# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## IV SEMESTER B.TECH MAKE UP EXAMINATIONS, JUNE 2016

## SUBJECT: MATLAB FOR ENGINEERS [ELE 3287]

### (OPEN ELECTIVE- I)

### REVISED CREDIT SYSTEM

Time: 3 Hours 09 JULY 2016 MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- **Write clearly the code , input and output**

1A. Define the variables x and z as x = 9.6 and z = 8.1, then evaluate

I. $xz^2 - \left(\frac{2z}{3x}\right)^{\frac{s}{5}}$

II. $\frac{443z}{2x^8} + \frac{e^{-xz}}{(x+z)}$ **(03)**

1B. Create a 5x7 matrix in which the first row are the numbers 1 through 7, second row are the numbers 8 through 14, the third row are the numbers 15 through 21, and so on. From this matrix create a new 3x4 matrix that is made from 2nd through 4th rows, and 1st , 3rd , 5th and 7th columns of the first matrix **(03)**

1C. A train and a car are approaching a road crossing. At t = 0 the train is 400m south of the crossing traveling north at a constant speed of 54m/s. At the same time the car is 200m west of the crossing traveling east a speed of 28 m/s and accelerating at 4 m/s$^2$. Determine the position of the train and the car, the distance between them, and the speed of the train relative to the car every second for the next 10 seconds. To show the results, create an 11*6 matrix in which each row has the time in the first column and the train position, car position, distance between the train and the car, car speed, and the speed of the train relative to the car, in the next five columns, respectively. **(04)**

2A. Use MATLAB to show that the sum of infinite series $\sum_0^n \frac{1}{(2n+1)(2n+2)}$ converges to ln(2).

Do it by computing the sum for:
a) n = 50 b) n = 500 c) n = 5000
Also find the error in each case. **(03)**

2B. Two projectiles A and B, are shot at the same instant from the same spot. Projectile A is shot at a speed of 680 m/s at an angle of 65° and projectile B is shot at a speed of 780 m/s at an angle of 42°. Determine which projectile will hit the ground first. Then, take the flying time $t_f$ of that projectile and divide into ten increments by creating a vector 't' with 11 equally spaced elements (the first element is 0, the last is $t_f$ ). Calculate the distance between the two projectiles at the eleven times in vector in t.

$V_x = Vcos(\theta), \quad V_y = Vsin(\theta), \quad t_{max} = \frac{2Vsin(\theta)}{g}$ **(04)**

2C. A circuit with seven resistors of 2, 4, 6, 8, 10, 12 and 14 ohms are connected in series. Write a program in a script file that calculates the voltage across each resistor and the power dissipated in each resistor. When the script file is executed it request the user to first enter the source voltage and then to enter the resistance of the resistor in vector. The program display a table with resistance listed in first column, the voltage across the resistor in second column and the power dissipated in the resistor in the third column. Following the table the program displays the current in the circuit and the total power.

$V = iR; \quad P = i^2R$ **(03)**

3A. The position x as a function of time of a particle that moves along a curve given by $x(t) = 0.5t^3 - 3t^2 - 10t + 20$ m. Derive the expression for velocity and acceleration of the particle and make plots of position, velocity and acceleration as a function of time from $0 \le t \le 10$s. Use the subplot command to make three plots on the same page with the plot of position on the top, the velocity at the middle and the acceleration at the bottom. Label the axe appropriately with the correct units. **(03)**

3B. Use loops and condition statement to create a 5 x 8 matrix in which the value of each element is equal to the square root of the sum of element of indices unless the element is an even-numbered column or row. The value of the element in an even numbered column or row is equal to the sum of the elements indices squared. The indices of an element in a matrix are the row number and column number of the elements. **(03)**

