

**Bajaj College of Science, Wardha (Autonomous)**  
**Syllabus for B. Sc. I (SEM-I) w.e.f. Session 2021-22**  
**Physics I (BCSPHYT101)**

**Unit I: Kepler's Law and Gravitation [10h]**

Gravitation: Newton's law of gravitation, Relation between  $G$  and  $g$ , Gravitational field, Gravitational potential, Escape velocity, Kepler's laws of planetary motion, Satellite in circular orbit and applications. Geosynchronous orbits, Relation between Mass and Gravity of different celestial object, Relation between Mass and Escape Velocity of different celestial object, Communication Satellite.

**Unit II: Astrophysics [10h]**

Astrophysics: The constituents of universe (Solar system, Stars, Galaxies), Types of Galaxies, size of a planet ( $d=D.\alpha$ ), distance of a planet by parallax method ( $D=b/\theta$ ), Mass of the sun and the planets ( $M=4\pi^2r^3/GT^2$ ), Structure of sun and Solar interior, surface temperature of sun ( $T=[R/r]^{1/2} \cdot [S/\sigma]^{1/4}$ ) and Solar luminosity, Stellar spectra. The Milky Way (shape, size, clusters), Death of Star (Red Giant, White Dwarf, Nova, Neutron Star, Supernova, Black Hole), Gravitational Waves, LIGO.

**Unit III: Free oscillations, Damped oscillations and Forced oscillations [10h]**

**Free oscillations:** Introduction to linear and angular S.H.M., Composition of two perpendicular linear SHMs for 1:1 and 1:2 (without mathematical derivation), Lissajous's figure, Formation of Lissajous's figure using CRO, applications of Lissajous's figure.

**Damped oscillations:** Differential equation of damped harmonic oscillator and its solution, Energy equation of damped oscillations, Power dissipation and quality factor.

**Forced oscillations:** Forced oscillation with one degree of freedom, Differential equation of forced oscillation and its solution, Resonance (Amplitude), Sharpness of resonance, Power dissipation, Quality factor and bandwidth.

**Unit IV: Elasticity [10h]**

Introduction, Hooke's Law, Different elastic constants, Relation between elastic constants  $Y$ ,  $K$ ,  $\eta$  and  $\sigma$ , Elastic Limit, work done in stretching a wire, bending of beam, bending moment, Internal and external bending moment, Cantilever, Torsional pendulum, Maxwell's needle, Modern applications of Elasticity: Hanging/Suspension bridges, Modern cranes.

**Unit V: Viscosity and Surface Tension [10h]**

Introduction, Streamline and turbulent flow, Equation of continuity, Bernoulli's theorem and its applications, Poiseuille's Law, Reynold's number, Terminal Velocity, Stoke's law, Variation of viscosity with temperature, Introduction of Surface Tension, Angle of contact and wetting, Surface energy, Surface tension by Quincke's and Capillary rise methods, Modern applications of Viscosity and Surface Tension: Hydrophobic surfaces, Fluid Merging Viscosity Measurement.

**Unit VI: Electrostatics, Dielectrics and Capacitor [10h]**

Introduction (Qualitative idea only), Coulombs law in vacuum in vector form, Force between two charges, Electric Field Intensity, Electric potential, Electric potential Energy, Electric Dipole and dipole moment, Electric field intensity due to a dipole, Conservative nature of electrostatic field, Electric field as a negative gradient of potential, Introduction, Definition of polar and non-polar molecules, Polarization of charges in a dielectric, Three electric vectors  $D$ ,  $E$  and  $P$  and relation between them, Claussius-Mossotti equation, Concept of capacitance, Parallel plate capacitor without and with dielectric, super capacitor.



## Laboratory – 1

(BCSPHYP101)

### List of the Experiments (Any 10) [40h]

1. To determine the Young's modulus (Y) by bending of beam.
2. To determine the Young's modulus (Y) by cantilever.
3. To determine the modulus of rigidity ( $\eta$ ) by Maxwell's needle.
4. To determine the modulus of rigidity ( $\eta$ ) by statical method.
5. To determine the modulus of rigidity ( $\eta$ ) by torsional pendulum.
6. To determine the surface tension (T) of the liquid by Fergusson method.
7. To determine the surface tension (T) by capillary rise method.
8. To determine the coefficient of viscosity ( $\eta$ ) by using Poiseuille's method.
9. To determine the dielectric constant of a material.
10. To calculate the acceleration due to gravity by compound pendulum.
11. To study the Lissajous's figure.
12. To study the spring constant of a spring.
13. To calculate the solar constant.
14. To determine the resolving power of telescope.
15. To determine the terminal velocity using Stoke's law.

