Shiksha Mandal's

Bajaj College of Science, Wardha (Autonomous)
Syllabus for B. Sc. II (SEM-III) w.e.f. 2024-25
PHYSICS MAJOR DSC III: WAVES AND OPTICS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Course Description:

This course is designed for students of undergraduate course. This course is designed for 60 hours theory and 60 hours practical. 4 credits are allotted to the theory course whereas 2 credits are allotted for laboratory course.

Course Objectives:

The course aims to provide students with a comprehensive understanding of wave motion, superposition of two harmonic waves and sound, geometrical optics, wave optics, interference, diffraction, and polarization. The course will cover theoretical concepts and practical experiments to help students develop a strong foundation in the subject. The objectives of this course are:

- To understand the concepts of wave motion and its properties.
- To learn about the superposition of two harmonic waves and sound.
- To comprehend the elementary geometrical optics in the paraxial approximation.
- To understand the wave optics and interference.
- To learn about diffraction and polarization of light.
- To perform experiments to understand the theoretical concepts.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- CO1: Understand the concepts related to wave motion, including wave equation, particle and wave velocities, differential equation, pressure of a longitudinal wave, and intensity of wave.
- CO2: Understand the concepts related to superposition of two harmonic waves and standing waves in strings, including phase and group velocities, changes with respect to position and time, energy of vibrating string, transfer of energy, normal modes of stretched strings, and plucked and struck strings.
- CO3: Understand the concepts related the principles of geometrical optics in the paraxial approximation, to analyse and solve problems related to reflection and refraction at a plane boundary from Huygens' principle and Fermat's principle, Snell's Law, total internal reflection, image formation by reflection at a spherical boundary, concave and convex mirrors, and refraction at a spherical boundary and by converging and diverging thin lenses.
- CO4: Understand the concepts related and solve problems related to electromagnetic nature of light, wave front, temporal and spatial coherence,

interference in thin films, Newton's Rings, Michelson Interferometer, and Fabry-Perot interferometer.

- CO5: Analyse Fraunhofer diffraction to solve problems related to single slit, circular aperture, double slit, multiple slits, diffraction grating, and Fresnel Diffraction.
- CO6: Understand the concepts related and solve problems related to the transverse nature of light waves and plane polarized light – production and analysis, Brewster's law, Malus' law, double refraction through crystals, calcite crystal and Nicol prism, circular and elliptical polarization, wave plates, polarimeter, and applications of polarization.

Syllabus:

Unit I: Wave Motion

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. [10 hrs]

Unit II: Superposition of Two Harmonic Waves and Sound

Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. Sound: Characteristics and production in various musical instruments. Theory of beats. [10 hrs]

Unit III: Geometrical Optics

Elementary geometrical optics in the paraxial approximation. Refractive index; reflection and refraction at a plane boundary from Huygens' principle and Fermat's principle; Snell's Law; total internal reflection. Image formation by reflection at a spherical boundary; concave and convex mirrors. Real and virtual images, Magnification. Image formation by refraction at a spherical boundary and by converging and diverging thin lenses. Cardinal points. Derivation of the expression for the focal length of a thin lens and thick lens. [10 hrs]

Unit IV: Wave Optics: Interference

Electromagnetic nature of light. Definition and properties of wave front. Temporal and Spatial Coherence. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer -(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. [10 hrs]

Unit V: Wave Optics: Diffraction

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. [10 hrs]

Unit VI: Wave Optics: Polarization

Transverse nature of light waves. Plane polarized light – production and analysis. Brewster's law, Malus' law. Double refraction through crystals, calcite crystal and Nicol prism. Circular and elliptical polarization. Wave plates, polarimeter. Applications of polarization. [10 hrs]

References:

- A textbook of Sound by Brij Lal, N Subramanyam, Vikas Publishing House.
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
- A Textbook of Optics by Brij Lal, M. N. Avadhanulu, and N. Subrahmanyam, S. Chand Publication
- Optical Physics by Lipson, Lipson and Lipson, 4th edition, Cambridge University Press.

PHYSICS DSC III LAB: WAVES AND OPTICS: Any 10 (60 Lectures)

1. To determine the focal length of long focus convex lens using short focus lens.
2. Familiarization with Schuster`s focussing; determination of angle of prism.
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power of the Material of a given Prism using Mercury Light
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of Sodium/Mercury light using plane diffraction grating
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. Study of Helmholtz resonator.
13. Study of microphone.
14. Study of waves on a stretched string.
15. To determine the focal length of thick lens.

