Reg. No.															

B.Tech. DEGREE EXAMINATION, MAY 2024

Fifth & Sixth Semester

18MEO122J/18MEO122JA – ELECTRONICS THERMAL MANAGEMENT

(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

(Standard heat and mass transfer data book is permitted)

Note:

(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

	Marks	BL	CO	PO
1. This will cause an increase in their on-resistance that, it turn, will result in higher power dissipation and higher temperature. (A) Thermal runaway (B) Electrical overstress (C) Ionic contamination (D) Electromigration	1	1	1	1,2
2. The rate of expansion or contraction of a unit length of a material per unit change in its temperature (A) Coefficient of Thermal Expansion (CTE) (B) Coefficient of Electronic Thermal Expansion (CETE) (C) Coefficient of Design Expansion (CDE) (D) Coefficient of Mechanical of thermal Expansion (CME)	1	1	1	1,2
3. Molecules in gases and liquids and electrons in metals move relatively freely (A) Translational energy (B) Rotational energy (C) Vibrational energy (D) Electronic bonding energy	1	1	1	1,2
4. The amount of heat transfer rate per unit area. This is called (A) Heat transfer rate (B) Power (C) Energy transfer as heat (D) Work	1	1	1	1,2
5. If the energy of a system does not change with time (A) Closed system (B) Fixed mass system (C) Control volume (D) Steady state system	1	1	2	1,2
6. The energy required to increase temperature of unit mass of a material by one degree is called (A) Equations of state (B) Specific heat (C) Specific heat at constant pressure (D) Specific heat at constant volume	1	1	2	1,2
7. Forced convection air flow with velocity over a constant temperature flat plat with length (A) Laminar forced convection air flow (B) Turbulent forced convection air flow (C) Laminar natural convection from a vertical at plate (D) Turbulent natural convection from a vertical at plate	1	1	3	1,2

8. An electric resistor or an integrates circuit, and a light bulb. Such a system do not allow any mass flow in or out of the system. Sub a system is called — 1 1 3 1,2
   (A) Control mass (B) Control volume
   (C) Open system (D) Partially closed system

9. Thermal resistance, which is directly proportional to the thickness of the layer and inversely proportional to its conductivity and surface area, opposes the conduction heat transfer. — 1 1 2 1,2
   (A) Conduction thermal resistance (B) Convection thermal resistance
   (C) Radiation thermal resistance (D) Conduction, convection and radiation thermal resistance

10. The ratio of heat transfer rate from the fin to heat transfer rate from the base of the fin if the fin was not there — 1 1 2 1,2
   (A) Fin with convection and radiation from fin tip (B) Fin with corrected length
   (C) Fin with the constant tip temperature (D) Fin effectiveness

11. If temperature and therefore conduction heat transfer rate are function of time, the heat transfer — 1 1 3 1,2
   (A) Heat balance equation (B) Heat conduction equation
   (C) Steady-state heat transfer (D) Transient heat transfer

12. The motion of a fluid, either a gas or a liquid, can be divided into two basic flow conditions, namely — 1 1 3 1,2
   (A) Laminar and turbulent (B) Laminar
   (C) Turbulent (D) Non linear

13. Steady-state heat conduction with constant thermal conductivity — 1 1 2 1,2
   (A) Diffusion equation (B) Poisson equation
   (C) Laplace equation (D) Fourier's law of heat conduction

14. The weight of this object forces it to go downward in the fluid. But, as it moves down, the fluid exerts a force to it in the opposite direction — 1 1 3 1,2
   (A) Volumetric thermal expansion coefficient (B) Temperature boundary layer
   (C) Velocity boundary layer (D) Buoyancy force

15. The fluid has partial or no contact with a solid surface on part of the flow and extends to infinity with no interference by a solid surface on the rest of the flow — 1 1 3 1,2
   (A) Internal flows (B) External flows
   (C) Forced convection (D) Natural or free convection

16. As per radiation theory, the amount of radiated energy is directly proportional to the — 1 1 4 1,2
   (A) Square root of the absolute temperature (B) Square of the absolute temperature
   (C) Cubic power of the absolute temperature (D) Fourth power of the absolute temperature

