BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IM.Sc. **SEMESTER : IX**
BRANCH: FOOD TECHNOLOGY **SESSION : MO/19**

SUBJECT: SAF3003 AUTOMATION IN FOOD PROCESSING INDUSTRY

TIME: 3:00 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. **The question paper contains 7 questions each of 12 marks and total 84 marks.**
2. **Candidates may attempt any 5 questions maximum of 60 marks.**
3. **The missing data, if any, may be assumed suitably.**
4. **Before attempting the question paper, be sure that you have got the correct question paper.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

Q.1(a) Briefly describe the following: [6]
(i) Thermocouple Types (ii) Thermocouple Protection (iii) Digital Thermometer

Q.1(b) Discuss the "Bourdon tube pressure gauge" and its working principle with the help of a clear sketch. [6]

Q.2(a) Briefly describe "Capacitance probe" used for level measurement. [6]

Q.2(b) Discuss the "Turbine flow meter" and its working principle with the help of a clear sketch. [6]

Q.3(a) (1) Find the Laplace transform of [8]

$$f(t) = \begin{cases} 2 ; & 0 \le t < 2 \\ 0 ; & \text{otherwise} \end{cases}$$

(2) Use Laplace transform technique to solve the following:

$$y'' - 6y' + 5y = 0$$

with $y(0) = 1$; $y'(0) = -3$

Q.3(b) Derive the transfer function **H(s)/Q(s)** for the liquid-level system of Figure 1 when the tank level operates about the steady-state value of h_s = 1 ft. [4]

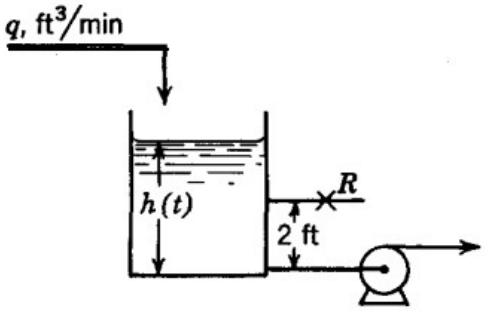

Figure 1

The pump removes water at a constant rate of 10 cfm (cubic feet per minute); this rate is independent of head. The cross-sectional area of the tank is 1.0 ft^2 and the resistance is 0.5 ft/cfm.

Q.4 Consider the mixed tank heater as shown in Figure 2. Determine the response of the outlet temperature of the tank to a step increase in the heat input of 42 kw. [12]

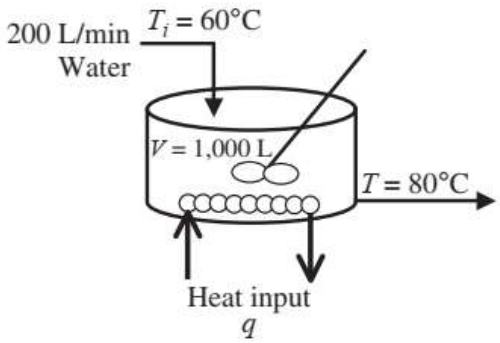

Figure 2

PTO

Q.5(a) Explain the working principle of air-to-close and air-to-open pneumatic control valves. [6]

Q.5(b) Compare the performance of P, PI and PID controllers. [6]

Q.6(a) Use the least square method to determine the equation of line of best fit for the following data: [8]

x	2	3	5	7	9
y	4	5	7	10	15

Q.6(b) Briefly describe static modeling and dynamic modeling. [4]

Q.7 A research study was conducted to examine the clinical efficacy of a new antidepressant. Depressed patients were randomly assigned to one of three groups: Group 1 (a placebo group), Group 2 (a group that received a low dose of the drug), and Group 3 (a group that received a moderate dose of the drug). After four weeks of treatment, the patients completed the Beck Depression Inventory. The higher the score, the more depressed the patient. The data are presented below. [12]

Group 1 (Placebo)	**Group 2 (Low Dose)**	**Group 2 (Moderate Dose)**
38	22	14
47	19	26
39	8	11
25	23	18
42	31	5

Null hypothesis: There will be no difference in depression levels between the three groups.
Carry out the ANOVA analysis at 0.01 level of significance ($F_{critical}$ = 6.93).

::::::27/11/2019::::::E