Academic Council

Item No: _____

Devrukh Shikshan Prasarak Mandal's

Nya. TATYASAHEB ATHALYE ARTS, Ved. S.R. SAPRE COMMERCE & Vid. DADASAHEB PITRE SCIENCE COLLEGE, DEVRUKH [AUTONOMOUS]

Syllabus for S.Y. B.Sc.
Program: B.Sc.
Course: Physics
Credit Based Semester and Grading System with the Effect from
Academic Year 2020-21

Syllabus for B.Sc. Physics (Theory and Practical)
As per credit based system
Second Year B.Sc.2020–2021.

The revised syllabus in Physics as per credit based system for the Second Year B.Sc. Course will be implemented from the academic year **2020–2021.**

Preamble:

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.

Objectives:

- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hands on activities, study visits, projects etc.

Course code	Title	Credits
Semester III		
USPHT31	Mathematical Physics, Optics and Thermodynamics	2
USPHT32	Electronics and Nuclear Physics	2
USPHT33	Classical Physics and Basics of Quantum Mechanics	2
USPHP3	Practical I	3
		Total= 09
Semester IV		
USPHT41	Electrodynamics, Optics and Thermodynamics	2
USPHT42	Electronics and Communication	2
USPHT43	Classical Physics and Quantum Mechanics.	2
USPHP4	Practical II	3
		Total=09

Semester – III
Paper – I

Unit – I

1. Derivatives and integration techniques.

2. Vector Calculus:

   The □ operator, Definitions and physical significance of Gradient, Divergence and Curl, Problems based on Gradient, Divergence and Curl.

3. Differential equations**:**
   Introduction, order and degree, Ordinary differential equations, First order homogeneous and non- homogeneous equations with variable coefficients, Exact differentials, General first order Linear Differential Equation.

Unit – II

1. Polarization:
   Concept and types of polarization, Un-polarized, Plane polarized and Partially polarized light, Polarization by reflection and Brewster's law, Various methods of production of polarized light, Polarization by refraction –pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction, Polarizer and Analyzer, Malus' Law, Anisotropic crystal, Optic Axis, Double refraction, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Nicol Prism, theory of superposition of e-Ray and o-Ray, Retarders, Quarter wave plate, Half wave plate, Production of linearly polarized light, Production of elliptically /circularly polarized light, Analysis and applications of polarized light.

2. Interference:
   Michelson's interferometer, Formation of circular fringes, applications. Fabry Perot Interfeometer, Formation of fringes and applications.

Unit – III

Conversion of heat into work, heat engine, Carnot's cycle: its efficiency.
Second law of thermodynamics, Statements, Equivalence of Kelvin and Plank statement, Carnot's theorem, Reversible and irreversible process, Absolute scale of temperature.
Otto engine, Efficiency of Otto cycle, Diesel cycle, Efficiency of Diesel cycle, Otto and diesel comparison

References:

1. MS:Murray R Spiegel, Schaum's outline of Theory and problems of Vector Analysis, Asian Student Edition.
2. CH: Charlie Harper, Introduction to Mathematical Physics , 2009 (EEE) PHI Learning Pvt. Ltd.

3. A Text Book Of Optics By: Dr.N.Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (S.Chand, 25th Revised edition2012 Reprint 2013).
4. Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008, 2009.
5. Heat thermodynamics and Statistical Physics, Brijlal, N.Subramanyam, P. S. Hemne, S. Chand, edition 2007.

Semester – III
Paper – II

Unit – I

1. Transistor biasing, inherent variations of transistor parameters, stabilisation, essentials of a transistor biasing circuit, stability factor, methods of transistor biasing, base resistor method, emitter bias circuit, circuit analysis of emitter bias, biasing with collector feedback resistor, voltage divider bias method, stability factor for voltage divider bias.

2. General amplifier characteristics: concept of amplification, amplifier notations, current gain, voltage gain, power gain, input resistance, output resistance, general theory of feedback, reasons for negative feedback, loop gain.
3. Practical circuit of transistor amplifier, phase reversal in CE amplifier, frequency response, decibel gain and bandwidth.

Unit – II

1. Alternating current theory: (Concept of L, R, and C: Review) AC circuit containing pure R, pure L and pure C, representation of sinusoids by complex numbers, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in AC circuit. Q-factor.
2. Transformer – Construction, principle, types, equation and application.
3. AC-bridges: General AC bridge, Maxwell, de-Sauty, Wien Bridge.

