KSKV KACHCHH UNIVERSITY

T. Y. B. Sc. PHYSICS Syllabus

(In force from June 2009)

PAPER VI

(Mathematical Physics, Quantum Mechanics, Classical Mechanics)

UNIT-I

Mathematical Physics

Coordinate System : Curvilinear coordinates; Orthogonal Curvilinear coordinates; Element of surface area; Volume element; Gradient in Orthogonal Curvilinear coordinates; Divergence in Orthogonal Curvilinear coordinates; Curl of a vector in Orthogonal Curvilinear coordinates; Rectangular Cartesian coordinates; Spherical polar coordinates; Cylindrical coordinates. (NO DERIVATIONS)

Ref. : Introduction to Classical Mechanics by – R.G. Takwale & P.S. Puranik
(Appendix A, Art. A.1 to A.9 & A.11)

Differential Equations : Some partial differential equations in Physics; The method of separation of variables; Separation of Helmholtz equation in Cartesian coordinates; Separation of Helmholtz equation in Spherical polar coordinates; Separation of Helmholtz equation in cylindrical coordinates; Laplace's equation in various coordinate systems.

Ref. : Mathematical Physics by – P.K. Chattopadhyay
(Chapter 2, Art. 2.1 & 2.2)

Second 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.

Ref. : Mathematical Physics by – P.K. Chattopadhyay
(Chapter 3, Art. 3.1 to 3.4)

Some Special Functions in Physics : Bessel functions; Legendre polynomials.

Ref. : Mathematical Physics by – P.K. Chattopadhyay
(Chapter 5, Art. 5.1 & 5.4)

UNIT-II

Quantum Mechanics

Exactly Soluble Eigenvalue Problems : (A) The Simple harmonic oscillator; (B) Angular momentum; (C) Three dimensional square well potential; (D) The Hydrogen atom; (E) Other problems in three dimensions.

Ref. : A Textbook of quantum mechanics by – P. M. Mathews & K. Venkatesan
(Chapter 4, Art. 4.1 to 4.4, 4.6 to 4.10, 4.13 & 4.14, 4.15 to 4.17, 4.20 & 4.21)

UNIT-III

Quantum Mechanics

Representations, Transformations and Symmetries : Quantum states, State vectors and Wave functions; The Hilbert space of state vectors, Dirac notation; Dynamical variables and linear operators; Representations; Continuous basis-The Schrodinger representation; Degeneracy, labeling by commuting observables; Change of basis, Unitary transformations; Unitary transformations induced by change of coordinate system : Translations; Unitary transformations; Unitary transformations induced by rotation of coordinate system; The algebra of rotation generators; Transformation of dynamical variables; Symmetries and conservation laws; Space inversion; Time reversal.

Ref. : A Textbook of quantum mechanics by – P. M. Mathews & K. Venkatesan
(Chapter 7, Art. 7.1 to 7.14)

UNIT-IV

Classical Mechanics

Lagrangian Formulation : Constraints; Generalised coordinates; D'Alembert's principle; Lagrange's equations; A general equation for kinetic energy; Symmetries and laws of conservation; Cyclic or ignorable coordinates; Velocity-dependent potential of electromagnetic field.

Ref. : Introduction to Classical Mechanics by – R.G. Takwale & P.S. Puranik
(Chapter 8, Art. 8.1 to 8.8)

Motion of a rigid body : Euler's theorem; Angular momentum and kinetic energy; The inertia tensor; Euler's equations of motion; Torque-free motion.

Ref. : Introduction to Classical Mechanics by – R.G. Takwale & P.S. Puranik
(Chapter 10, Art. 10.1 to 10.5)

UNIT-V

Classical Mechanics

Variational Principle : Lagrange's and Hamilton's Equations : Configuration space; Some techniques of calculus of variation; Applications of variational principle; Hamilton's principle; Equivalence of Lagrange's and Newton's equations; Advantages of Lagrangian formulation-electromechanical analogies; Lagrange's undetermined multipliers; Applications of the Lagrangian method of undetermined multipliers; Hamilton's equations of motion; Some applications of the Hamiltonian formulation; Phase space; Comments on the Hamiltonian formulation.