### Reference Books for Theory:

1. University Physics: Young, XIth edition, Pearson Education.
2. Concepts of Physics: H.C. Verma, Bharati Bhavan Publishers.
3. Fundamental of Physics (Eighth Edition), Halliday/Resnick/Walker; Wiley.
4. Mechanics: D.S. Mathur, S. Chand and Company.
5. Physics for Degree Students, C.L. Arora, P.S. Hemne, S Chand Publication.
6. Unified Physics, B.Sc. I by R.P. Goyal.
7. Waves and Oscillations, by Stephenson.
8. A Text Book of Oscillations, waves and Acoustics, by Dr. M. Ghosh, Dr. D. Bhattacharya.
9. Oscillation, waves and sound, by Sharma and Saxena.
10. Waves and oscillation, by N. Subrahmanyam and Brijlal.
11. The Physics of waves and oscillation, by N. K. Bajaj, Tata McGraw-Hill, publishing co. ltd.
12. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
13. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VIth Edition. Pearson Education /Prentice Hall International, New Delhi.
14. General Properties of Matter, by- J. C. Upadhyay, Ram Prasad & Sons.
15. Mechanics, by-B. M. Roy, Das Ganu Publications.
16. The Great Universe, by G. K. Sasidharan, S Chand publications.
17. Astronomy structure of the universe, by- A. E. Roy, D. Clarke, Adam Hilger Pub.

### Reference Books for practicals:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, Asia Publication House.
2. A text book of Practical Physics, Induprakash and Ramakrishna, 11th edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th edition, reprinted 1985, Heinemann Education Publishers.
5. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication House, New Delhi.

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**Bajaj College of Science, Wardha (Autonomous)**  
**Syllabus for B. Sc. I (SEM-II) w.e.f. Session 2021-22**  
**Physics II (BCSPHYT102)**

**Unit I: Electric Current and Electromagnetic Induction [10h]**

Electric Current: Current Density, Equation of continuity, Kirchhoff's laws, Rise and Decay of currents in LR circuit, Rise and Decay of charge in CR, Decay of charge in LCR.

Electromagnetic induction: Faraday's laws, Lenz's law, self-induction and mutual induction.

**Unit II: a.c. circuits [10h]**

Transformer: Theory, Principle of working and its applications.

Application of complex number in solving an a.c. circuit, j-operator method: a.c. applied to pure resistive circuit, a.c. applied to pure capacitive circuit, a.c. applied to pure inductive circuit, a.c. applied to LR circuit, a.c. applied to CR circuit, a.c. applied to series LCR circuit, a.c. applied to parallel LCR circuit. Power in a.c. circuit, wattless current, power factor (PF).

**Unit III: Magnetostatics [10h]**

Force on a moving charge, Lorentz force equation and definition of B, force on a straight conductor carrying current in a uniform magnetic field, torque on a rectangular current loop, Biot-Savart's law: Calculation of B for straight conductor, circular coil. Ampere's Law and its applications for the magnetic field for solenoid and toroid. Non-existence of magnetic monopole.

Field due to a magnetic dipole, free and bound currents, Magnetic dipole moment, angular momentum and gyromagnetic ratio. Magnetization vector (M), relationship between B, H and M. Magnetic susceptibility and permeability relationship.

**Unit IV: Magnetism [10h]**

Introduction of dia, para and ferro-magnetic materials. Langevin's theory of diamagnetism, its application as superconductor, critical magnetic field and Meissner effect, classical Langevin's theory of paramagnetism (without derivation), ferromagnetism, ferromagnetic domain, Curie-Weiss Law, curie temperature, Anti-ferromagnetism, Neel temperature ferrimagnetism, ferrites and its applications, Hysteresis loss (B-H curve).

**Unit V: Kinetic theory of gases and Transport phenomenon in gases [10h]**

Kinetic theory of gases: assumptions, Boyle's law, equipartition of energy and its applications to specific heat of gases; monatomic and diatomic gases, molecular collision, mean free path and collision cross section, estimate of molecular diameter and mean free path.

Transport phenomenon in gases: Transport of mass, momentum, energy and their relationship,

dependence on temperature and pressure, Vander Waal's gas (Real gas, Equation of state), critical constants.

