

Department of Mechanical Engineering**BASIC HEAT TRANSFER FOR ELECTRONIC SYSTEMS (Open Elective-I)**

SYLLABUS FOR B.E.III-SEMESTER

L:T:P(Hrs/week):2:0:0	SEE Marks:60	Course Code: U200E330ME
Credits :02	CIE Marks:40	Duration of SEE:03Hours

COURSE OBJECTIVE	COURSE OUTCOMES <i>On completion of the course, students will be able to</i>
The objective of this course is to study the basic laws of thermodynamics and the cooling of electronic equipment along with basic modes of heat transfer	<ol style="list-style-type: none"> 1 understand and apply the first and Second laws of thermodynamics to various engineering problems. 2 formulate heat conduction problems in rectangular, cylindrical and spherical coordinate system by transforming the physical system into a mathematical model. 3 to determine heat transfer coefficient in forced and free convection heat transfer. 4 analyse heat transfer processes involved in cooling of electronic components

UNIT-I: BASIC THERMODYNAMICS

Basic Concepts-System, Types of Systems, Control Volume, Surrounding, Boundaries, Universe, Macroscopic and Microscopic viewpoints, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi-static process; Zeroth Law of Thermodynamics, First and Second laws of Thermodynamics. Numerical problems.

UNIT-II: heat transfer: Conduction

Heat Transfer – Different Modes, governing laws and application to heat transfer: Fourier, Newton, Stefan-Boltzmann laws; general heat conduction equation - Steady state one-dimensional heat conduction through slabs, hollow cylinders and spheres. Concept of thermal resistance in series and parallel (composite systems), contact resistance, overall heat transfer coefficient. Critical radius of insulation. Heat transfer with and without internal heat generation. Numerical problems.

UNIT-III: heat transfer: Convection

Extended surfaces: Fins - Applications of fins, Fin Equation, Fin Effectiveness and Efficiency. Convection Heat Transfer: Heat transfer coefficient - Forced and Natural Convection in Electronic Devices, non dimensional numbers - Nusselt number, Reynolds number, Grashoff number and Prandtl number, forced and free convection correlations - flat plates and cylinders. Numerical problems.

UNIT-IV: COOLING OF ELECTRONIC EQUIPMENT


Needs & Goals; Temperature effects on different failure modes; Electronic equipment for airplanes, missiles, satellites and spacecraft; electronic equipment for ships & submarines; electronic equipment for communication systems and ground support system; chassis and circuit boards cooling.

Learning Resources:

1. P.K. Nag, "Engineering Thermodynamics", Tata Mc Graw Hill, 4th Edition, 2008.
2. Yunus Cengel & Boles, "Thermodynamics – An Engineering Approach", TMH New Delhi, 2008.
3. Sachadeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Ltd Publishers, New Delhi, 2010.
4. Dave S. Steinberg, "Cooling Techniques for Electronic Equipment", Second Edition, John Wiley & Sons, 1991.
5. Yunus Cengel & Afshin J Ghajar, "Heat and Mass Transfer: Fundamentals & its Applications", Mc Graw Hill, 5th Edition, 2013.

The break-up of CIE: Internal Tests+ Assignments + Quizzes

1	No. of Internal Tests:	02	Max. Marks for each Internal Test:	30
2	No. of Assignments:	02	Max. Marks for each Assignment:	05
3	No. of Quizzes:	02	Max. Marks for each Quiz Test:	05
Duration of Internal Test: 1 Hour 30 Minutes				


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