Demonstrations:

- Optical Activity
- Fabry Perot Interferometer
- Comparison of zone plate with convex lens
- Malus' law

References:

- Advanced Practical Physics for students, B.L. Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson, and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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Bajaj College of Science, Wardha (Autonomous)

Syllabus for B. Sc. II (SEM-III) w.e.f. 2024-25

PHYSICS MINOR: WAVES AND OPTICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

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- To understand the wave optics and interference.
- To learn about diffraction and polarization of light.
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- CO4: Understand the concepts related and solve problems related to electromagnetic nature of light, wave front, temporal and spatial coherence,

interference in thin films, Newton’s Rings, Michelson Interferometer, and Fabry-Perot interferometer.

- CO5: Analyse Fraunhofer diffraction to solve problems related to single slit, circular aperture, double slit, multiple slits, diffraction grating, and Fresnel Diffraction.
- CO6: Understand the concepts related and solve problems related to the transverse nature of light waves and plane polarized light – production and analysis, Brewster’s law, Malus’ law, double refraction through crystals, calcite crystal and Nicol prism, circular and elliptical polarization, wave plates, polarimeter, and applications of polarization.

Syllabus:

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Unit III: Geometrical Optics

Elementary geometrical optics in the paraxial approximation. Refractive index; reflection and refraction at a plane boundary from Huygens’ principle and Fermat’s principle; Snell’s Law; total internal reflection. Image formation by reflection at a spherical boundary; concave and convex mirrors. Real and virtual images, Magnification. Image formation by refraction at a spherical boundary and by converging and diverging thin lenses. Cardinal points. Derivation of the expression for the focal length of a thin lens and thick lens. [10 hrs]

Unit IV: Wave Optics: Interference

Electromagnetic nature of light. Definition and properties of wave front. Temporal and Spatial Coherence. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton’s Rings: Measurement of wavelength and refractive index. Michelson Interferometer -(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. [10 hrs]

Unit V: Wave Optics: Diffraction

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. [10 hrs]

Unit VI: Wave Optics: Polarization

Transverse nature of light waves. Plane polarized light – production and analysis. Brewster's law, Malus' law. Double refraction through crystals, calcite crystal and Nicol prism. Circular and elliptical polarization. Wave plates, polarimeter. Applications of polarization. [10 hrs]

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- A Textbook of Optics by Brij Lal, M. N. Avadhanulu, and N. Subrahmanyam, S. Chand Publication
- Optical Physics by Lipson, Lipson and Lipson, 4th edition, Cambridge University Press.

PHYSICS DSC III LAB: WAVES AND OPTICS: Any 10 (60 Lectures)

1. To determine the focal length of long focus convex lens using short focus lens.
2. Familiarization with Schuster`s focussing; determination of angle of prism.
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power of the Material of a given Prism using Mercury Light
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of Sodium/Mercury light using plane diffraction grating
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. Study of Helmholtz resonator.
13. Study of microphone.
14. Study of waves on a stretched string.
15. To determine the focal length of thick lens.

Demonstrations:

- Optical Activity
- Fabry Perot Interferometer
- Comparison of zone plate with convex lens
- Malus' law

References:

- Advanced Practical Physics for students, B.L. Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson, and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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Bajaj College of Science, Wardha (Autonomous)

Proposed Syllabus for Four Year Multidisciplinary UG Program with DSC as Major
(e.g. Four Year B.Sc. Honors/Research Program)

Program: B.Sc.
(Academic Session 2023-24)
Syllabus

THERMAL PHYSICS AND STATISTICAL MECHANICS

A Semester IV course in
Physics
Syllabus under Autonomy

Shiksha Mandal’s

Bajaj College of Science, Wardha (Autonomous)
Syllabus for B. Sc. II (SEM-IV) w.e.f. 2024-25
PHYSICS MAJOR DSC IV: THERMAL PHYSICS AND STATISTICAL MECHANICS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Course Description:

This course is designed for students of undergraduate course with Physics as subject in B.Sc. Programme. This course is designed for 60 hours theory and 60 hours practical. 4 credits are allotted to the theory course whereas 2 credits are allotted for laboratory course.

Course Objectives:

The course aims to provide students with a comprehensive understanding of Kinetic theory of gases, Thermodynamics and Statistical Physics. The course will cover theoretical concepts and practical experiments to help students develop a strong foundation in the subject. The objectives of this course are:

- To understand the concepts of real gas and ideal gas and associated phenomenon.
- To learn about the kinetic theory of gases and various transport phenomenon.
- To understand the laws of thermodynamics and Carnot cycle.
- To learn about concept of entropy, the Clausius Clapeyron equation and Maxwell’s equation and their applications.
- To understand the basics of statistical Physics
- To develop understanding about MB, BE and FD statistics and its applications.

Course learning outcomes: Upon completion of this course student will be able to

CO1: Understand the properties of gases and use kinetic theory to explain gas behaviour.

