MALLA REDDY UNIVERSITY
DEPARTMENT OF MATHEMATICS
MODELLING & CODING ON MATRICES AND DIFFERENTIAL EQUATIONS
(20 MARKS)

Students are instructed to utilize the knowledge they acquired in the course on Matrices and Differential equations, to build mathematical models, and use their understanding of coding.

CODING TO MATHS PROBLEMS (1 X 10 = 10 MARKS)

1. Write Python code to find the Rank, Eigen Values and Eigen vectors of a matrix.

2. Write Python code to solve system of equations using Gauss elimination method.

3. Write Python code to solve the system of equations using LU decomposition method.

4. Write Python code to express the given matrix as a product of lower and upper triangular matrices.

5. Write Python code to find the nature of a quadratic form.

6. Write Python code to solve the second order differential equation with constant coefficients.

MATHEMATICAL MODEL DEVELOPMENT (1 X 10 = 10 MARKS)

1. The perimeter of a triangle is 36 inches. Twice the length of the longest side minus the length of the shortest is 26 inches. The sum of the length of the longest side and twice the sum of the both the other side lengths is 56 inches. Find the sides.

2. The perimeter of a triangle is 30 inches. The shortest side is 4 inches shorter than the longest side. The longest side is 6 inches less than the sum of the other two sides. Find the lengths.

3. A health bar is made from a corn mixture, an egg mixtures and a vegetable mixture. 100 grams of corn mixture contains 25 grams of protein, 30 grams of carbohydrates and 40 grams of fat. The egg mixture contains 40 grams of protein and 20 grams of both carbohydrates and fat. The vegetable mixture contains 20 grams of protein, 10 grams of carbohydrates and 30 grams of fat. How many grams of each mixture should be used to create a health bar that contain 220 grams of protein, 10 grams of carbohydrates and 260 grams of fat.

4. In a T20 match, India need just 6 runs to win with 1 ball left to go in the last over. The last ball was bowled and the batsman at the crease hit it high up. The ball traversed along a path in a vertical plane and the equation of the paths $y = ax^2 + bx + c$ with respect to *xy*-coordinate system in the vertical plane. And the ball traversed through the points (10,8), (20,16), (40,22). Can you conclude that India won the match? All the distances are measured in meters and the meeting point at the plane of the path with the farthest boundary line is (70,0).

5. A population of insects in a region will grow at a rate that is proportional to their current population. In the absence of any outside factors the population will triple in two weeks time. On any given day there is a net migration into the area of 15 insects and 16 are eaten by the local bird population and 7 die of natural causes. If there are initially 100 insects in the area will the population survive? If not, when do they die out?

6. Construct the population of prey-predator model using the following assumptions.
   a. The prey will grow at a rate that is proportional to its current population if there is no predators
   b. The population of predator will decrease at a rate proportional to its current population if there is no prey.
   c. The number of encounters between predator and prey will be proportional to the product of the populations
   d. Each encounter between the predator and prey will increase the population of the predator and decrease the population of the prey.