Unit – III

1. Interaction between particles and matter, Ionization chamber, Proportional counter and GM counter, problems
2. Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, problems. Fusion and fission definitions and qualitative discussion with examples.

References:

1. Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand –Multicoloured illustrative edition).
2. Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – Reprint – 2013).
3. Kaplan: Nuclear Physics, Irving Kaplan, 2nd Ed. Narosa Publishing House
4. SBP: Dr. S. B. Patel, Nuclear Physics Reprint 2009, New Age International

Semester – III
Paper – III

Unit – I

1. Compound pendulum:
   Expression for period, maximum and minimum time period, centres of suspension and oscillations, reversible compound pendulum. Kater's reversible pendulum, compound pendulum and simple pendulum- a relative study.

2. Damped Vibrations: Decay of free vibrations of a simple harmonic oscillator due to the damping force proportional to the first power of velocity, types of damping, Energy of a damped oscillator, logarithmic decrement, relaxation time and quality factor.

3. Forced vibration and resonance: Forced damped harmonic oscillator, special cases: low driving frequency, high driving frequency, Resonance. Quality factor of a driven oscillator.

Unit – II

1. Origin of Quantum Mechanics:
   Review of Black body radiation, Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty, concept of wave function, Born interpretation of wave function, concepts of operator in quantum mechanics examples – position, momentum and energy operators, eigenvalue equations, expectation values of operators, schrodinger equation, postulates of Quantum Mechanics, analogy between wave equation and schrodinger equation, time dependent and time independent (steady state) Schrodinger equation, stationary states, superposition principle, probability current density, equation of continuity and its physical significance.

Unit – III

1. Charged particle dynamics:
   Force on charged particle in electric and magnetic field, equation of motion, motion of a charged particle in a constant and uniform electric field, Charged particle in a uniform and constant magnetic field. Motion of a charged particle in parallel electric and magnetic fields, helical motion and pitch, Velocity selector, cyclotron.

References:

1. Resnick and Halliday : Physics – I
2. Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.)
3. Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill.
4. Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.
5. Mechanics and Electrodynamics Rev Edn. 2005 by Brijlal and Subramanyan and Jeevan Seshan

Experiments

Group A

1. Error calculations in an experiment
2. Circuit connections using Breadboard
3. Spectrometer – Schuster's Method
4. RI by spectrometer
5. RI of liquid using Newton's Rings
6. Thermal conductivity by Lee's method
7. Brewster's Law
8. J by electrical method

Group B

1. Use of CRO
2. Bridge Rectifier – Ripple (with and without C filter)
3. Zerner Regulator
4. Effect of temperature on BJT
5. LCR series resonance
6. LCR parallel resonance
7. CR AC circuit
8. De Sauty's Bridge

Group C

1. Y by vibration
2. Logarithmic Decrement
3. MI of Lamina
4. Jager's Method – Surface Tension
5. Resonance Pendulum
6. Flat Spiral Spring
7. C by BG
8. High/Low Pass filters

Semester – IV
Paper – I

Unit – I

1. Curvilinear Coordinates: Cylindrical Coordinates, Spherical Coordinates.
2. Product rules and second derivatives involving the ∇ operator, Line, Surface and Volume Integrals, The Fundamental Theorems of Gradient, Divergence and Curl.
3. Second-order linear homogeneous differential equations with constant coefficients. Step response of LCR circuit, SHM

Unit – II

1. Fresnel's Diffraction:
Fresnel's assumptions, Half period zones, Fresnel diffraction due to straight edge, intensity pattern, Positions of maxima and minima, Fresnel diffraction due to a narrow slit and a narrow wire.

2. Fraunhoffer Diffraction:
Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at a double slit, missing orders, Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima.

3. Resolving Power:
Concept of resolution of two objects and two closely spaced wavelengths, limiting angle of resolution and resolving power, Rayleigh's criterion, resolving power of optical instruments - telescope, prism, plane transmission grating.

Unit – III

Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, generalized form of first and second law, entropy change of an ideal gas, entropy of steam, entropy and unavailable energy, entropy and disorder, absolute entropy.

References:

1. Introduction to Electrodynamics 3rd Ed by D.J. Griffith.
2. CH: Charlie Harper, Introduction to Mathematical Physics , 2009 (EEE) PHI Learning Pvt. Ltd.
3. A Text Book Of Optics By: Dr. N. Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (S. Chand, 25th Revised edition 2012 Reprint 2013).
4. Ajoy Ghatak: OPTICS (5thedition)
5. Heat thermodynamics and Statistical Physics, Brijlal, N.Subramanyam, P. S. Hemne, S. Chand, edition 2007.
6. Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008, 2009.