#### **Unit VI: Thermodynamics [10h]**

Zeroth Law of thermodynamics, first law of thermodynamics, conversion of heat into work, applications of first law, work done during isothermal and adiabatic processes, reversible & irreversible processes, second law & entropy, third law of thermodynamics, unattainability of absolute zero, Carnot's cycle, Carnot's theorem, entropy changes in reversible & irreversible processes, entropy temperature (TS) diagrams, Maxwell's relations & applications - Joule-Thomson Effect, Clausius Clapeyron Equation.

#### **Reference Books for Theory:**

1. University physics, by H. D. Young, R. A. Freedman: Pearson
2. Electricity and Magnetism, by Satya Prakash: Pragati Prakashan
3. Basic Electrical Engineering, B.L. Thareja: S. Chand
4. Electricity and Magnetism: B. Ghosh: Books and Allied Publisher
5. Heat, Thermodynamics and Statistical Physics by Singhal, Agrawal: Pragati Prakashan
6. Heat, thermodynamics and statistical physics by Brijlal, Subramayam and Hemne: S. Chand

### **Laboratory – 2** **(BCSPHYP102)**

#### **List of Experiments: (Any 10) [40h]**

1. To determine the time constant ( $\tau$ ) of CR circuit.
2. To determine the unknown inductance (L) using series LR circuit.
3. To determine the unknown capacitance using series CR circuit.
4. To determine the frequency of a.c. mains ( $n$ ) using Fleming's left hand rule.
5. To determine the quality factor (Q) of a series LCR a.c. circuit.
6. To study the characteristics of a transformer.
7. To determine ( $\gamma$ ) ratio of specific heats of gas by Clement and Desorm's method.
8. To determine the thermal conductivity of a bad conductor by Lee's disc method.
9. To determine the horizontal component of Earth's magnetic field and magnetic moment of the magnet.
10. To study the variation of magnetic field along the axis of a current carrying circular coil.
11. To study of magnetic field by vibration magnetometer.
12. To determine the magnetic susceptibility of  $\text{FeCl}_3$  solution.
13. To calculate the mechanical equivalent of heat by Calender and Barn's constant flow method.



14. To study the variation of total thermal radiation with temperature using the torch bulb filament.

**Reference Books for Practicals:**

1. Advanced Practical Physics for students by B.L. Flint & H.T. Worsnop: Asia Publishing House.
2. A Text Book of Practical Physics by Indu Prakash and Ramakrishna: Kitab Mahal, New Delhi.
3. Physics through experiments by B Saraf et. al. : Vikas Publications.
4. Advanced practical physics by Chauhan & Singh: Pragati Prakashan.
5. Practical Physics by D. Chattopadhyaya et al: Central Publications.



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## **Bajaj College of Science, Wardha (Autonomous)**

### **Syllabus for B.Sc. II (Sem III) w.e.f. 2022-23**

#### **Physics III (BCSPHYT203)**

##### **Unit I: Waves, Sound and Architectural Acoustics [10h]**

Waves: Speed of transverse wave along a string, formation of standing waves, transverse stationary vibrations of strings and harmonics, longitudinal vibrations in a gas column: open and closed at one end.

Sound: Mechanism of hearing, Quality of sound, Intensity and loudness, bel and decibel, music, musical scales (diatonic and tempered), types of musical instrument.

Architectural Acoustics: Acoustics of building, reverberation and reverberation period, Sabine's formula, factors affecting the acoustics of building, requirements for good acoustics.

##### **Unit II: Electro- Acoustics, Ultrasonics and Power Supply [10h]**

Applied electro-acoustics: Transducers and their characteristics, microphones, loudspeakers.

Ultrasonics: Properties and production of ultrasonic waves, piezoelectric effect, piezoelectric generator, magnetostriction effect and oscillators, frequency of ultrasonic waves, applications of ultrasonic waves (measurement of depth of sea, SONAR system and medical science).

Power supply: Introduction, rectification using half wave and full wave rectifiers ( $I_{d.c.}$ ,  $V_{d.c.}$ ,  $I_{r.m.s.}$ ,  $\eta$  and ripple factor), Working of Full wave bridge rectifier, filters, difference between regulated and unregulated power supply, line and load regulation, voltage stabilization, Zener diode as voltage regulator, Voltage regulation using IC, applications of voltage regulation.