3C. In a low pass RC filter (a filter that passes signal of low frequency), the ratio of the magnitude of voltages is given by $\left|\frac{V_o}{V_i}\right| = \frac{1}{\sqrt{(1+(\omega RC)^2)}}$, where $\omega$ is the frequency of the input signal. Write a user-defined MATLAB function that calculates the magnitude ratio. For the function name and argument use RV = lowpass (R, C, $\omega$). The input argument are R in ohms, Capacitance C in Farad and input frequency $\omega$ in rad/s. Write a program in script file that uses the lowpass function to generate a plot of RV as a function of $\omega$ for $10^{-3} \le \omega \le 10^6$ rad/s. The plot has a long arithmetic scale on the horizontal axis. When the script file is executed it prompts the user to enter the value of R and C. Label the axes and also give it a title. Run the script file with R= 1400 ohms and C=10 μF. **(04)**

4A. Write a user define function that calculate the maximum (or minimum) of a quadratic equation of the form $f(x) = ax^2 + bx + c$.
Name the function [x, y, w] = maxormin (a, b, c). The input argument are the coefficients a, b and c. The output arguments x are the coordinates of the maximum (or minimum). y is the maximum (or minimum) value, and w which is equal to 1 if y is a maximum, and equal to 2 if y is a minimum.
Use the function to determine the maximum or minimum of the following function.
a) $f(x) = 6x^2 - 18x + 6$ b) $f(x) = -4x^2 - 20x + 5$ **(02)**

4B. Write down a user defined function that sorts the elements of a matrix. For the function name and argument use B = matrixsort1(A), where A is any size matrix and B is a matrix of the same size with the elements of a rearranged in an ascending order row after row where the (1,1) element is the smallest and the (m,n) element is the largest.
Test your function on a 4 x 7 matrix element (integers) randomly distributed between -30 and 30. Use the rand command to generate the matrix. **(04)**

4C. Write a program in a script file that calculates the cost of mailing a package according to the following prices schedule using Switch-Case statement.
The programmer asks the user to enter the weight and type of service. If a weight larger than 50 Kg is entered for ground or air service a message 'Ground or (Air) services is not available' is displayed. If a weight larger than 10 Kg is entered for overnight service a message 'Overnight services is not available'

| Type of service | Weight (0-2Kg) | Weight (2-10Kg) | Weight (10-50Kg) |
|---|---|---|---|
| Ground | 200 | 200+25 for each additional 1 Kg above 2 Kg | 400+20 for each additional 1 Kg above 10 Kg |
| Air | 300 | 300+50 for each additional 1 Kg above 2 Kg | 700+40 for each additional 1 Kg above 10 Kg |
| Over-Night | 500 | 500+100 for each additional 1 Kg above 2 Kg | No overnight service |

**(04)**

5A. Viscosity μ is a property of gases and fluids that characterize their resistance to flow. For most material viscosity is highly sensitive to temperature. Below is a table that gives the viscosity of SAE 10W oil at different temperatures. Determine an equation that can be fitted to the data. This function can be fitted to the data by using MATLAB polyfit (x, y, 2) function (second degree polynomial) where independent variable is T and the dependent variable is ln(μ).

| Temp(Celcius) | -20 | 0 | 20 | 40 | 60 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|
| Viscosity($Ns/m^2$) | 4 | 0.38 | 0.095 | 0.032 | 0.015 | 0.0078 | 0.0045 | 0.0032 |

**(03)**

5B. Make a 3-D surface plot and a 3-D contour plot of a function

$z = -\frac{x^2}{4} - \frac{y^2}{4}$ in domain $-1 \le x \le 3$ and $1 \le y \le 4$ **(03)**

5C. An RC series circuit with R = 10 Ω & C = 100 mF is connected to a dc source of 1000 V through a switch. Using Simulink, plot capacitor voltage and current for time, $0 \le t \le 10$s, if the switch is closed at t = 0.5 s & the circuit elements are initially relaxed. Draw the block diagram and the results.

$$V - iR - v_c = 0; \qquad i = C\frac{dv_c}{dt}$$

**(04)**