Ref. : Introduction to Classical Mechanics by – R.G. Takwale & P.S. Puranik
(Chapter 11, Art. 11.1 to 11.7 & 11.9 to 11.13)

T.Y.B.Sc.
PHYSICS PAPER – VII
MOLECULAR SPECTROSCOPY, SOLID STATE PHYSICS & STATISTICAL MECHANICS

UNIT – I

Born-Heimer Approximation Separation of electronic and nuclear motion, Types of molecular spectra,

PURE ROTATIONAL SPECTRA:

Salient features of rotational spectra, Molecular requirement for rotational spectra, Experimental arrangement. Molecule as a rigid rotator – Explanation of rotational spectra (without solving Schrodinger equation to get energy formula) , The non rigid rotator, Isotope effect.

VIBRATIONAL ROTATIONAL SPECTA

Salient features of vibrational rotational spectra, Molecule as a harmonic oscillator, Molecule as anharmonic oscillator, Molecule as vibrating rotator- Fine structure of infra red bands, Thermal distribution of vibrational and rotational levels.

UNIT – II

RAMAN SPECTRA

Nature of Raman spectra, Experimental arrangement of Raman spectra, Classical theory of Raman effect, Quantum theory of Raman effect, Raman spectra and molecular structure, Infra red spectra versus Raman spectra.

FLUORESCENCE AND PHOSPHORESCENCE

Luminescence, Mechanism of fluorescent emission, Mechanism of phosphorescent emission, Fluorescent spectrum compared with Raman spectrum.

CLASSIFICATION OF MOLECULAR ELECTRONIC STATES

Molecular electronic states, Symmetry properties of electronic eigen function.

Reference : Atomic And Molecular Spectra by Rajkumar.

UNIT – III

ELASTIC CONSTANTS AND ELASTIC WAVES

Analysis of elastic strains, Dilation, Stress components, Elastic compliances and stiffness constants. Elastic waves in cubic crystals, waves in [1 0 0] direction, waves in [1 1 0] direction, Experimental determination of elastic constants, Third order elastic constants.

SUPER CONDUCTIVITY

Experimental survey, Occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, Heat capacity, Isotope effect, Energy gap, Microwave and infra red properties.

UNIT – IV

FREE ELECTRON FERMI GAS – I

Energy levels and density of orbitals in one dimension, Effect of temperature on Fermi – Dirac distribution, Free electron gas in three dimension. Heat capacity of the electron gas. Experimental heat capacity of metals . Electrical conductivity and Ohm's law. Experimental electrical resistivity of metals . Thermal conductivity of metals . Ratio of thermal to electrical conductivity, Hall effect.

Reference : Introduction to Solid State Physics by C. Kittle

MAGNETIC FLUID

What are magnetic fluid? How are the magnetic fluid prepared?, What are the factors to be kept in view while preparing magnetic fluids?, Properties of Magnetic fluids, Applications of magnetic fluids.

Reference: Electronic Materials by P.D.S.VERMA

UNIT – V

BOSE-EINSTEIN STATISTIC

Failures and limitation of Maxwell-Boltzmann statistic. The Bose-Einstein statistic. Quantum statistic of a gas. The Einstein condensation. Plank's radiation formula from Bose-Einstein distribution.

FERMI-DIRAC STATISTIC

Introduction to Fermi-Dirac statistic, The Fermi-Dirac distribution formula. Calculation of constants. Comparison of three statistics. The Fermi function. Calculation of Fermi energy at absolute zero. Mean energy of an electron at absolute zero. Small effect of the electron gas on the heat capacity of metals. Thermonic emission (Dishman-Richardson Equation)

Reference : Elementary statistical Mechanics by
K. S. Nadgowda and A. V. Tankhiwale
Nagpur University, Nagpur.

T.Y.B.Sc.
PHYSICS PAPER – IX
NUCLEAR PHYSICS, BIO-PHYSICS & COMPUTER

UNIT – I

ALPHA RAYS : SPECTRA AND DECAY

Range of alpha particles, Disintegration energy of spontaneous alpha decay, Alpha decay paradox – Barrier penetration .

BETA RAYS

Introduction, Continuous Beta –ray spectrum - difficulties encountered to understand it, Pauli's Neutrino hypothesis, The detection of neutrino, Parity non-conservation in beta decay .

UNIT – II

GAMMA RAYS

Introduction, Gamma ray emission – selection rules – multipolarity in gamma transitions, Internal conversion, Nuclear Isomerism.

ELEMENTARY PARTICALES

Leptons, Hadrons, Elementary particle quantum numbers, Isospin, Quarks, History of universe .
(Reference : Concept of modern physics 4^{th} edition by A. Beiser)

UNIT – III

THE LIQUID DROP MODEL OF THE NUCLEUS

Introduction, Binding energies of nuclei – plot of B/A against A, Weizsacher's semi empirical mass formula, Mass parabolas : Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission, Nucleon emission .

