VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

Physics

IV Semester Syllabus

Bachelor of Science

With effect from 2022-23 and onwards

Name of the Department: Physics

Semester-IV

DSC 4: Thermal Physics and Electronics

Course Title: Thermal Physics and Electronics	**Course code: :** 21BSC4C4PHL
Total Contact Hours: 55	**Course Credits: 04**
Internal Assessment Marks: 40 marks	**Duration of SEE: 02 hours**
Semester End Examination Marks: 60 marks	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Apply laws of thermodynamics to the thermodynamical situations.
2. Use thermodynamical potentials to understand physical systems.
3. Explain kinetic theory of gases and laws of radiation.
4. Analyse the performance of semiconductor devices and junction transistors.
5. Analyse digital electronic circuits.

DSC 4: Thermal Physics and Electronics

Unit	Description	Hours
1	**Introduction:** Review of the concepts of Heat and Temperature. Zeroth Law of thermodynamics (1 Hour) **First Law of Thermodynamics:** Differential form, Internal Energy. Equation of state for an adiabatic process, Work Done during Isothermal and Adiabatic Processes. (4Hours) **Second Law of Thermodynamics:** Kelvin-Planck and Clausius Statements and their Equivalence. Reversible and Irreversible processes with examples. Heat Engines: Carnot engine & efficiency (no derivation). Refrigeration & coefficient of performance, Applications of Carnot engine in locomotion, Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy (6 Hours)	11
2	**Third Law of Thermodynamics:** Statement, Significance and Unattainability of Absolute Zero. (3 Hours)	11

	Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Properties and Applications. (2 Hour) **Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations (1) First order Phase Transitions with examples, Clausius - Clapeyron Equation (2) Values of Cp-Cv (3) JouleThomson Effect and Joule-Thomson coefficient and Derive an equation for Vander Walls gas. Attainment of low temperature by liquefaction of gases and adiabatic demagnetization. (6 Hours)	
3	**Kinetic Theory of Gases: Distribution of Velocities:** Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas: Mean, RMS and Most Probable Speeds. Degrees of Freedom, Law of Equipartition of Energy. Specific heats of Gases. (5 Hours) **Radiation:** Blackbody radiation, spectral distribution, the concept of energy density and pressure of radiation, Wien's law, Wien's displacement law, Stefan-Boltzmann law, Rayleigh-Jeans law, Ultraviolet Radiation catastrophe and Planck's law of radiation. (6 Hours)	11
4	**Semiconductor devices:** Review of Intrinsic and Extrinsic semiconductors, p-n junction and its Characteristics and Parameters, Diode approximations, Half-wave rectifier, Full-wave rectifier, Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator. (5 hours) **Junction Transistors:** Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Base, Common Emitter and Common Collector Characteristics. Field Effect Transistor (FET) and its characteristics. Transistor as an Amplifier and Oscillator. (6 hours)	11
5	**Electronics:** Integrated Circuits (Analog and Digital), Operational Amplifier, Ideal characteristics of Op-Amp, Inverting and Non-Inverting Configurations. Applications- Voltage Follower, Addition and Subtraction. (4 hours) **Digital:** Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. (3 hours) **Boolean Algebra Theorems:** De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, Algebraic Simplification, Implementation of NAND and NOR functions. (4 hours)	11

Text Books:

1. Heat and Thermodynamics, Brijlal and Subramanyam, Publishing House Pvt. Ltd.
2. Heat and thermodynamics by A K Saxena and C M Tiwari, Alpha science.
3. Electronic Devices and Circuits, David A. Bell, 2004, PHI, New Delhi
4. Integrated Electronics, Jacob Millman and CC Halkias
5. Digital Fundamentals, Floyd, 2001, PHI, New Delhi

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988,

Name of the Department: Physics

Semester-IV

DSC 4: Thermal Physics and Electronics Lab

Course Title: Thermal Physics and Electronics Lab	**Course code:** 21BSC4C4PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks: 25	**Duration of SEE: 03 hours**
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Design experiments in thermal physics and electronics.
2. Execute experiments in thermal physics and electronics.
3. Analyse experimental results in thermal physics and electronics.

DSC 4: Thermal Physics and Electronics Lab

List of Experiments:

1. Mechanical Equivalent of Heat by Callender and Barne's method.
2. Coefficient of thermal conductivity of Copper by Searle's apparatus
3. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
4. Determination of Stefan's constant / Verification of Stefan's law
5. Variation of thermo-emf across two junctions of a thermocouple with temperature
6. Verification of Clausius –Clapeyron equation and determination of specific enthalpy.
7. V-I Characteristics of Silicon & Germanium PN Junction diodes (FB & RB)
8. V-I Characteristics of Zener Diode and voltage regulator.
9. Characteristics of BJT in Common Emitter Configuration.
10. Frequency response of CE Amplifier

11. Frequency response of CC Amplifier (Emitter Follower).
12. Half Wave and Full Wave Rectifier Without Filter Half Wave and Full Wave Rectifier with Filter
13. Applications of Operational Amplifier - Non-inverting and Inverting op-amp circuits
14. Operational Amplifier as Voltage follower, Adder and Subtractor circuits.
15. Truth table verification of logic gates.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. Basic Electronics Lab (P242) Manual 2015-16, National Institute of Science Education and Research, Bhubaneswar, 2015.
2. B.L. Worsnop, H.T. Flint, “Advanced Practical Physics for Students”, Methuen & Co., Ltd., London, 1962, 9e.
3. S. Panigrahi, B. Mallick, “Engineering Practical Physics”, Cengage Learning India Pvt. Ltd., 2015, 1e