##### **Unit III: Geometric Optics and Interference of light [10h]**

Thick lens, thin lens and lens combinations, Eyepieces (Ramsden's and Huygen's).

Interference in equal thickness thin film, phase change on reflection, refraction, and transmitted system. Newton's ring and its application to determine the wavelength and refractive index, Michelson Interferometer and its application to wavelength determination and wavelength difference, Fabry- Perrot Interferometer and its application.

##### **Unit IV: Diffraction of light [10h]**

Fresnel's diffraction- Half period zones, Zone plates, Diffraction due to straight edge and due to narrow slit.

Fraunhofer diffraction- Fraunhofer diffraction at a single slit, at circular aperture, Plane diffraction grating and its application, Resolving power of grating, Rayleigh's criterion for resolution.

##### **Unit V: Polarization [10 h]**

Production of polarized light: reflection, scattering, pile of plates, double refraction, polaroid. Brewster's law, Malus' law. Superposition of two disturbances. Phenomenon of double refraction: Uniaxial and biaxial crystal, positive and negative crystal, ordinary and extraordinary rays. Double refraction in uniaxial calcite crystal, Nicol prism, phase retardation plates ( Half wave and Quarter wave plates), production of elliptical and circular polarized light (mathematical approach), optical activity, half shade polarimeter. Applications.

#### **Unit VI: Electrodynamics [10 h]**

Electromagnetic spectrum, Electromagnetic (EM) waves and their characteristics, Equation of continuity, displacement current, Maxwell's equations and its significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, radiation pressure, transverse nature of EM waves and applications of electromagnetic waves.

#### **Laboratory-3 (BCSPHY P203)**

#### **List of Experiments: (Any 10) [40h]**

1. To study the speed of waves on stretched string.
2. To determine unknown frequency and to verify the law of inverse variation of frequency and volume of air by Helmholtz resonator.
3. To determine the velocity of sound wave in air (gas) with Kundt's tube.
4. To study the characteristics of microphone.
5. To study the current regulation and ripple factor of half wave/full wave rectifier using semiconductor diodes with L and  $\Pi$  type filter.
6. To study the characteristics of Zener diode.
7. To study the Zener diode voltage regulating characteristics.
8. To determine the focal length of long focus convex lens using short focus convex lens.
9. To study the different lenses and eyepieces.
10. To determine the wavelength of monochromatic light using Newton's ring.
11. To determine the refractive index of material of double image prism.
12. To study of polarization of light by reflection (Brewster's law).
13. To determine the resolving power of a grating.
14. To determine the wavelength of prominent lines of mercury by plane transmission grating.
15. To determine the concentration of sugar solution by half shade polarimeter.

#### **Reference Books for theory:**

1. A textbook of sound, Subramanyam and Brijlal, Vikas Prakashan.
2. A textbook of Oscillations, Waves and Acoustics by Dr. M. Ghosh, Dr. D. Bhattacharya (S. Chand).
3. Science and Technology of Ultrasonics by Baldevraj, Narosa publication.
4. Optics by Ajoy Ghatak, McGraw Hill Publications.
5. Elements of Electronics by M. K. Bagde, S. P. Singh, K Singh, S Chand publications.
6. A Textbook of Electrical Technology by B.L Thareja, S Chand Publications
7. Physics for Degree students for B. Sc. Second year, by C. L. Arora, Dr. P. S. Hemne.



**Reference Books for Practicals:**

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. A textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Collection of Experimental Problems in Physics by Rajesh Khaparde, H. C. Pradhan, Notion Press.
5. Advanced practical physics, Chauhan & Singh, Pragati Publications.



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## **Bajaj College of Science, Wardha (Autonomous)**

### **Syllabus for B. Sc. II (SEM-IV) w.e.f. 2022-23**

#### **Physics IV (BCSPHYT204)**

##### **Unit I : Crystallography [10h]**

Solids: Amorphous and Crystalline Materials. Lattice translation vectors. Lattice with a Basis. Unit Cell. Crystal symmetry, Miller Indices. Types of Lattices. Packing fraction, density calculation. Closed pack structures (fcc, hcp). Crystal structure of CsCl, NaCl, Diamond. Concept of reciprocal Lattice and its construction,

