than Economics)

(Algebra and Calculus)

(Admission of 2005 and onwards)

Time : 2 Hours

Maximum Marks : 38

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory and carries **eight** marks.
Attempt **six** more questions from the remaining Question
Nos. 2 to 10, selecting **two** questions each from Sections I,
II and III. Each question carries **five** marks.

1. (a) Are the columns of $A = \begin{bmatrix} -5 & 5 & 5 \\ 9 & 0 & 9 \\ 4 & 6 & 16 \end{bmatrix}$

linearly independent? Justify.

(b) If two lines have direction cosines proportional to $(1, 2, 3)$ and $(-2, 1, 3)$ respectively, find the direction cosines of the line perpendicular to both of them.

(c) Locate the relative maxima and minima of $f(x) = x^4 - 2x^2$.

(d) Find the sum of the Geometric series :

$$5 + \frac{5}{4} + \frac{5}{4^2} + \dots + \frac{5}{4^k} + \dots \quad (2 + 2 + 2 + 2)$$

Section I

2. Discuss the consistency of the following system of equations : 5

$$2x + 3y + 4z = 11$$

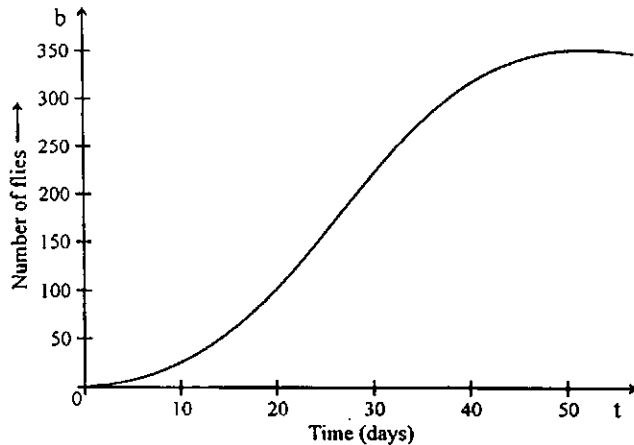
$$x + 5y + 7z = 15$$

$$3x + 11y + 13z = 25$$

If found consistent, solve it.

3. Find the equation of the sphere through the points $(4, -1, 2)$, $(0, -2, 3)$, $(1, 5, -1)$ and $(2, 0, 1)$. 5

4. The graph below shows how a population of fruit flies grew in a 50-day experiment. The number of flies was counted at regular intervals, the counted values plotted with respect to time. 5
- (i) Find the average growth rate from day 20 to 50.
- (ii) During what days does the population seem to be increasing fastest ?



Section II

5. Discuss concavity and convexity of $f(x) = \sin x$ on $[0, 2\pi]$. Also find its point of inflexion. 5
6. Verify the hypotheses and conclusion of Lagrange's Mean Value Theorem for function $f(x) = x^2 + x, x \in [-4, 6]$ 5
7. Give MacLaurin's series for the function $f(x) = e^x, -\infty < x < \infty$ 5
 Find sum of series at $x = 1$.

Section III

8. Evaluate $\int \frac{dx}{\sqrt{x}(x+4)}$ 5
9. Consider the integral $\int \frac{dx}{x^3 - x}$
- (a) Evaluate the integral using the substitution $x = \sec \theta$.
- (b) Evaluate the integral using the substitution $x = \sin \theta$ 5
10. According to United Nations data, the world population in 1998 was approximately 5.9 billion and growing at a rate of about 1.33% per year. Assuming an exponential growth model, estimate the world population at the beginning of the year 2023. 5
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