UNIT – IV

NUCLEAR ENERGY

Introduction, Neutron induced fission, Asymmetrical fission – mass yield, Emission of delayed neutrons by fission fragments, Energy released in the fission of ^{295}U, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor, Nuclear reactors .

NUCLEAR PHYSICS IN OTHER AREAS OF PHYSICS

Introduction, The technique of NMR, Some experiments with NMR, The Mossbauer effect, Some experiments using Mossbauer effect.

Reference : Nuclear Physics An Introduction by S.b.Patel

UNIT – V

BIOPHYSICS

What is biophysics?, Resting and Action potential ,Propagation of action potential, The bioelectric potential, The electrocardiogram (ECG), Electroencephelogram (EEG), Electro myogram (EMG), Other bioelectric potentials.

ELECTRODES

Introduction, Biopotential electrodes, Microelectrodes, Body surface electrodes, Needle electrodes.

Reference : (1)Biomedical Instrumentation & Measurement by L.Cromwell, F.J.Weibell Prentice Hall of India Pvt Ltd.
(2) Biophysics by Pattabhi & Gautham

COMPUTER

Complete chapters 3 & 4 of **Programming in ANSI C** 2nd edition by **E. Balaguruswamy**

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(In force from June 2009)

PAPER X

(Electronics)

UNIT-I

General Amplifier Characteristics:

Introduction; Concept of amplification; Amplifier notations; current gain; voltage gain; power gain; Amplifier input resistance; Amplifier output resistance; Maximum power transfer; Conversion efficiency; Classes of amplifier operation; Harmonic distortion; Three point method of calculating harmonic distortion; Five point method of calculating harmonic distortion; Measurement of harmonic distortion; Other types of amplifier distortion; DeciBels; Other equations for DeciBel computation; Zero dB reference level; Use of voltmeter as dB indicator; Voltmeter range correction factor; Impedance correction factor; Frequency response curve; Amplifier band width; Phase relationship in amplifier; Square wave testing.

Ref. : Electronic devices and circuits by - A. Mottershead
(Chapter 7, Art. 7.0 to 7.13, 7.15 & 7.16, 8.1 to 8.8, 8.10 & 8.11)

Negative Feed back in Transistor Amplifier

Introduction; General theory of feed back; Reason for negative feed back; Loop gain; Types of negative feed back in transistor circuits; Darlington connection; Biasing the Darlington amplifier.

Ref. : Electronic devices and circuits by - A. Mottershead
(Chapter 17, Art. 17.0 to 17.6)

Transistor Oscillators

Introduction; Effect of positive feed back; requirements for oscillation; Phase shift oscillator; Resonant circuit oscillators; The Colpitts oscillator; The Hartley oscillator.

Ref. : Electronic devices and circuits by - A. Mottershead
(Chapter 18, Art. 18.0 to 18.3 & 18.6)

UNIT-II

Low Frequency Response of a Transistor Amplifier

Effect of an emitter bypass capacitor on low frequency response; Effect of a coupling capacitor on low frequency response; Cascading of CE stages, mid frequency gains; Low frequency response of cascaded stages; Amplifier low frequency response to a square wave; Transformer coupled transistor amplifiers; Low frequency response of a transformer coupled amplifier; Step response of a transformer coupled amplifier.

Ref. : Electronic devices and circuits by - A. Mottershead
(Chapter 15, Art. 15.0 to 15.8)

High Frequency Response of a Transistor Amplifier

Introduction; High frequency model for the common emitter amplifier; Approximate CE high frequency model with a resistive load; CE short circuit current gain; High frequency current gain with a resistive load; High frequency response of cascaded CE stages; Amplifier high frequency response to a square wave; High frequency response of a transformer coupled amplifier.

Ref. : Electronic devices and circuits by - A. Mottershead
(Chapter 16, Art. 16.0 to 16.7)

UNIT-III

Circuit Analysis and Design

Boolean laws and theorem; Sum of products method; Truth table to Karnaugh map; Pairs, quads and octets; Karnaugh simplifications; Don't care conditions; Product of sums method; Product of sums simplification; Exclusive OR gates.

Ref. : Digital Principles and Applications by – Malvino and Leach
(Chapters 2 & 3, Art. 2.1 to 2.8 & 3.7)

Number systems and Codes

Hexadecimal numbers; The ASCII code; The Excess 3 code; The Gray code.