##### **Unit II: X-rays and X-ray diffraction [10h]**

Production of X-rays, X-ray spectra, Brehmstrahlung, Characteristic X-rays. **X-ray tubes & types:** Coolidge tube's construction and working. Application of X-rays (Imaging, diffraction, Auger effect) Moseley's Laws, Diffraction of X-rays by crystals. Bragg's Law. Different methods of X-ray diffraction. Bragg's spectrometer. Diffraction in Reciprocal space. Bragg's law in reciprocal space. diffraction patterns of NaCl, BaTiO<sub>3</sub>

##### **Unit III: Molecular Physics [10h]**

The quantization of energy: vibrational and rotational energies, Regions of the spectrum, **Microwave Spectroscopy:** types of molecules based on moment of inertia, rigid diatomic molecules, Intensity distribution in rotational levels, **Infra-Red Spectroscopy:** The vibrating diatomic molecule, Diatomic molecules as harmonic and anharmonic oscillator (concept only), The diatomic vibrating rotator, Rotational-vibrational spectra, Rotational-Vibrational Spectra of CO molecule, Born Oppenheimer approximation. **Raman Spectroscopy:** Raman effect, Classical and quantum theory, Pure rotational Raman Spectra (linear molecule), Applications of Raman effect. Electronic spectra, Dissociation energy.

##### **Unit IV: LASER [10h]**

Spontaneous and stimulated emissions, Theory of laser action, three and four level Lasing action, Einstein's coefficients, components of LASER system, Characteristics of laser beam, Ruby LASER, He-Ne laser, Semiconductor lasers, CO<sub>2</sub> Laser, Nd: Yag Laser. Comparison of laser systems, Applications of lasers, Laser Cooling.

##### **Unit V: Solid State Electronics [10h]**

Bipolar junction transistor (BJT), Construction and Working, CB, CE and CC modes, Static Characteristics in CB and CE modes, Graphical analysis of CE configuration, Current gains  $\alpha$  and  $\beta$ , Relations between  $\alpha$  and  $\beta$ , Transistor leakage currents, Comparison of CB, CE and CC modes, Transistor as an amplifier in CE mode, DC Load line and Q-point, Hybrid parameters, Equivalent circuit at low frequency in CE mode, Cut off and saturation points, Different transistor biasing methods, Stabilization, Stability factor,.

#### **Unit VI: Field Effect Transistor [10h]**

**Field Effect Transistor (FET): JFET:** Construction, working and principle of JFET, Characteristics of JFET, Analysis of JFET circuit, Expression for drain current, Parameters, JFET as an amplifier (input and output impedance, voltage gain), Advantage of JFET over BJT. **MOSFET:** Types of MOSFET, Construction and working of MOSFET, Characteristics of MOSFET, Special features and applications of MOSFET.

#### **Laboratory-4 (BCSPHY P204)**

#### **List of Experiments: (Any 10) [40h]**

1. To study the divergence of LASER beam.
2. To determine the wavelength of LASER beam using plane diffraction grating.
3. To construct SC, BCC, FCC structures and to find packing fraction and co-ordination number.
4. To determine lattice parameter 'a' of a unit cell of cubic crystal using X-ray diffraction pattern.
5. Identification of unknown wavelength /element from line emission spectra.
6. Study of vibrational spectra through infra-red spectroscopy.
7. Study of rotational spectra of CO/HCl molecule.
8. To determine Planck's constant by using LED.
9. Study of solar cell as photovoltaic cell.
10. To study the characteristics of transistor in C-E mode.
11. To study the characteristics of transistor in C-B mode.
12. To study the characteristics of Field Effect Transistor (FET).
13. To study the frequency response of single stage common emitter amplifier.
14. To study the frequency response of two stage RC coupled common emitter amplifier.
15. To determine the hybrid parameters of a transistor.
16. To determine the value of Boltzmann's constant using transistor.
17. To study the characteristics of Depletion Metal Oxide Semiconductor Field Effect Transistor (MOSFET).
18. To determine the energy gap of semiconductors using PN junction diode in reverse bias mode.




**Reference Books for Theory:**

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
3. Material Science and Engineering, William Callister, Wiley.
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.
5. Elements of Spectroscopy, by –Pragati Prakashan, Gupta, Kumar, Sharma.
6. Optics and Spectroscopy by-R. Murugesan and Kiruthiga Sivaprakash, S Chand publication.
7. Advanced Molecular Physics by-Shriram and Sharma.
8. Electronics Principles by Malvino and Bates: Mcgraw Hill Education.
9. Electronic Devices and Circuit Theory by Boylsted : Pearson Publication.
10. Textbook of Electrical Technology by B.L. Thareja: S. Chand Publication.
11. Optics and Spectroscopy, by- R. Murugesan , Kiruthign Sivaprakash.
12. Physics for Degree students for B. Sc. Second year, by- C. L. Arora, Dr. P. S. Hemne.
13. Solid State Physics and Electronics, by- R. K. Puri, and V. K. Babbar.
14. A text book of Optics, by- Dr. Subrahmanyam, Brijlal and M. N. Avadhanulu.

