FUNDAMENTALS OF ELCTGRONIC PACKAGING (ME 60006)
Spring 2019: End-semester examination

Full marks: 60   *Attempt all questions*   Time: 3 Hours

Instructions: Clearly mention any assumptions made by you.

___

1. Estimate the maximum shear strain range in the solder joint of a BGA package assembled onto a FR4 printed circuit board (PCB) subjected to a temperature range of 0ºC to 100ºC. The package has a distance of 17 mm from neutral point (DNP) to the outermost solder joint and a solder height of 0.5 mm. The CTE of the package substrate and FR4 PCB are 15 ppm/ºC and 18 ppm/ºC respectively.

    What will be % change in solder joint strain if the package substrate is a ceramic with CTE of 6 ppm/ºC?

    10

2. Can a PNP transistor be formed by externally connecting two P-N diodes together? Justify your answer.

    A company has adopted a very stringent Environmental Stress Screening process of its products before shipment. How would the mortality curve vary as a result of this measure? Explain your answer.

    5 + 5 = 10

3. 1000 BGA components are thermally cycled, and the quoted failure rate for this component is 0.001 (0.1%) per hour. What is the probability that a component will survive after 200 hours.

    Consider a component that fails 4 times on an average over a period of 16,000 hours. Find the reliability and MTBF of the component.

    5 + 5 = 10

A silicon chip 4mm x 4mm x 0.3mm thick is soldered to a ceramic circuit card that is bonded to a cold plate as shown below. The inner surface temperature of the cold plate is maintained at 20ºC. Determine the temperature of the junctions on the chip as a function of heat dissipated. Assume the circuit card and cold plate lateral dimensions to be infinitely larger compared to the chips and thermal conductivities of Si, solder, ceramic and epoxy to be 120 W/m-K, 296 W/m-K, 30 W/m-K and 0.2 W/m-K respectively.
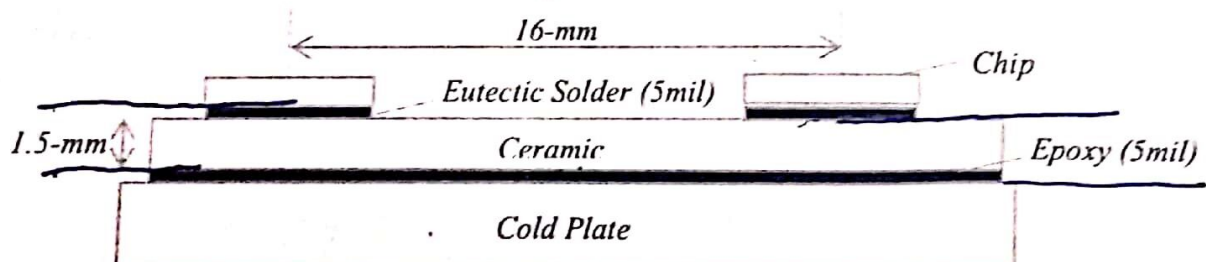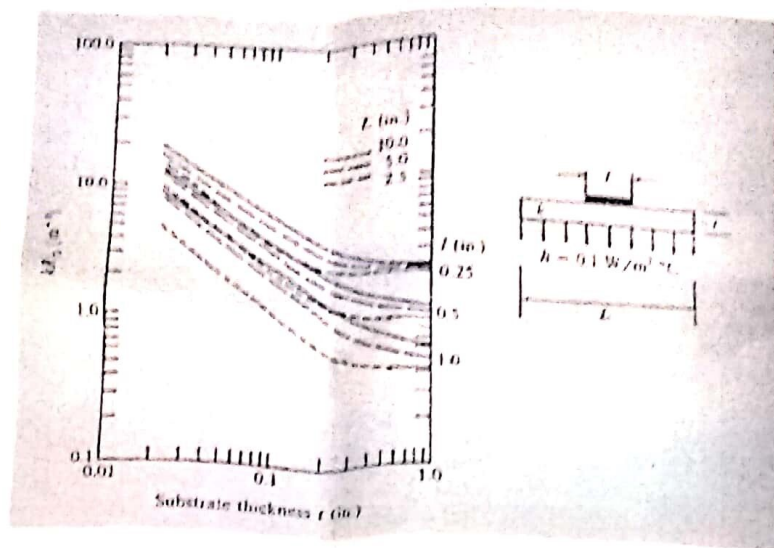
10

5. Consider the following configuration. It is claimed that the total thermal resistance from sink to ambient is given by $\dfrac{1}{hA} + \dfrac{1}{2\dot{m}C_p}$. Is it correct? Justify your answer

10

6. One of the statistical models used for saturation behavior is the Michaelis-Mentin model given by

$$y = \frac{\theta_1 t}{\theta_2 + t}$$

. Is there any transformation possible to linearize this model?

Reliability testing is in progress to identify a suitable thermal interface material. Two materials A and B have undergone bake tests at 125ºC and 150ºC. The results are shown below. If the material has to be certified for operation at 90ºC, which one would you choose and why?

5 + 5 = 10