SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar
Third Year B. Sc. [Applied Physics] Course Structure for Semester(CBCS) System
SEMESTER-5

Course Type	Subject	Course Code	Name of Course	Theory/ Practical	Credits	Contact Hrs/week	Exam duration in hrs	Component of Marks		
								Internal	External	Total
Core Course	Applied Physics	US05CAPH01	Quantum and Statistical Mechanics	Theory	3	3	3	30	70	100
		US05CAPH02	Solid State Physics	Theory	3	3	3	30	70	100
		US05CAPH03	Mathematical Methods in Physics and FORTRAN – 1	Theory	3	3	3	30	70	100
		US05CAPH04	Process Instrumentation – 1	Theory	3	3	3	30	70	100
		US05CAPH05	Thermal Physics and Remote Sensing	Theory	3	3	3	30	70	100
		US05CAPH06	Introduction to 8085 microprocessor and control systems - 1	Theory	3	3	3	30	70	100
		US05CAPH07	Applied Physics Practicals	Practical	2	4	3	30	70	100
		US05CAPH08	Applied Physics Practicals	Practical	2	4	3	30	70	100
		US05CAPH09	Applied Physics Practicals	Practical(Project Work)	2	4	3	30	70	100
					Total 24 Credits	Total 30 hours				

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH01 (3 Credit Course)
COURSE TITLE : Quantum and Statistical Mechanics
(Effective from June 2019)

Unit-1 Quantum Mechanics - I

Concepts of classical mechanics: Mechanics of material systems, Electromagnetic fields and light, Inadequacy of classical concepts: macroscopic statistical phenomena, black body radiation, Electromagnetic radiation: photoelectric effect, Atomics structure and atomic spectra: the Rutherford atom model, Bohr's postulates, Bohr's theory of the hydrogen spectrum, Bohr-Sommerfeld quantum rules degeneracy, Space quantization, Limitations of the old quantum theory, De Broglie's Hypothesis. The motion of a free wave packet: Classical approximation and the uncertainty particles, Uncertainties introduced in the process of measurement.

Unit-2 Quantum Mechanics - II

Photons: the quantization of fields A free particle in one dimension, Generalization to three dimensions, The operator correspondence and the Schrodinger equation for a particle subject to forces, Normalization and Probability interpretation, Non-normalizable wave functions and Box normalization, Conservation of probability, Expectation values, Ehrenfest's theorem, Admissibility conditions on the wave function, Stationary states: the time independent Schrodinger equation, A particle in a square well potential.

UNIT-3 Statistical Mechanics – I

Basic concept of statistical mechanics, Phase space, Ensemble, Grand canonical, canonical and micro canonical ensemble, Density of states, partition function, internal energy, entropy, MB statistics: Introduction, distribution of gas molecules (KE and velocity), applications, limitation, Illustrative examples.

Unit-4 Statistical Mechanics – II

Bose Einstein statistics: Introduction, derivation of distribution law, derivation of Plank's law of radiation, Bose Einstein condensate. Fermi dirac statistics: Introduction, derivation of distribution law, Application: specific heat of metals comparison: Maxwell Boltzmann, Bose Einstein, and Fermi dirac statistics. Illustrative examples.

REFERENCE BOOK:

1. A textbook of Quantum Mechanics by P M Mathews and K Venkatesan.
2. Quantum mechanics concepts and applications by Nouredine Zettili
3. Concept of Modern Physics, Arthur Baiser (Asian Edition)
4. Heat Thermodynamics and Statistical Physics, Brij lal & N Subramanyam (S. Chand Publisher).
5. Fundamentals of Statistical Mechanics, by B B Laud.

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH02 (3 Credit Course)
COURSE TITLE : Solid State Physics
(Effective from June 2019)

UNIT-1: Crystallography

Introduction, Lattice points and space lattice, The basics and crystal structure, Unit Cell, Unit Cell versus Primitive Cell, Unit Cell and lattice parameters, Crystal types, Two dimensional crystal lattice, Seven crystal system, Symmetry Operations (Translational, Point, & Hybrid), Metallic and common crystal structures, Relation between the density of crystal materials and lattice constants, Directions planes and Miller Indices of crystal planes, important features of Miller indices in a cubic crystal, separation between lattice planes in cubic crystal.

UNIT 2: Thermal properties of solids

Introduction, Force between atoms, Cohesion of atoms and cohesive energy, Calculation of cohesive energy, Calculation of lattice energy of ionic crystals, Calculation of Madelung constant of ionic crystals, The Born–Haber cycle, Bonding in solids, Primary Bonds (Covalent, Metallic, Ionic and Mixed), Secondary bonds (van der Waals and Hydrogen Bond), Properties of primary and secondary bonds, Wave mechanical concept of atom, Atomic size, Ionic radii, Empirical ionic radii, variation of ionic radii, Covalent radii, Metallic radii, van der Waals radii.