**Reference Books for Practical:**

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
5. Physics through experiments, B Saraf et. al.,Vikas Publications 1987.
6. Advanced practical physics, Chauhan & Singh, Pragathi Publications 1ed.
7. Practical Physics, D. Chattopadhyaya et al, Central Publications.
8. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002.
9. Practical Physics, D C Tayal 2002.

  
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## **Bajaj College of Science, Wardha (Autonomous)**

### **Syllabus for B. Sc. III (SEM-V) w.e.f. 2019-20**

#### **Physics V (BCSPHYT305)**

##### **Unit I: Atomic Physics [10h]**

Introduction (Revision of Bohr's model, Sommerfeld and Chadwick Model), Vector Atomic model, Stern-Gerlach experiment, spinning of electron, space quantization, selection rules, quantum numbers, L-S and J-J coupling, Pauli's exclusion principle, Hund's rule, Zeeman Effect: Normal Zeeman effect and Anomalous Zeeman effect.

##### **Unit II: Relativity [10h]**

Frame of references, Inertial and Non-Inertial frames, Galilean transformation equations, Galilean invariance and conservation laws, Michelson-Morley experiment and its negative result. Postulates of special theory of relativity, Lorentz transformation, Length contraction, Time dilation, velocity addition theorem, variation of mass with velocity, Mass Energy equivalence, Particle with zero rest mass.

##### **Unit III: Quantum Mechanics - I [10h]**

Failure of Classical Physics, black body radiations, photoelectric effect, Einstein's explanation of photoelectric effect, Compton Effect, Wave Particle Duality, de Broglie's Hypothesis, Davisson and Germer experiment, concept of phase velocity and group velocity, wave packet, Heisenberg's Uncertainty Principle: Non-existence of electron inside the nucleus. Thought experiment: Gamma Ray Microscope.

##### **Unit IV: Nuclear Physics I [10h]**

G.M counter, Linear Accelerator, Cyclotron, velocity selector, Bainbridge Mass Spectrograph, Nuclear reactions, Discovery of neutron, Packing fraction, Mass defect and binding energy, Nuclear fission, Liquid drop model, shell model of the nucleus, chain reaction, Nuclear reactors, Nuclear fusion, cosmic rays .

##### **Unit V: Nanomaterials and Characterizations [10h]**

**Nanomaterials-** Introduction to Nanoscience and Nanotechnology, Difference between nanomaterials and bulk materials, reduction of dimensions, 3D, 2D, 1D & 0D materials, various morphologies of nanomaterials, Bottom up and top down approaches of synthesis, size dependent physical properties. Determination of size of nanocrystallites by Scherrer's formula, **Characterization Techniques-** Scanning Electron Microscope (SEM), Transmission Electron Microscopy (TEM), Polarimeter, Colorimeter and UV-vis. Spectrophotometry.

## **Unit VI: Statistical Physics [10h]**

Introduction: Phase space,  $\mu$ -space, Gamma space, probability distribution, thermodynamic probability, principle of a prior probability, Boltzmann's entropy relation, Macro and micro states, Maxwell-Boltzmann distribution law, its application to molecular speeds, limitations of M-B law, distinction between mean, rms and most probable speed, Bose-Einstein Statistics (no derivation), indistinguishability of particles and its consequences, Derivation of Planck's radiation law, Wein's displacement law and Rayleigh's law, Estimation of temperature of sun. Fermi-Dirac distribution law (no derivation), Fermi energy, Fermi level, Fermi Temperature. Comparisons between M-B, B-E and F-D statistics.

