Total No. of printed pages = 7

FPT-302/EFE- I/3rd Sem/2018/M

ELEMENTS OF FOOD ENGINEERING–I

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer questions from PART-A and PART-B as per the following instructions.

PART – A

Answer *all* questions. 5×5=25

1. (a) MCQ type : 1×5=5

(i) Which of the following is not the state variable in a thermodynamic system ?

(a) Pressure (b) Volume

(c) Density (d) Temperature

(ii) Which of the following is the path variable in a thermodynamic system ?

(a) Heat (b) Entropy

(c) Work (d) All of these

[Turn over

(iii) The process of heat transfer by the movement of mass from one place to another is called

(a) Conduction (b) Convection

(c) Radiation (d) Induction

(iv) The process of heat transfer from one object to another because of molecular motion and intertaction is called

(a) Covection (b) Conduction

(c) Radiation (d) Induction

(v) Mechanical equivalent of heat is associated with

(a) Newton (b) Kelvin

(c) Joule (d) Boltzmann

(b) Fill up the gaps : 1×5=5

(i) In isothermal process, the —— remains constant.

(ii) The SI unit of heat transfer coefficient is ——.

(iii) The radiation emitted by black body is known as ——.

(iv) —— absorbs heat from food materials in refrigerator.

(v) No change of pressure indicates —— process.

(c) Objective type questions : 1×5=5

(i) What is the heat capacity ?

(ii) Define adiabatic process.

(iii) What is thermodynamic property ?

(iv) What is the function of heat engine ?

(v) What do you understand by thermodynamic cycle ?

(d) One sentence questions : 1×5=5

(i) Which mechanical device is responsible for vapourization of water in vapour compression refrigeration cycle ?

(ii) Which equipment is required for exchange of heat between liquid substances ?

(iii) Energy in which form is reached from the sun to the earth's surafce ?

(iv) Mention an example of cryogenic fluid.

(v) What is the Freon-22 ?

(e) Match the following columns : 1×5=5

GROUP – I	GROUP – II
A. Heat flux	(i) Plank
B. Compressor	(ii) Boiler
C. Freezing time calculation	(iii) 2nd law of thermodynamics
D. Steam consumption	(iv) Fourier's law
E. Clausius statement	(v) Refrigerator

	A	B	C	D	E
(a)	(i)	(iii)	(iv)	(v)	(ii)
(b)	(ii)	(iii)	(v)	(iv)	(i)
(c)	(iv)	(v)	(i)	(ii)	(iii)
(d)	(iii)	(v)	(i)	(ii)	(iv)

PART – B

Answer any *five* questions from the following :

9×5=45

2. (a) Define the term internal energy. Derive First law of thermodynamics. 2+3=5

(b) Define thermodynamic property. Distinguish between extensive and intensive property. 2+2=4

3. (a) Differentiate between reversible process and irreversible process. What do you mean by pure substance ? 2+1=3

(b) Explain the working mechanism of Carnot engine. 6

4. (a) State and explain Fourier's law of heat conduction. What do you mean by heat flux ? 3+1=4

(b) 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 are maintanied at 100°C and 30°C respectively. 5

5. (a) 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 temperature and final wall temperature of the slab respectively. 4

(b) A cold storage has a wall comprising 11cm brick on the outside, then 7.5 cm of concrete and then 10 cm cork. The mean temperature within the store is maintained at $-18^{\circ}C$ and mean temperature of the outside surface of the wall is $20^{\circ}C$. The thermal conductivities for brick, concrete and cork are 0.69, 0.76 and 0.043 $W/m^{\circ}C$ respectively. By considering unit area determine

(i) the thermal resistance and

(ii) rate of heat loss through the wall. 5

6. (a) Diffetrentiate between natural and forced convection. Give the mathematical expression of overall heat transfer coefficient. What is LMTD ? 1+1+2=4

(b) Hot water at $70^{\circ}C$ is flowing over the upper surface of 3m long plate whose surface temperature is $25^{\circ}C$. If the Nusselt number is 521 and coefficient of thermal conductivity K is 0.685 W/mk. Calculate the convective heat transfer coefficient and also heat flux. 5

7. (a) Define emissivity of the body. State Stefan-Boltzmann's law of radiation. 1+3=4

(b) Consider a cu
× 20 cm at 1000K suspend
30°C. Assuming the body closely approx
mates 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. 5

8. Write short notes on any *three* of the following :

(a) Application of refrigeration and freezing in food preservation.

(b) Coefficient of performance of refrigerator.

(c) Food freezing by direct contact with liquid refrigerant.

(d) Shell and tube heat exchanger.

(e) Liquid disel oil fired boiler. 3×3=9

(b) Consider a cubical body of 20 cm × 20 cm × 20 cm at 1000K suspended in the air at 30°C. 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. 5

8. Write short notes on any *three* of the following :

(a) Application of refrigeration and freezing in food preservation.

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(c) Food freezing by direct contact with liquid refrigerant.

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