SILVER OAK UNIVERSITY

Silver Oak Institute of Science

Bachelor of Science Physics

Course Name: Introduction to Mathematical Physics and Thermodynamics

Course Code: 2050253202

Semester: 3rd

Prerequisite:

1. Strong foundation in calculus, including differential and integral calculus.

Course Objectives:

1. Understand partial differential equations in physics, focusing on separation of variables in various coordinate systems and their application to Laplace's and Helmholtz's equations.
2. Master solution techniques for second-order differential equations, including series solutions and methods for obtaining second solutions, and apply them to ordinary and singular points, as well as systems of linear and nonlinear equations.
3. Gain knowledge of heat and thermodynamics principles, including entropy, TS diagrams, and pure substance analysis, along with mathematical methods such as characteristic functions, Maxwell's relations, and equations for internal energy and heat capacity in open systems.

Teaching Scheme:

Teaching Scheme				
L	T	P	Contact Hours	Credit
2	0	4	6	4

Contents:

Unit	Topics	Teaching Hours	% Weightage
1	Some partial differential equations in physics, the method of Separation of variables, separation of Helmholtz equation in Cartesian coordinates, in spherical polar and cylindrical Coordinates, Laplace's equation in various coordinates, Choice of coordinate system and separability of a partial differential equation, Parabolic coordinates system, Prolate Spheroidal coordinates system, various examples based on the separation of variables. **2nd order differential equations** Ordinary and Singular points, Series solution around an ordinary point, Series solution around a regular singular point: the method of Frobenius, Getting a second solution, Alternative method of getting the second solution, System of linear first order differential equations, Non-linear differential equations, related examples.	14	50
2	**Heat & Thermodynamics** Entropy: Reversible part of the second law (Clausius theorem), Entropy, Principle of increase of entropy, TS diagram, Application of the Entropy principle. Pure substances: Volume expansitivity: Cubic Expansion coefficient, Compressibility	14	50

	Mathematical methods in thermodynamics Characteristics functions, Enthalpy, Helmholtz & Gib's functions, two mathematical theorems, Maxwell's relations, Tds equations, Internal energy equations, Heat Energy equations, Heat capacity equations. Open Systems: Joule-Thomson expansion, Liquefication of gases by the Joule-Thomson expansion		

Course Outcomes:

Sr. No.	CO Statement	Unit
CO-1	Describe the method of Separation of variables for partial differential equations in physics.	1
CO-2	Apply series solutions and the Frobenius method to 2nd order differential equations.	1
CO-3	Utilize mathematical methods including characteristics functions and Maxwell's relations in thermodynamics.	2
CO-4	Demonstrate experimental techniques such as electron diffraction and analyzing polarized light.	2

Teaching & Learning Methodology:

1. Conceptual Learning
2. Cooperative based Learning
3. Competency based Learning
4. Problem - based Learning

List of Experiments: **Total Hours: 56**

Sr. No.	Practical Name
1	Load line and determination of Q point for BJT.
2	Study of electron diffraction pattern.
3	Resolving power of grating.
4	Diffraction by single slit.
5	Analysis of elliptical polarized light using photocell.
6	Least Square Method.
7	C programming

Books Recommended:-

1. Mark W. Zemansky and R.H. Dittman, "Heat & Thermodynamics", McGraw Hill, Int.
2. P.K. Chattopadhyay, "Mathematical Physics", New Age International Publishers
3. Richard E. Sonntag, Claus Borgoakke, and Gordon J. Van Wylen," Fundamentals of Thermodynamics", Wiley

List of Open-Source Software/learning website:

1. http://silveroakuni.ac.in/video-lecture

CO-PO-PSO Matrix:

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO-1	3	1	1	1	1	3	2	1	2	1	2	1	2
CO-2	3	2	1	2	2	1	1	2	1	2	2	1	1
CO-3	3	2	1	2	2	1	2	2	1	2	2	1	2
CO-4	3	2	1	1	2	1	1	1	2	2	2	1	1