### **Laboratory-5 (BSCPHYP305)**

#### **List of Experiments (Any 10) [40h]**

1. To determine the Rydberg's constant by hydrogen spectra.
2. To study the absorption spectra of iodine vapours.
3. To determine the  $e/m$  ratio by Thomson method.
4. To determine  $e/m$  by Helical method.
5. To determine the Planck's constant by using photocell/solar cell.
6. To determine the Planck's constant by using LED.
7. To study the random decay of nuclear disintegration and determination of decay constant using one colored face dices.
8. To study the statistical distribution from the given data and to find most probable, average and rms value.
9. To draw the plateau curve of a Geiger Mueller counter.
10. To determine the size of nanocrystals by using Scherrer formula.
11. To determine the unknown concentration of  $\text{KMnO}_4$  solution using colorimeter.
12. To determine the electric charge of an electron by Millikan's oil drop method.
13. To determine the electronic charge and work function of a cathode material using photocell.
14. To study inverse square law using static characteristics of photocell.
15. To determine the specific rotation of a given optically active compound glucose using half shade polarimeter.
16. To analyze the image of SEM/TEM of nanoparticles.
17. To calculate the optical band gap of nanomaterial by UV visible spectrum.



**Reference Books for Theory:**

1. Atomic Physics by J.B. Rajam.
2. Nuclear Physics by S.N. Ghoshal (S.Chand).
3. Introductory Nuclear Physics by Kenneth Krene(John Wiley and sons)
4. Concepts of Modern Physics: Arthur Beiser (Tata Mc Graw Hill)
5. Physics for Degree Students BSc-III by C.L.Arora and P.S.Hemne.(S.Chand)
6. Elements of Special Theory of Relativity by M.K.Bagde and S.P.Singh (S.Chand)
7. Introduction to theory of Relativity by P.G. Bergmann
8. Introduction to Special Theory of Relativity by Shrivastava.
9. Material Science and Engineering, William Callister, Wiley.
10. Fundamentals of statistical and thermal physics - by F.Reif.
11. Fundamental of Statistical Mechanics - By B.B. Laud.
12. Statistical Physics: Berkeley Physics Course Volume-5 by F. Reif TataMcGraw-Hill Company Ltd, 2008).
13. Introduction to Quantum Mechanics, David J. Griffith, 2<sup>nd</sup> Ed. 2005, Pearson Education.
14. Quantum Mechanics, G. Aruldas, 2<sup>nd</sup> Edn. 2002, PHI Learning of India.
15. Quantum Mechanics by Chatwal and Anand (Himalaya Publications)
16. Introduction to Nanotechnology by Charles Poole
17. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni

**Reference Books for Practicals:**

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
5. Physics through experiments, B Saraf *et al*, Vikas Publications 1987.
6. Advanced practical physics, Chauhan & Singh, Pragathi Publications 1<sup>st</sup> Ed.
7. Practical Physics, D. Chattopadhyaya *et al.*, Central Publications.
8. An Advanced Course in Practical Physics, D Chattopadhyay, PC Rakshit, BSaha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
9. Practical Physics, D C Tayal, 2002.

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## **Bajaj College of Science, Wardha (Autonomous)**

### **Syllabus for B. Sc. III (SEM-VI) w.e.f. 2019-20**

#### **Physics VI (BCSPHYT306)**

##### **Unit I: Quantum II [10h]**

Schrodinger's Equation: Time dependent and time independent equations, wave function  $\Psi$  and its physical significance, Operators, Expectation values of dynamical quantities, Ehrenfest theorem, Eigen values and Eigen functions, Free particle, Free Particle in a one dimensional box and three dimensional box.

##### **Unit II: Nuclear II [10h]**

Radioactivity: stability of nucleus, Law of radioactive decay, Mean life & half-life;  $\alpha$ -decay, Range of alpha particles, Geiger Nuttal law, Magnetic spectrometer for the energy of  $\alpha$  particles, Tunneling, Gamow's theory of  $\alpha$ -decay,  $\beta$ -decay, measurement of energy of  $\beta$ -decay and end point energy, Neutrino theory of  $\beta$ -decay, Gamma decay, energy of gamma photon.

##### **Unit III: Physics of Solid State [10h]**

Drude Lorentz model, Mean free path, Electrical and thermal conductivity, Weidmann Franz law (derivation), thermoelectric effect, Density of states, Fermi energy, Fermi temperature. Band theory of solids- Bloch theorem (statement only), Kroning Penny model, concept of hole, Hall effect, Energy bands in solid, distinction between metal, semiconductor and insulator.

##### **Unit IV: Operational Amplifier and Oscillators [10h]**

Operational Amplifier : Direct coupled amplifier, Difference amplifier, parameters of Op-Amp, Basic idea of IC-741, Application of Op-Amp as Inverting amplifier, Non-Inverting amplifier, Adder, subtractor, Integrator, Differentiator.