UNIT 3: Free electron theory of metals:

Introduction of free electron gas, the Drude-Lorentz theory, electrical conductivity of metals, thermal conductivity of metals, Lorentz modifications to Drude model, the Sommerfeld Model, the Fermi-Dirac distribution function, Quantum theory of free electrons in a box, free electron concentration, Number of electrons per energy interval at 0K, properties of a degenerate fermi gas at T>0K, electrical conductivity and Ohm's law, electronic specific heat, thermionic emission, escapes of electron from a metal.

UNIT 4: Band theory of solids

Introduction of band theory; Density of states; k-space; bloch wave; Bloch theorem; Kronig penney model; origin of energy gap; Brillouin Zones; number of possible wave functions per band; velocity of electrons according to band theory; influence of electric field; distinction between metals, insulators, and intrinsic semiconductors; direct experimental evidence for band structure.

Reference book:

1. Fundamentals of solid state physics, Saxena, Gupta, saxena, Pragati prakashan, Meerut
2. Solid state physics, R. K. Puri, V. K. Babbar (S. Chand publication)
3. Introduction of solid state physics (8^{th} edition), Charles Kittel (John wiley and sons).

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH03 (3 Credit Course)
COURSE TITLE : Mathematical Methods in Physics and FORTRAN – 1
(Effective from June 2019)

UNIT – 1 : Linear Equations : Vectors, Matrices and Determinants

Introduction to linear equations, Sets of linear equations, Row reduction, Determinants : Evaluating determinants, useful facts about determinants, Cramer's rule, Vectors : Notation, magnitude of a vector, addition of vectors, vectors in terms of components, multiplication of vectors, scalar product, angle between two vectors, perpendicular and parallel vectors, vector product, Lines and planes, Matrix operations, Matrix equations, transpose of a matrix, multiplication of matrix by a number, addition of matrices, multiplication of matrices, application of matrix multiplication

UNIT – 2 : Multiple Integrals : Applications of Integration

Introduction, double and triple integrals, Iterated integrals, Applications of integration : single and multiple integrals, change of variables in integrals : Jacobians, spherical and cylindrical coordinates, Jacobians, surface integrals

UNIT – 3 : FORTRAN Programming

Evolution of Fortran, evolution of Fortran 90, simple Fortran 90 programs, writing a program, input statement, some Fortran 90 program examples, numeric constants and variables, constants-integer constants, rule, examples, real constants, rule, examples, scalar variables, declaring variable names, implicit declaration, named constants, Arithmatic expressions : arithmetic operators and modes of expressions, integer expressions, real expressions, precedence of operations in expressions, examples of arithmetic expressions

UNIT – 4 : FORTRAN Programming

Assignment statements, defining variables, some problems due to rounding of real numbers, mixed mode expressions, intrinsic functions, examples of use of functions, input/output statements, list-directed input statements, list-directed output statements, Conditional statements, relational operators, the block IF construct, Implementing loops in programs, the block DO loop, count controlled DO loop, rules to be followed in writing DO loops, program examples.

Text Books:

1. Mathematical methods in the physical sciences, Mary L. Boas, John Wiley and Sons
2. Computer programming in FORTRAN 90 and 95, V. Rajaraman, Prentice Hall of India, New Delhi

Reference Books:

1. Mathematical methods in Physics, D. Biswas, New Central Book Agency (P) Ltd., Kolkata
2. Numerical Recipes in FORTRAN, the art of scientific computing, W. H. Press, S. A. Teukolsky, W. T. Vetterling, Brian P. Flannery, Cambridge University Press, Delhi.

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH04 (3 Credit Course)
COURSE TITLE : Process Instrumentation – 1
(Effective from June 2019)

Unit- 1 Temperature Measurement

Introduction, Temperature scales, International practical temperature scales (IPTS), Measurement of temperature, Non electrical methods, Bimetallic thermometer, Liquid-in-glass thermometer Pressure thermometer, Electrical methods: Electrical resistance thermometers, Thermistor, Pyrometer.

Unit- 2 Pressure Measurement

Introduction, Terminology, Pressure units and measuring instruments, Manometer, Manometric liquids, Advantages and disadvantages of manometers, Low pressure gauge: Mcleod gauge, Thermal conductivity gauge, Resistance thermometer (Pirani) gauge, Ionisation gauge, Measurement of High pressure, Cathode ray oscilloscope for varying pressure measurement.

Unit-3 Force and Torque Measurement

Introduction: force, work, torque and power with units, Force measurement: Scales and balances, Hydraulic load cell, Pneumatic load cell, Torque measurement: mechanical torsion meter, optical torsion meter and electrical torsion meter, Shaft power measurement (Dynamometers): Absorption dynamometers, Transmission dynamometers, driving dynamometers, Dynamometer characteristics.

Unit-4 Miscellaneous Measurement

Density and specific gravity, Specific gravity measuring methods: Pycnometer or specific gravity bottle method, Hydrometer method, Specific gravity balance method, Weight of fixed volume method, Differential-pressure method, Liquid level: Direct and indirect liquid level measurement, Electric liquid-level sensors, Viscosity, Humidity and moisture.