Ref. : Digital Principles and Applications by – Malvino and Leach
(Chapter 4, Art. 4.5 to 4.8)

Arithmetic Circuits

Binary addition; Binary subtraction; Unsigned binary numbers; Sign-magnitude numbers; 2's compliment representation; 2's compliment arithmetic; Arithmetic building blocks; The adder – subtracter; Binary multiplication and division; Digital comparator; Decoder; Demultiplexer; Data selector; Encoder.

Ref. : Digital Principles and Applications by – Malvino and Leach
(Chapter 5, Art. 5.1 to 5.9)

UNIT-IV

Network Transformations

Principle of duality; Reduction of a complicated network; Conversion between T and π sections; The bridged-T network; Lattice network; The reciprocity theorem; The compensation theorem; Driving point impedance; Transfer impedance; Parallel T network.

Ref. : Networks, Lines and Fields by – J. D. Ryder
(Chapter 1, Art. 1.3 to 1.7, 1.9, 1.12, 1.14, 1.17)

Resonance

Definition of Q, the factor of merit; Series resonant circuit; Band width of the series resonant circuit; Parallel resonance; Conditions for maximum impedance; Currents in anti resonant circuits; Impedance variation with frequency, universal resonance curves; Band width of anti resonant circuits.

Ref. : Networks, Lines and Fields by – J. D. Ryder
(Chapter 2, Art. 2.1 to 2.8)

UNIT-V

Operational Amplifiers

The basic operational amplifier; The differential amplifier; Offset error voltages and currents; Temperature drift of input offset voltage and current; Measurement of operational amplifier parameters; Basic operational amplifier applications; Differential dc amplifier.

Ref. : Integrated Electronics by – Millman and Halkias
(Chapters 15 &16, Art. 15.1, 15.2, 15.6 to 15.8, 16.1, 16.2)

Amplitude Modulation

Introduction; Amplitude modulation; Amplitude modulation index; Modulation index for sinusoidal AM; Frequency spectrum for sinusoidal AM; Average power for sinusoidal AM; Effective voltage and current for sinusoidal AM; Amplitude modulator circuits; Amplitude demodulator circuits.

Ref. : Electronic Communications by – Roddy and Coolen
(Chapter 8, Art. 8.1 to 8.7, 8.10, 8.11)

Cathode Ray Oscilloscope

Cathode ray oscilloscope; Cathode ray tube; Electron gun; Deflecting plates; Screen; Methods of focusing; Deflection systems; Mathematical expression for electrostatic deflection; Electromagnetic deflection system; Magnetic deflection in CR tube; Time base; Cathode ray oscilloscope; Wave form tracing in electrostatic CRO; Uses of Cathode ray oscilloscope.

Ref. : Electronics and Radio Engineering by – M. L. Gupta
(Chapter 36, Art. 36.1 to 36.11, 36.17 to 36.19)

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T. Y. B. Sc. PHYSICS PRACTICALS

(In force from June 2009)

UNIT – I

(1) Acceleration due to gravity by Keter's pendulum (fixed knife edges).
(2) Acceleration due to gravity by Keter's pendulum (movable knife edges).
(3) e/k by power transistor.
(4) To determine coefficient of thermal conductivity of rubber tube.
(5) Study of thermocouple.
(6) Viscosity by Log decrement method.
(7) Stefan's constant for radiation.
(8) Computer Programming "C ".

UNIT – II

(1) Refractive index by total internal reflection using Gauss eye piece.
(2) Febry Parot etalon – determination of thickness of air film.
(3) Michelson interferometer – to determine the wavelength of light.
(4) Michelson interferometer – to determine wavelength difference.
(5) I–V characteristic of solar cell - to find fill factor and voltage factor.
(6) To study the Edser – Butler Bands .
(7) To determine the wavelength of monochromatic light using Bi-Prism.
(8) Dielectric constant of a liquid.

UNIT – III

(1) Hysterisis by Magnetometer.
(2) Comparison of capacitances by Mixture method.
(3) Determination of capacitance by Schering bridge.
(4) Self inductance of coil by Rayleigh's method.
(5) Mutual inductance by Ballistic galvanometer.
(6) Measurement of phase and frequency by C.R.O.
(7) Characteristics of GM tube.
(8) Passive Filters.

UNIT – IV

(1) Hartley oscillator – Measurement of frequency by CRO.
(2) Colpitt oscillator – Measurement of frequency by CRO.
(3) Parallel resonance – Determination of band width and Q- factor.
(4) Series resonance – Determination of band width and Q- factor.
(5) Half adder and full adder.
(6) OP AMP inverting / non inverting amplifier.
(7) To Study the C.E. Amplifier Circuit.
(8) Series voltage regulator.