Oscillators: Concept of feedback, Physical considerations of tuned circuits, Phase shift oscillators, Hartley Oscillator, Colpitt's oscillator.

##### **Unit V: Digital Electronics [10h]**

Number Systems- Unitary systems, Binary, decimal, octal, hexadecimal and their inter-conversions, Binary coded decimal (BCD), Addition and subtraction of binary numbers, 1S, 2S and 10S compliment, basic logic gates, NOR, NAND, Ex-OR, Ex-NOR gates and their truth table, Half adder, Full adder, Half subtractor and full subtractor, Boolean equations, De Morgan's theorem and its verification.

##### **Unit VI: Communication and Fiber Optics [10h]**

**Communication:** Modulations and its needs, Amplitude modulation. Frequency spectrum, modulation factor, over modulation, percentage modulation, Expression for power and currents in AM wave. Disadvantages. Frequency modulation. Frequency deviation, carrier swing,

modulation index, Deviation ratio, Expression for F M wave, frequency spectrum, significant side band terms, F M bandwidth, merits and demerits.

**Fiber Optics-** Importance of optical fiber, Propagation of light waves in optical fiber, Basic structure, step index monomode fiber, Graded index fiber, Acceptance angle and acceptance cone, Numerical aperture, Fiber losses and their units (basic concept), Electrical and optical band width, band width length product, Dispersion in optical fiber, applications.

### **Laboratory-6** **(BSCPHYP306)**

#### **List of Experiments (Any 12) [40h]**

1. To determine the energy gap of semiconductor using PN junction diode in reverse bias mode.
2. To determine the Hall coefficient of charge carriers in semiconductor.
3. Study of thermo emf.
4. To study the Op-Amp as an inverting and non-inverting amplifier.
5. To study the Op-Amp as adder/subtractor.
6. To study the Op-Amp as integrator/differentiator.
7. To study the phase shift/Wein's bridge oscillator.
8. To study the Hartley/Colpitts oscillator.
9. To study the Amplitude modulation
10. To study Diode as detector.
11. To study the Frequency modulation.
12. To organize basic operations (AND, OR, NOT) using universal gates (NAND, NOR).
13. To verify the De Morgan's theorem.
14. To study the characteristics of NOR/NAND gate and verification of truth table.
15. To verify the laws of Boolean algebra.
16. To study the Ex-OR gate as half adder and full adder.
17. To study the Ex-OR gate as half subtractor and full subtractor.
18. Determination of step index of optical fiber.
19. To study total internal reflection and determination of critical angle.

#### **Reference Books for Theory:**

1. Introduction to Quantum Mechanics, David J. Griffiths, 2<sup>nd</sup> Ed. 2005, Pearson Education.
2. Quantum Mechanics, G. Aruldas, 2<sup>nd</sup> Edn. 2002, PHI Learning of India.
3. Introductory Nuclear Physics by Kenneth Krene (John Wiley and sons)



4. Nuclear Physics by S.N. Ghoshal (S. Chand).
5. Perspectives of modern physics - By A. Beiser.
6. Concepts of Modern Physics: Arthur Beiser (Tata Mc Graw Hill)
7. Introduction to Solid State Physics, Charles Kittel, 8<sup>th</sup> Ed., 2004, Wiley India Pvt. Ltd
8. Solid State Physics and Electronics, by R. K. Puri, and V. K. Babbar.
9. Elements of Solid State Physics, J.P. Srivastava, 2<sup>nd</sup> Ed., 2006, Prentice-Hall of India
10. Op-Amp and Linear Integrated Circuits, 2<sup>nd</sup> edition by Ramakant Gaikwad (PHI)
11. Digital and Analog Technique by Navneet, Gokhale, Kale (Kitab Mahal)
12. Basic Electronics by B.C. Theraja (S.Chand)
13. An Introduction to Fiber Optics by Allen Shotwell
14. Optical Fiber Communication by John M. Senior.
15. Digital Principle and Application by Malvino and Leach.
16. Digital Electronics by V.K. Jain.
17. Communication Electronics by A. Kumar

**Reference Books for Practicals:**

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
5. Physics through experiments, B Saraf et. al., Vikas Publications 1987.
6. Advanced practical physics, Chauhan & Singh, Pragathi Publications 1ed.
7. Practical Physics, D. Chattopadhyaya et al., Central Publications.
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