END SEMESTER/ RE-TEST EXAMINATION, 2020

Semester: 3rd

Subject code: FPT-302

Subject:Elements of Food Engineering-I

Full Marks: 70 (Part A-25 + Part B-45)

Duration: 3 hours

Instructions:

1. Questions on Part A are compulsory
2. Answer any five questions from Part B

PART-A MARK-25		
Questions no.	questions	marks
Question 1	Fill in the blanks:	1x10-10
1a	Entropy is mathematically expressed as_____	
1b	The S.I unit of heat transfer coefficient is _____	
1c	Specific heat at constant volume (C_v) is mathematically expressed as _____	
1d	The value of R is _____ lit-aim/gmmole/K	
1e	The value of standard atmospheric pressure is _____	
1f	The radiation emitted by black body is known as _____	
1g	_____ absorbs heat from food materials in refrigerator	
1h	Carnot cycle is a _____ thermodynamic cycle	
1i	Total energy is the sum of _____ and_____	
1j	Second law of thermodynamics is explained by _____ statement and _____ statement	
Question no.2	Write true or false:	1x10=10
2a	Saturated steam and superheated steam are same	
2b	Refrigeration and freezing are related to vapour compression	

	refrigeration cycle	
2c	Heat exchanger is not suitable for exchange of heat between liquid substances	
2d	Energy in form of radiation is reached from the sun to the earth's surface	
2e	Liquid nitrogen and liquid carbon dioxide are examples of cryogenic fluid	
2f	Heat flux is defined as amount of heat transfer per unit length of conducting material	
2g	Freon 22 is a permitted refrigerant	
2h	Freezing time can be calculated by Fourier's Law	
2i	Boiler can supply superheated steam	
2j	Evaporator is the heart of a refrigeration system	
Question no. 3	Choose the correct answer	1x5=5
Q 3a	Which of the following is not the state variable in a thermodynamic system?	
(i) Pressure (ii)Volume (ii) Density (iv) Temperature		
3b	Which of the following is the path variable in a thermodynamic system?	
(i) Heat (ii) Entropy (iii) Work (iv) Both (i) and (iii)		
3c	The process of heat transfer by the movement of mass from one place to another is called	
(i) Conduction (ii) Convection (iii) Radiation (iv) None of these		
3d	The process of heat transfer from object to another because of molecular motion and interaction is called	
(i) Convection (ii) Conduction (iii) Radiation (iv) Induction		
3e	The unit of mechanical equivalent of heat is expressed by	
(i) Newton (ii) Kelvin (iii) Joule (iv) Boltzmann		

PART-B, MARK-45		
Questions no.	Questions Attempt any five questions from the following:	Marks 5x9=45
Question no. 4		9
Q4a	Define the term internal energy and enthalpy.	3
Q4b	Give the mathematical expression of First Law of Thermodynamics by explaining significance of each term.	3
Q4c	What do you understand by thermodynamic property? Distinguish between extensive and intensive variables in a thermodynamic system.	3
Question no.5		
Q5a	Differentiate between reversible process and irreversible process with examples.	2
Q5b	What do you mean by pure and mixed substances?	1
Q5c	Give the mechanism of function of heat engine and heat pump.	6
Question no. 6		9
Q6a	State and explain Fourier's law of heat conduction.	3
Q6b	How mean area of a hollow cylinder can be calculated?	2
Q6c	Determine the rate of heat loss through a wall of red brick(K=.70W/mK) of 5cm in length,4m in height and .25m in thickness, if wall of surface is maintained at 150^0C and 50^0C respectively.	4
Question no. 7		9
Q7a	Prove that the steady state heat conduction through a cylindrical wall is $Q=2\pi KL\ (T_i-T_o)/\ln(r_o/r_i)$ where r_i and r_o= Inner and outer radius of long cylindrical layer respectively, L= length of the cylinder, Ti and T_o=Inner and outer surface temperatures of the layer ($T_i>T_o$) and K=Average thermal conductivity.	4
Q7b	A pipeline, 150/160mm diameter, carries steam. The temperature of the inside surface is 120^0C and that of the outside surface is 119.8^0C.The thermal conductivity of the tube material is 50w/mk. Find the rate of heat loss from a length 1m of the pipe line.	5
Question no. 8	A cold storage has a wall comprising 11cm brick on the outside, then 7.5cm of concrete and then 10cm cork. The mean temperature within the store is maintained at -18^0C and mean temperature of the outside surface of the wall is 20^0C.The thermal conductivities for brick, concrete and cork are 0.69, 0.76 and 0.043W/m^{0}C respectively. By considering unit area determine (i) The thermal resistance and (ii) Rate of heat loss though the wall.	9

Question no. 9	Find the thermal resistance of steady state heat conduction through composite slab where x_1,x_2 and x_3 are the relative thickness,K_1,K_2 and K_3 are the thermal conductivities,Q is the amount of heat transferred, A is the uniform area and T_1,T_2,T_3 and T_4 are the initial wall temperature, two intermediate temperatures and final wall temperature of the slab respectively.	9
Question no. 10		9
Q 10a	Give the mathematical expression of overall heat transfer coefficient. What is LMTD?	4
Q10b	Hot water at 70^0C is flowing over the upper surface of 3m long flat plate whose surface temperature is 25^0C. If the Nusselt number is 521 and coefficient of thermal conductivity, K is 0.685W/mK, calculate the convective heat transfer coefficient and also heat flux.	5
Question no. 11		9
Q11a	State and explain Stefan-Boltzmann's law of radiation	3
Q11b	Consider a cubical body of 40cmx40cmx40cm at 1000K suspended in the air at 25^0C. Assuming the body closely approximates a black body. Now determine the rate at which the cube emits radiation energy in watt. Take Stefan-Boltzmann's constant=5.67×10^{-8}W/m^{2}K^4	6