Reference book:

1. Instrumentation measurement and analysis   B C Nakra and K K Chaudhry
2. Mechanical measurements and control by D S KUMAR

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH05 (3 Credit Course)
COURSE TITLE : Thermal Physics and Remote Sensing
(Effective from June 2019)

UNIT 1 : Transmission of Heat

Introduction, Coefficient of thermal conductivity, Rectilinear flow of heat along a bar, Cylindrical flow of heat, Spherical shell method (Radial flow of heat), Searle's method, Lee and Charlton's method for bad conductors, Lee's method for liquids, Thermal Conductivity of rubber, Thermal Conductivity of glass

UNIT 2 : Radiation of Heat

Kirchoff's law, Stefan-Boltzmann's law, Wien's Displacement law (statement only), Rayleigh-Jeans law, Planck' radiation law, Derivation of Stefan's law, Derivation of Newton's law of cooling from Stefan's law, Experimental verification of Stefan's law, Determination of Stefan's constant (Laboratory Method), Disappearing filament optical pyrometer, Total radiation pyrometer, Solar Constant, The Green House Effect

UNIT 3 : Remote Sensing : Physical Basis of Signatures

Introduction, signature in the reflective OIR region, vegetation, soil, water and snow, signature in Thermal Infrared(TIR), signature in microwave region, vegetation, soil, water and snow

UNIT 4 : Remote Sensors – An Overview

Classification of remote sensors, selection of sensor parameters, spatial resolution, spectral resolution, location of spectral bands, radiometric resolution, radiometric quality, temporal resolution, the spacecraft, global positioning system

Text Books:

1. Heat, Thermodynamics and Statistical Mechanics, Brij Lal, N. Subrahmanyam and P S Hemne, S.Chand & Co. Ltd., New Delhi
2. Fundamentals of remote sensing, George Joseph, University Press, Hyderabad

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH06 (3 Credit Course)
COURSE TITLE : Introduction to 8085 microprocessor and control systems - 1
(Effective from June 2019)

Unit 1 Microprocessor-based systems: hardware and interfacing

A microprocessors as a programmable device, organization of microprocessor based system, machine language, assembly language, operating systems, microprocessor-controlled temperature system (MCTS), the 8085 hardware and programming model, instruction classification, instruction, data format and storage, microprocessor architecture and its operations, input and output devices, review devices for interfacing (tri-state device, buffer, decoder, encoder)

Unit 2 8085 microprocessor architecture and instructions

The 8085 microprocessor, demultiplexing the bus AD_7-AD_0, generating control signals, a detailed look at the 8085 MPU and its architecture, opcode fetch machine cycle, OUT instruction, IN instruction, data transfer operations, addressing modes, arithmetic operations, logic operations, branch operations

Unit 3 Discontinuous and continuous controllers

Discontinuous control system, ON-OFF control system, multi-position control system, floating control system (single-speed, multi-speed), continuous control system, proportional control system, integral control system, derivative control system, proportional-integral control system, proportional-derivative control system, proportional-integral-derivative control system

Unit 4 Miscellaneous control systems

Block diagram representation of process control systems, components of process control system, sensor and transmitters, transfer function of control system, open-loop control system, closed-loop control system, feedforward control system, cascade control system, ratio control system, analog and digital control system, linear and non-linear control systems

Text Books

1. Microprocessor architecture, programming and applications by Ramesh S. Gaonkar
2. Understanding 8085/8086 microprocessor and peripheral ICs through questions and answers by S. K. Sen
3. Process control instrumentation by Curtis Johnson
4. Industrial instrumentation and control by S. K. Singh

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH07 (2 Credit : 4 hours)
COURSE TITLE : Applied Physics Practicals
(Effective from June 2019)

List of Experiments :

1. Phage angle by C. R. O
2. Constants of ballistic galvanometer
3. Low resistance by ballistic galvanometer
4. e/m by Thomson method
5. Mutual inductance by Carey-Foster method
6. Maxwell's bridge
7. RC phase-shift oscillator
8. To study the charging and discharging of a capacitor in an LC circuit
9. 8085 microprocessor kit based experiments
    a. Introduction to 8085 μP kit
    b. Data transfer operations
    c. Arithmetic operations - I
    d. Logic operations

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH08 (2 Credit : 4 hours)
COURSE TITLE : Applied Physics Practicals
(Effective from June 2019)

List of Experiments :

1. Determination of velocity of sound using Resonating column of air.
2. Cardinal points of a lens system
3. Determination of the viscosity of a viscous liquid by Stoke's method
4. Newton's rings – determination of thickness of mica sheet
5. Spherical aberration of a plano-convex lens
6. Edser-Butler plate. To calibrate spectrometer
7. R. P. of Grating
8. Determination of wavelength using Biprism
9. R. P. of Telescope
10. Temperature measurement using Radiation Pyrometer
11. Computer based experiments using FORTRAN Programming.

SARDAR PATEL UNIVERSITY
SYLLABUS FOR APPLIED PHYSICS
B. Sc. SEMESTER – 5
APPLIED PHYSICS COURSE CODE : US05CAPH09 (2 Credit : 4 hours)
COURSE TITLE : Project Work (Applied Physics)
(Effective from June 2019)

PROJECT WORK BASED ON THE CONCEPTS OF APPLIED PHYSICS