17.	Black body emissivity is equal to (A) 1 (B) 0.5 (C) 3 (D) Infinity	1	1	4	1,2
18.	Heat transport process in a fluid involving the combined action of heat conduction and energy storage when the fluid is undergoing a mixing motion (A) Convection (B) Natural convection (C) Forced convection (D) Mixed	1	1	5	1,2
19.	The amount of frictional force, at the surface, per unit area of the surface is called (A) Viscous shear stress (B) Velocity boundary layer (C) Local friction coefficient (D) Shear stress	1	1	5	1,2
20.	The ratio of momentum diffusivity to thermal diffusivity of a fluid (A) Reynolds number (B) Prandtl number (C) Eckert number (D) Nusselt number	1	1	5	1,2

PART – B (5 × 4 = 20 Marks)
Answer **ANY FIVE** Questions

		Marks	BL	CO	PO
21.	Define energy, differentiate energy transfer from transformation with examples.	4	2	1	1,2
22.	How convection heat transfer can be enhanced in electronic gadget of your choice? Brief with examples.	4	3	1	1,2
23.	What do you understand from lumped system analysis? Brief its importance.	4	2	2	1,2
24.	Sketch the different boundary layers nearer to heated PCB when it is oriented (i) horizontally and (ii) Vertically	4	2	3	1,2
25.	Write short notes on black body radiation. How does it differs from gray body radiation?	4	2	4	1,2
26.	How will you measure surface temperature of aluminium heat sink with RTD?	4	2	5	1,2
27.	Why thermal contact resistance need to be estimated? And also how this can be minimized in electronic system.	4	3	2	1,2

PART – C (5 × 12 = 60 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
28. a.	Explain different modes of heat transfer possible in electronic system of your choice with neat sketches.	12	1	1	1,2
	(OR)				
b.	Consider a computer processor under forced convection which is embedded with pin fin heat sink using silicon paste, apply electrical analogy and estimate total thermal resistance of this module by establishing proper thermal resistance network. Assume suitable materials and prefer your own notations.	12	3	1	1,2
29. a.i.	List the assumptions made and derive one dimensional steady state heat conduction equation with suitable boundary conditions.	8	2	2	1,2
ii.	The inner surface of PCB board is at 40° C and outer surface at 30°C. calculate heat per m^2 area of the PCB board if the thermal conductivity of the board is 0.2 W/m.K and thickness 2 mm.	4	4	2	1,2
	(OR)				
b.	What is cold plate and how it supports and enhances the performance of electronics systems? Also, comment on conformal and non-conformal meshing while modelling cold plate.	12	3	2	1,2
30. a.	Sketch and explain the flow over hot plate mounted horizontally and showcase hydrodynamic and thermal boundary layers at different flow regimes. Also, comment on which of the forced convection flow regime is more preferable for better heat dissipation comparatively.	12	3	3	1,2
	(OR)				
b.i.	Compare the inline and staggered pin fin heat sinks and also comment on the performance on the basis of local flow behavior and heat dissipation.	8	2	3	1,2
ii.	Water at 20°C flows over a 0.05 m long flat plate whose temperature is 60°C with a velocity of 2 m/s. Determine the rate of convection heat transfer per unit width of the entire plate. Take the convection heat transfer coefficient 55.2 W/m^2K.	4	4	3	1,2
31. a.	Explain radiation heat transfer through electromagnetic wave theory and photon theory with appropriate sketches.	12	2	4	1,2
	(OR)				
b.i.	Explain reflectivity, absorptivity and transmissivity.	9	2	4	1,2
ii.	The filament of a 75 W bulb may be considered as a black body radiating into a black enclosure ay 70°C, filament diameter is 0.1 mm and length is 5 cm considering the radiation, determine the filament temperature. Take Stefan-Boltzmann constant as $5.670374419\times 10^{-8} W/(m^2\times K^4)$.	3	4	4	1,2
32. a.	Explain pressure and velocity measurement methods which can be adaptable for electronic cooling jacket.	12	2	5	1,2
	(OR)				
b.	Explain temperature measurement techniques using radiation thermometry.	12	2	5	1,2

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