CH-913 Thermoelectrics

Credit Hours: 3-0

Prerequisite: Nil

Course Objectives

This course will introduce the principles of converting heat into electricity. The first part of the course will include fundamental theories; Seebeck effect, Peltier effect, Thomson relation, thermal and electrical contact resistances. The second part of the course will account for the charge carriers; the phonons and electrons. Trends in thermoelectric properties will be reviewed in domains of; electrical conductivity, seebeck coefficient, electronic contribution to thermal conductivity, optimum doping, and alloying. In last part applications will be discussed regarding waste heat recovery in automobiles, solar thermoelectric generator, electronic thermal control, etc.

Course Outcomes

This course will provide experts on thermoelectric science and technology. After completion of this course, students will be able to demonstrate the knowledge of;

a. Seebeck Coefficient, Peltier, and Thomson effect in relation to crystal structure.
b. The energy harvesting from waste heat and future energy/power production methods.
c. Wherever required, synthesis of cost effective thermoelectric materials with better properties than conventional ons.

Course Contents

Introduction to thermoelectric materials, Phenomenology, Thermal & electrical Equilibrium, Seebeck-Peltier and Thompson effects.

Phonon and Electron Dispersion Relation. Optimization and selection of thermoelectric material with respect to; Power Factor, mobility, effective mass, lattice thermal conductivity, temperature effect and energy gap.

Improvement in Thermal Conductivity, Specific Materials – Bismuth Telluride; pure material, band structure, diffusion, solid solutions, recent advances .

Thermoelectric Material Synthesis & characterization; General Principles, Growth From the Melt, Sintering, Thick and Thin films.

Review of Thermoelectric Materials; Bismuth and Bismuth–Antimony, Lead Telluride, Silicon–Germanium

Skutterudites, Clathrates, Oxides, Zinc Antimonide, Half-Heusler Compounds, Metal Silicides and Boro-Carbides etc.

Recommended Books

1. H. J. Goldsmis, Introduction to Thermoelectricity, springer Series in Materials Science, ISSN 0933-033X, ISBN 978-3-642-00715-6 e-ISBN 978-3-642-00716-3, DOI 10.1007/978-3-642-00716-3, 2010.
2. V. Zlati, A. C. Hewson, Poperties and Applications of Thermoelectric Materials; The Search for New Materials for Thermoelectric Devices, Springer Science ,2009.