CO2: Understand the kinetic theory of gases and various transport phenomenon associated with the gases.

CO3: learn about the various laws of thermodynamics, application of these laws to various thermodynamic process and Carnot cycle.

CO4: Use thermodynamic relations like Maxwell’s relation, Clausius Clapeyron equation to explain various thermodynamic processes.

CO5: Develop understanding about the basics of Statistical mechanics especially those involving many-particle systems.

CO6: understand quantum and classical statistical mechanics for ideal systems and will be able to apply MB, BE and FD statistics to different systems.

Theory (04 Credit) **(60 Hrs)**

UNIT-I **(10 Hrs)**

Ideal Gas: Kinetic Model, Boyle's law, interpretation of Temperature, estimation of rms speed of molecules, Brownian Motion, Estimate of Avogadro Number, equipartition of energy and its applications to specific heat of gases; monatomic and diatomic gases, Isothermal and Adiabatic expansion of an ideal gas, Application to atmospheric physics.

Real Gas: Van der Waals' Gas, Equation of state, Nature of Van der Waals' forces, The critical Constants.

UNIT-II **(10 Hrs)**

Real Gas: Joule Thomson Effect, Joule Thomson Porous Plug Experiment, Distinction between Joule Expansion, Joule Thomson Expansion, and Adiabatic Expansion.

Transport Phenomenon in Gases: molecular collision, mean free path and collision cross section, estimate of molecular diameter, and mean free path, Transport of mass, momentum, energy and their relationship, dependence on temperature and pressure.

UNIT-III **(10 Hrs)**

The Laws of Thermodynamics-I: Thermodynamic variables, Extrinsic and intrinsic variables, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Applications of First Law to various thermodynamical Processes, General Relation between C_P & C_V, Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes, Carnot's Cycle and its Efficiency, Carnot's Theorem, The Second law of Thermodynamics.

UNIT-IV **(10 Hrs)**

The Laws of Thermodynamics-II: Entropy, Entropy changes in reversible & irreversible processes, Entropy-Temperature diagrams, The thermodynamic scale of temperature, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamic Relationships: Maxwells general relationships, application to Joule-Thomson Cooling, Joule Thomson Coefficient, Temperature of inversion, Clausius-Clapeyron heat equation, Thermodynamic potentials and their significance, Relation of thermodynamic potentials with their variables, Refrigeration, Air conditioning (concept only)

UNIT-V **(10 Hrs)**

The Statistical Basis of Thermodynamics: Probability and thermodynamic probability, Principal of equal a priori probability, Probability distribution and narrowing with increase in number of particles.

Universal Laws in Statistical Mechanics: Degrees of Freedom, Position Space, Momentum Space, Phase Space, The μ-space and γ-space, Division of phase space into cell, Macrostates and Microstate, Fundamental postulates of statistical mechanics, Density of states, Boltzmann entropy relation, .

UNIT-VI **(10 Hrs)**

Classical Statistics: Three kinds of particles, Maxwell Boltzmann energy distribution law, Applications of Maxwell Boltzmann Distribution law, Mean, RMS and Most Probable Speeds.

Quantum Statistics: Need of Quantum Statistics, Development of Quantum Statistics, Indistinguishability of particles and its consequences, Bose-Einstein Distribution Law (No Derivation), Fermi Dirac Distribution Law and its application to free electrons in the metals, Fermi level , Fermi temperature and Fermi Energy, Fermi energy at absolute zero E_{F_0} for electrons in a metal, Comparison between MB, BE and FD statistics.

Reference Books:

- Heat Thermodynamics and Statistical Physics, Brijlal, N. Subrahmanyam, P.S. Hemne, 2007, S. Chand Publications
- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W. Zemasky and R. Dittman, 1981, McGraw Hill 14
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears & G.L. Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications

Laboratory (02 Credits) **60 Hrs**

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Experimental Determination of ratio of specific heat (γ) using Clement and Desormes Method
3. Measurement of Planck's constant using black body radiation.
4. To determine Stefan's Constant.
5. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
6. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
7. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
8. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.

9. To study the variation of thermo-emf across two junctions of a thermocouple with temperature.
10. To record and analyse the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system.
11. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.
12. To determine the efficiency of electric kettle.
13. Study of statistical distribution from given data and to find the most probable, average and RMS value.
14. Statistical determination of possible macrostates and their deviation (10 coin system)

Reference Books:

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
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Proposed Syllabus for Four Year Multidisciplinary UG Program with DSC as Major
(e.g. Four Year B.Sc. Honors/Research Program)

Program: B.Sc.
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Syllabus

THERMAL PHYSICS AND STATISTICAL MECHANICS

A Semester IV course in
Physics
Syllabus under Autonomy

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Syllabus for B. Sc. II (SEM-IV) w.e.f. 2024-25

PHYSICS MINOR IV: THERMAL PHYSICS AND STATISTICAL MECHANICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Course Description:

This course is designed for students of undergraduate course without Physics as subject in B.Sc. Programme. This course is designed for 60 hours theory and 60 hours practical. 4 credits are allotted to the theory course whereas 2 credits are allotted for laboratory course.

