

SYBCom Semester III

Open Elective (Quantitative Techniques III)

Question Bank

Module 1: Arithmetic

- Linear equations in one variable and its applications.

- 1) If 5 is subtracted from twice an unknown number, the difference is 13. Find the number. [9]
- 2) A number subtracted from 9 is equal to 2 times the number. Find the number. [3]
- 3) Multiply an unknown number by five is equal to adding twelve to the unknown number. Find the number. [3]
- 4) Adding nine to a number gives the same result as subtracting seven from three times the number. Find the number. [8]
- 5) To complete a job, three workers get paid at a rate of \$12 per hour. If the total pay for the job was \$180, then how many hours did the three workers spend on the job? [5]
- 6) A farmer cuts a 300-foot fence into two pieces of different sizes. The longer piece should be four times as long as the shorter piece. How long are the two pieces? [60,240]

- Quadratic equations and its applications.

- 1) A two-digit number is such that the product of the digits is 14. When 45 is added to the number, then the digits interchange their places. Find the number. [27]
- 2) A two-digit number is such that the product of the digits is 18. When 63 is subtracted to the number, then the digits interchange their places. Find the number. [92]
- 3) A two-digit number is four times the sum of its digits and twice the product of its digits. Find the number. [36]
- 4) The sum of ages of a son and his father is 35 years and the product of their ages is 150. Find their present ages. [5, 30]
- 5) The age of a father is equal to the square of the age of his son. The sum of the age of the father and five times the age of the son is 66 years. Find their present ages. [6, 36]

- Applications of exponential functions

- 1) Consider a population of bacteria with an initial population of 200 bacteria and a growth constant of 0.02. This population grows according to the function $f(t) = t_0 \cdot e^{kt}$, where t is measured in minutes. How many bacteria are present in the population after 5 hours? When does the population reach 100000 bacteria? {Hint: $e^6 = 403.43$, $\ln(500) = 6.2146$ } [80,686 bacteria, 310.73 minutes]
- 2) Consider a population of bacteria with an initial population of 150 bacteria and a growth constant of 0.03. This population grows according to the function $f(t) = t_0 \cdot e^{kt}$, where t is measured in minutes. How many bacteria are present in the population after 3.5 hours? When does the population reach 10000 bacteria? $\{e^{6.3} = 544.57, \ln(66.67) = 4.20\}$ [81686 bacteria, 140 minutes]

- Applications of Logarithmic functions

1) If one earthquake has a MMS magnitude of 6.0, and another has a magnitude of 8.0, how much more powerful (in terms of earth movement) is the second earthquake? $[M = \frac{2}{3} \log \left(\frac{S}{S_0} \right)]$

[1000 times more powerful]

Module 2: Polynomial equations and Matrices

- Solving polynomial equations:

1) Show that $x + 2$ is a factor of $x^3 - 6x^2 - x + 30$. Find the remaining factors using synthetic division. Use the factors to determine the zeros of the polynomial. [-2, 3, 5]

2) Use the Factor Theorem to find the zeros of $f(x) = x^3 + 4x^2 - 4x - 16$ given that $x - 2$ is a factor of the polynomial. [2, -2, -4]

- Matrices:

1) Find the determinant of matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ [0]

2) Find determinant of $\begin{bmatrix} 2 & 2 & 1 \\ 3 & -1 & 0 \\ -2 & 0 & 5 \end{bmatrix}$ [-42]

3) Define Symmetric and Skew Symmetric Matrix. Give two examples of each. $[A^T = A, A^T = -A]$

4) Reduce following matrix row echelon form using elementary transformation

$$\begin{bmatrix} -1 & 1 & 3 \\ 1 & 3 & 5 \\ -3 & -1 & 13 \end{bmatrix} \quad \left[\begin{bmatrix} -1 & 1 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \right]$$

5) Solve a given linear system by Gaussian Elimination Method $2x - 5y = 4, 6x - 15y = 10$. [No Solution]

6) Show that matrix multiplication is not commutative for $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 0 & -2 \\ 7 & -2 & 1 \end{bmatrix}$ & $B = \begin{bmatrix} 1 & -1 & 2 \\ 4 & 0 & 1 \\ -3 & 0 & 3 \end{bmatrix}$

$$\left[AB = \begin{bmatrix} 0 & -1 & 13 \\ 10 & -4 & 2 \\ -4 & -7 & 15 \end{bmatrix}, \quad BA = \begin{bmatrix} 11 & -2 & 7 \\ 11 & 6 & 13 \\ 18 & -12 & -6 \end{bmatrix} \right]$$

7) Find the area of the triangle formed by (1,2), (7,1), (3,5). [10 sq. unit]