

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VIII • EXAMINATION – SUMMER 2014

Subject Code: 181406**Date: 27-05-2014****Subject Name: Food Engineering Computation and Numerical Analysis****Time: 10:30 am TO 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use log-log and semi-log paper wherever necessary.

- Q.1 (a)** Discuss the followings; **07**
1. Command windows
 2. Command history
 3. Data type
 4. Mat-files

- (b)** What do mean by interpolation? When is single and double interpolation of data necessary? Calculate the specific volume (m^3/kg) of superheated steam at 0.02 MPa and 625°C using the following data from steam table. **07**

Pressure (MPa)	Temperature (°C)	
	600	650
0.01	40.296	42.603
0.05	8.0576	8.5195

- Q.2 (a)** A 10 square meter wall is to be insulated with some insulating material. The maximum rate of heat transfer allowed through the entire insulating wall is 100 W. The maximum thickness of the insulating wall is 10 cm. Determine the thermal conductivity of the insulating wall if the permitted temperature gradient across the wall is 10°C. Develop a worksheet to determine the thermal conductivities of the insulation if the permissible temperature gradient is increased from 10 to 100° in increments of 10°C. **07**
- (b)** A steel pipe is being used to transport heated oil from a heat exchanger to a vessel. **07**
- The pipe has an internal diameter of 8 cm and its thickness is 2 cm. The thermal conductivity of steel is 17 W/m°C. The temperature of the inside surface of the pipe is 130°C. The thermal conductivity of the insulation is 0.5 W/m°C. The temperature of the outside surface of the insulation must not be greater than 25°C. Develop a worksheet to calculate the rate of heat transfer through the pipe walls under steady state conditions. If your goal is to reduce this heat transfer by 90%, what will be the required thermal conductivity of insulation?

OR

- (b)** Fresh orange juice containing 8% solid is concentrated in an evaporator to 55% solids. If the juice is entering at 500kg/hr. Develop a worksheet to calculate the amount of water removed and concentrated juice is produced. Also draw the flow diagram of the above process **07**

- Q.3 (a)** With help of a representative diagram **07**
- (i) Express the Cartesian co-ordinate (4, -3) as polar co-ordinate, correct to 2 decimal places, in both degree and radian.
 - (ii) Express the polar co-ordinate ($2.83, \frac{3\pi}{4}$ rad) as Cartesian co-ordinate, correct to 3 decimal places.

- (b) Solve the system of equations using Gauss-elimination method. 07

$$x + 2y + 3z = 10$$

$$x + 3y - 2z = 7$$

$$2x - y + z = 5$$

When Gauss-elimination method fails?

OR

- Q.3 (a) Using Gauss-Jordan elimination method, solve the following system of equations. 07

$$x + y + 2z = 9$$

$$2x + 4y - 3z = 1$$

$$3x + 6y - 5z = 0$$

- (b) Using Newton-Raphson method, determine the approximate positive root of the quadratic equation $5x^2 + 11x - 17 = 0$ correct to 3 significant figures. Check the value of the root by using the quadratic formula. 07

- Q.4 (a) 1000 kg of fruit juice with 10% solids is freeze concentrated to 40% solids. The dilute juice is fed to a freezer when ice crystals are formed and then slush is separated in a centrifuge separator in to ice crystals and concentrated juice. An amount of 500kg/hr of liquid is recycled from the separator to the freezer. Develop a worksheet to calculate the amount of ice that is removed in the separator and the amount of concentrated juice produced. 07

- (b) Write the shortcut commands of the followings in EXCEL; 07

1. Copy formula from cell above the active cell
2. Display tool menu
3. Use percentage format with no decimal places
4. Use two decimal place format with commas
5. Move to previous window
6. Hide rows
7. Unhide rows

OR

- Q.4 (a) What do you understand by curve fitting and interpolation in MATLAB? Give the steps to draw the straight line (linear) fit of the following data; 07

X	15	25	35	60	100
Y	25	37	67	170	507

Write the details of the following commands in plot commands which specify 07

- (b) Marker Style-option and Color Style-option in MATLAB.

Marker Style-option	Color Style-option
Red	X-mark
Blue	Square
White	Diamond
Yello	Circle

- Q.5 (a)** The Following equation is used to model the viscosity of a Herschel-Bulkley fluid, one that exhibits a yield stress and power law characteristics such as raisin paste. **07**

$$\sigma = k\gamma^n + \sigma_0$$

Where σ = shear stress in the fluid (Pa); k = fluid consistency index (Pa.sⁿ); n = flow behaviour index (no units); γ = shear rate (1/s) and σ_0 = yield stress (Pa).

What are the constants and variables in this equation? Is this a linear equation in σ ? If not, can you linearize it? How would the flow behaviour index and fluid consistency index be calculated if shear stress and shear rate data were given?

- (b)** The rate at which the population of a bacteria culture grows is proportional to the number of bacteria present. If the number of bacteria grew from 1000 to 5000 in 10 hours. Find the number of bacteria after 15 hours. **07**

OR

- Q.5 (a)** The decay of microorganisms are modeled with a general equation of the form **07**

$$N = N_0 e^{-kt}$$

where, N = Final spore load (Sterility level) at time t , no.

N_0 = Initial spore load (contamination level), no.

k = rate constant affecting the rate of decay (s⁻¹)

t = time (s)

- (i) Can you write the above equation in linear form?
- (ii) How would determine the rate constant (k) if spore load at different time interval are given?
- (iii) Define Decimal reduction time (D - value) from the equation and its relation with rate constant.
- (b)** (i) What are the two types of errors involving in numerical computations? Explain with suitable examples. **07**
- (ii) What are the different types of charts used by food engineers? Explain any one chart.
