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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Seventh Semester

18MEE451J - MICROELECTRONICS THERMAL MANAGEMENT

(For the candidates admitted during the academic year 2020 - 2021 & 2021 - 2022)

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** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks) — Marks | BL | CO

Answer **all** Questions

1. _____ is the chronology of advances in the integrated circuit (IC) is outlined in the following steps, with the trends more than 10^7 devices per chip — 1 | 1 | 1
   (A) 1990—Ultra-large-scale integration (ULSI)
   (B) 1975—Very-large-scale integration (VLSI)
   (C) 1969—Large-scale integration (LSI)
   (D) 1966—Medium-scale integration (MSI)

2. _____ is the rate of heat transfer in a medium is proportional to the product of the area normal to the path and the temperature gradient along the path. — 1 | 1 | 1
   (A) Law of heat conduction
   (B) Thermal conductivity
   (C) Heat transfer rate
   (D) The temperature gradient

3. _____ are heat transfer equations, initially, heat transfer in a liquid takes place by forced convection — 1 | 1 | 1
   (A) Single-phase forced convection (liquid)
   (B) Onset of sub cooled nucleate boiling
   (C) Two-phase forced convection
   (D) Critical heat flux

4. In the absence of _____, the contact resistance at the interface is directly proportional to the roughness and inversely proportional to the asperity slope — 1 | 1 | 1
   (A) Surface roughness and waviness
   (B) Mechanical properties of solids
   (C) Thermal properties of solids
   (D) Apparent contact pressure

5. MCM-C: Ceramic substrate (alumina) with thick film has — 1 | 1 | 2
   (A) Moderate cost
   (B) Most expensive
   (C) Very inexpensive
   (D) Low cost

6. The important thermal design considerations in a chip package are as spreading in. — 1 | 1 | 2
   (A) Die material
   (B) Cracks
   (C) High–thermal conductivity materials
   (D) Good match in coefficient of thermal expansion between materials

7. The coefficient of thermal expansion (CTE) of the chip, substrate, and board may be quite different in — 1 | 1 | 2
   (A) Thermal expansion matching
   (B) Thermal management
   (C) Mechanical rigidity
   (D) Dimensional stability

8. Thermal conductivity of basic PCB materials dielectric layer G10 is about. — 1 | 1 | 2
   (A) 0.25 W/(m·°C)
   (B) 0.30 W/(m·°C)
   (C) 0.35 W/(m·°C)
   (D) 0.52 W/(m·°C)

9.	For an array of equal-height modules, the Nusselt number for fully developed flow can be represented as (A) Heat transfer correlations (B) Pressure drop correlations (C) Heat transfer enhancement (D) Fans and air-handling systems	1	1	3
10.	_____ receive air at their axis of rotation and exhaust air at their periphery in a direction normal to the rotation axis. (A) Centrifugal fans (B) Axial fans (C) Propeller fans (D) Tube axial fans	1	1	3
11.	The ratio of heat transfer by convection to the heat transfer by conduction within a fluid (When the fluid is considered stationary) is called as (A) Nusselt number (B) Rayleigh number (C) Prandtl number (D) Grashof number	1	1	3
12.	_____ is used to transfer thermal energy from one fluid to another. (A) Heat exchanger (B) Cold plate (C) Heat sink (D) Heat pipe	1	1	3
13.	In _____, both fluids flow in the same direction and the final temperature of the colder fluid can never reach the exit temperature of the hot fluid. (A) Parallel-flow heat exchanger (B) Counter flow heat exchanger (C) Cross flow heat exchanger (D) Spiral flow heat exchanger	1	1	4
14.	A self-contained closed system that transfers heat through evaporation and condensation through wicks is termed as (A) Heat exchanger (B) Cold plate (C) Heat sink (D) Heat pipe	1	1	4
15.	For a circular disk, the characteristic length "L" for a square plate is taken as (A) The length of the side of the square (B) The arithmetic mean of the lengths of two sides (C) 0.9 × disk diameter (D) The surface area to P the perimeter	1	1	4
16.	In _____, the flow directions are normal to each other, and this is the most common flow arrangement in compact heat exchangers. (A) Parallel-flow heat exchanger (B) Counter flow heat exchanger (C) Cross-flow heat exchanger (D) Spiral flow heat exchanger	1	1	4
17.	_____ increases heat input to the evaporator results in only an increase in the rate of evaporation without any significant increase in operating temperature. (A) High heat transfer capacity (B) Precise isothermal control (C) Functional independence of evaporator and condenser (D) Quick thermal response	1	1	5
18.	Since there are no moving parts, the heat pipe can provide silent and _____ for long-life operation. (A) Remote applications (B) High reliability (C) Small size and lightweight (D) Big size and lightweight	1	1	5
19.	Large and smooth wall channels reduce the viscous losses along _____ when liquid returns from the evaporator to the condenser. (A) Pumping power (B) Liquid flow path (C) Radial thermal path (D) Liquid-vapor flow path	1	1	5
20.	A high latent heat and _____ are desirable in order to transfer the maximum amount of heat with the minimum mass flow rate. (A) Latent heat (B) Thermal conductivity (C) Surface tension (D) Viscosity	1	1	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

		Marks	BL	CO
21.	Explain cooling methods used in the industrial electronics.	4	2	1
22.	Discuss about board-cooling methods.	4	3	2
23.	Differentiate heat exchangers and cold plates.	4	3	3
24.	Explain operating temperatures of electronic systems.	4	3	4
25.	Explain the practical design procedure of electronic cooling systems.	4	3	5
26.	Explain cooling methods used in the industry for electronics.	4	3	4
27.	Explain condensation in electronic cooling.	4	3	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

		Marks	BL	CO
28.	(a) Explain the high heat flux flow boiling of refrigerants and water for electronic cooling.	12	3	1
	(OR)			
	(b) Explain pool boiling enhancement of three-dimensional complex structures.			
29.	(a) Explain die attachment, wire bonding, and encapsulation process in LED packaging.	12	3	2
	(OR)			
	(b) Explain thermal aspects of printed circuit board embedded power semiconductors.			
30.	(a) Explain microchannel heat sinks with nanofluids for cooling electronic components.	12	3	3
	(OR)			
	(b) Discuss experimental investigation of flat porous heat pipe for cooling TV box electronic chips.			
31.	(a) Discuss cooling of high heat flux miniaturized electronic devices using thermal ground plane.	12	3	4
	(OR)			
	(b) Explain applications and developments of ultra-thin micro heat pipes for electronic cooling.			
32.	(a) Explain the optimization of thermal management of silicon-based thermoelectric materials.	12	3	5
	(OR)			
	(b) Explain the visualization of a flat confined loop heat pipe for electronic devices cooling.			

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