Course Objectives:

The course aims to provide students with a comprehensive understanding of Kinetic theory of gases, Thermodynamics and Statistical Physics. The course will cover theoretical concepts and practical experiments to help students develop a strong foundation in the subject. The objectives of this course are:

- To understand the concepts of real gas and ideal gas and associated phenomenon.
- To learn about the kinetic theory of gases and various transport phenomenon.
- To understand the laws of thermodynamics and Carnot cycle.
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- To understand the basics of statistical Physics
- To develop understanding about MB, BE and FD statistics and its applications.

Course learning outcomes: Upon completion of this course student will be able to

CO1: Understand the properties of gases and use kinetic theory to explain gas behaviour.

CO2: Understand the kinetic theory of gases and various transport phenomenon associated with the gases.

CO3: learn about the various laws of thermodynamics, application of these laws to various thermodynamic process and Carnot cycle.

CO4: Use thermodynamic relations like Maxwell's relation, Clausius Clapeyron equation to explain various thermodynamic processes.

CO5: Develop understanding about the basics of Statistical mechanics especially those involving many-particle systems.

CO6: understand quantum and classical statistical mechanics for ideal systems and will be able to apply MB, BE and FD statistics to different systems.

Theory (04 Credit) **(60 Hrs)**

UNIT-I **(10 Hrs)**

Ideal Gas: Kinetic Model, Boyle's law, interpretation of Temperature, estimation of rms speed of molecules, Brownian Motion, Estimate of Avogadro Number, equipartition of energy and its applications to specific heat of gases; monatomic and diatomic gases, Isothermal and Adiabatic expansion of an ideal gas, Application to atmospheric physics.

Real Gas: Van der Waals' Gas, Equation of state, Nature of Van der Waals' forces, The critical Constants.

UNIT-II **(10 Hrs)**

Real Gas: Joule Thomson Effect, Joule Thomson Porous Plug Experiment, Distinction between Joule Expansion, Joule Thomson Expansion, and Adiabatic Expansion.

Transport Phenomenon in Gases: molecular collision, mean free path and collision cross section, estimate of molecular diameter, and mean free path, Transport of mass, momentum, energy and their relationship, dependence on temperature and pressure.

UNIT-III **(10 Hrs)**

The Laws of Thermodynamics-I: Thermodynamic variables, Extrinsic and intrinsic variables, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Applications of First Law to various thermodynamical Processes, General Relation between C_P & C_V, Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes, Carnot's Cycle and its Efficiency, Carnot's Theorem, The Second law of Thermodynamics.

UNIT-IV **(10 Hrs)**

The Laws of Thermodynamics-II: Entropy, Entropy changes in reversible & irreversible processes, Entropy-Temperature diagrams, The thermodynamic scale of temperature, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamic Relationships: Maxwells general relationships, application to Joule-Thomson Cooling, Joule Thomson Coefficient, Temperature of inversion, Clausius-Clapeyron heat equation, Thermodynamic potentials and their significance, Relation of thermodynamic potentials with their variables, Refrigeration, Air conditioning (concept only)

UNIT-V **(10 Hrs)**

The Statistical Basis of Thermodynamics: Probability and thermodynamic probability, Principal of equal a priori probability, Probability distribution and narrowing with increase in number of particles.

Universal Laws in Statistical Mechanics: Degrees of Freedom, Position Space, Momentum Space, Phase Space, The μ-space and γ-space, Division of phase space into cell, Macrostates and Microstate, Fundamental postulates of statistical mechanics, Density of states, Boltzmann entropy relation, .

UNIT-VI **(10 Hrs)**

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Quantum Statistics: Need of Quantum Statistics, Development of Quantum Statistics, Indistinguishability of particles and its consequences, Bose-Einstein Distribution Law (No Derivation), Fermi Dirac Distribution Law and its application to free electrons in the metals, Fermi level , Fermi temperature and Fermi Energy, Fermi energy at absolute zero E_{F_0} for electrons in a metal, Comparison between MB, BE and FD statistics.

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Laboratory (02 Credits) **60 Hrs**

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6. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
7. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
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9. To study the variation of thermo-emf across two junctions of a thermocouple with temperature.
10. To record and analyse the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system.
11. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.
12. To determine the efficiency of electric kettle.
13. Study of statistical distribution from given data and to find the most probable, average and RMS value.
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