Semester – IV
Paper – II

Unit – I

1. Sinusoidal Oscillators: Introduction, effect of positive feedback. Requirements for sustained oscillations, phase shift oscillator, Wien Bridge Oscillator, Colpitt's oscillator, Hartley oscillator

2. Operational Amplifiers: Introduction, Characteristics, Comparator operation, OPAMP as amplifier, Negative feedback, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier, Difference amplifier, Integrator and Differentiator.

Unit – II

1. Unsigned binary numbers, Sign-magnitude, 1's complement , 2's complement, Converting to and from 2's complement representation , 2's complement arithmetic, Half and full adder, adder-subtractor

2. RS Flip-Flops (only NOR gate latch, NAND gate latch) , Gated Flip-Flops, Edge-Triggered RS Flip-Flop, Edge- Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master- Slave Flip-Flops, Bounce elimination switch

3. Types of registers, Shift registers : SISO, SIPO, PISO, PIPO

4. Asynchronous counter 4-bit ripple counter in up/down modes, Synchronous counter only mod 8, Decade Counters mod-3, Mod5 and Mod10, shift counter

Unit – III

1. Basics of Communication
   Block diagram of communication system, types of communication system: simplex, duplex, analog and digital communication, Electromagnetic spectrum, base band and broad band communication. Noise concept and types, signal to noise ratio, noise figure, noise temperature.

2. Amplitude Modulation
   Need of modulation, concept of modulation, AM waveform, mathematical expression of AM, concept of sideband, demodulation principles. AM Receiver: TRF and super-heterodyne receiver,

3. Frequency Modulation
   Definition, mathematical representation, frequency spectrum, bandwidth and modulation index,
4. Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM.

References:

1. Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand –Multicoloured illustrative edition).
2. Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – Reprint – 2013).
3. LMS – Digital Principles and AplicationsBy Leach, Malvino, Saha 6thedn.

4. TF – Digital Fundamentals by Thomas L Floyd 10thedn. (Additional Reading)
5. RPJ – Modern Digital Electronics by R P Jain 4thedn. (Additional Reading)
6. Communication Electronics: Principles and applications by Louis E Frenzel 3rd edition TMH Publications.
7. Electronics Communication Systems by Kennedy.
8. Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication.

Semester – IV
Paper – III

Unit – I

Center of mass, motion of the center of mass, linear momentum of a particle, linear momentum of a system of particles, linear momentum w.r.t. CM coordinates (shift of origin from Lab to CM), conservation of linear momentum, some applications of principle of conservation of momentum, system of variable mass – motion of rocket
Torque acting on a particle, angular momentum of a particle, angular momentum of system of particles, total angular momentum w.r.t. CM coordinates, conservation of angular momentum

Unit – II

Applications of Schrodinger equation - I

Free particle, Particle in infinitely deep potential well (one – dimension), Particle in finitely deep potential well (one – dimension), Particle in two / three dimension rigid box, degeneracy of energy state

Unit – III

Applications of Schrodinger equation - II
Step potential, Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability), Theory of alpha particle decay from radioactive nucleus, Harmonic oscillator (one-dimension), correspondence principle.

References:

1. Resnick and Halliday : Physics – I
2.Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.)
3.Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill.
4.Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.
5. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
6. Quantum Mechanics. - By L. I. Schiff.

Experiments

Group A

1. Wavelength of LASER by grating
2. Wavelength of Hg lines using grating
3. RI of liquid by LASER and grating
4. RP of Telescope
5. Cylindrical Obstacle
6. Biprism
7. Stephan's Law – Electrical method
8. Band Pass Filter

Group B

1. Half / Full Adder
2. MS JK FF and ripple counter
3. Mod 2, 5, 10 counter
4. OPAMP – Comparator
5. OPAMP - Inverting Amplifier
6. Shift Registers
7. Amplitude / Frequency Modulation
8. Colpitt's Oscillator

Group C

1. OPAMP – Non-Inverting Amplifier and Voltage follower
2. OPAMP – Difference Amplifier
3. Square wave generator using logic gates
4. LCR oscillatory charging of capacitor
5. Magnetization curve
6. ExpEyes Experiment
7. Lissajous figure using CRO
8. Flat Spiral Spring