

## **ME 694 Thermal Design and Management of Electronic Equipment (3-0-0-6)**

### **Syllabus:**

Introduction– importance of thermal management of electronics, temperature effects on different failure modes; Basics of conduction, convection, radiation heat transfer; Cooling methods used in the industry for electronics–conduction cooling, cooling by heat sinks– design aspects of heat sinks, convection cooling, selection of fan, liquid immersion cooling, flow-through cooling of CCAs, cold-wall cooling, cold plates, jet impingement cooling, synthetic jet cooling, thermoelectric or solid state coolers, cooling using phase change– cooling with PCM materials, micro/mini channel cooling, cooling using heat pipes– working principle, selection of heat pipe working fluid; Selection of cooling technique– ranges of cooling rates of different cooling methods, selection criteria; Experimental techniques used for thermal measurements; Reliability issues: importance, bathtub curve.

### **Text/References:**

1. Younes Shabany, Heat Transfer: Thermal Management of Electronics, CRC Press Inc, 2010.
2. Ravi Kandasamy and Arun S. Mujumdar, Thermal Management of Electronic Components, Lambert Academic Publishing, 2010.
3. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, Wiley, 1991.
4. Sung Jin Kim, Sang Woo Lee, Air Cooling Technology for Electronic Equipment, Taylor & Francis, 1996.
5. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, 2001.
6. Yunus A. Cengel, Heat Transfer: A Practical Approach. McGraw-Hill, 2003.