

B. Sc. Semester-V			
Discipline Specific Core Course (DSC-9)-PHYSICS - Paper-IX			
Course	Name of Course	Theory Course Code	Practical Course Code
DSC-9	Electrostatics and Electric Currents	BPH5T09	BPH5P09
Credits (Th+Pr) = 2+1 = 3	Total Theory Teaching Hours = 30 Marks SEE = 80 IA = 20 Total = 100	Th Hrs/W: 2 Hrs/W	Pr Hrs/W: 2 Hrs/W
Electrostatics and Electric Currents			
Unit-I: Coulomb's Law & Electric fields	Introductory ideas of Electrostatics (Types of charge, properties of charge, additivity, conservation and quantization), Coulomb's Law in vector form, Electric Field Intensity due to point charges and continuous charge distributions, Principle of superposition, Field due to line, surface, and volume charge distributions. Work done in moving a charge in an electric field. Conservative nature of electrostatic field.	7 Hrs	
Unit-II: Electric Flux Density and Gauss's Law	Electric Flux and Electric Flux Density (D), Relationship between E and D , Gauss's Law in integral form, Applications of Gauss's Law to symmetric charge distributions: Infinite line charge, Infinite plane sheet, Spherical charge distributions, Divergence and Gauss's Law in differential form, Physical significance of divergence of E and D	8 Hrs	
Unit-III: Electric Potential and Energy	Electric potential and potential difference, Relation between Electric Field E and Electric potential V : ($\mathbf{E} = -\nabla V$). Potential due to point charge and continuous charge distributions, Equipotential surfaces, Energy stored in an electrostatic field, Energy density in electric fields. Electric potential due to short dipole and Fields due to short dipole. Torque on a dipole in an electric field.	7 Hrs	
Unit-IV: Conductors, Dielectrics, Capacitance and Electric currents	Conductors in electrostatic fields, Boundary conditions at conductor and dielectric interfaces, Polarization in dielectrics, Dielectric constant and permittivity, Parallel plate capacitor (with and without dielectric), Energy stored in capacitors, Applications of capacitor (Qualitative) Electric current: Current density and electric currents, steady current and time varying currents. Continuity equation, AC currents its characteristics. Resistance. Reactance and impedance, Power factor	8 Hrs	

Suggested Reference Books

1. Engineering Electromagnetics by William H. Hayt and John A. Buck, McGraw-Hill.

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2. Elements of Electromagnetics by Matthew N. O. Sadiku, Oxford University Press.
3. Introduction to Electrodynamics by David J. Griffiths, Pearson.
4. Electricity and Magnetism by K K Tewari S Chand Publications.
5. Electricity and Magnetism by D C Tayal by S Chand Publications.
6. Electricity and Magnetism by D N Vasudeva S Chand Publications.

Practical Course Code BPH5P09

(Electrostatics and Electric Currents)

Teaching Hours = 30 (Marks SEE+CIE=25+25=50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

1. Determination of Dielectric Constant of a Solid.
2. To determine the low resistance by Carrey Fosters bridge.
3. To Determine the Electric Dipole Moment of a Given Liquid.
4. To verify maximum power transfer theorem.
5. Measurement of Inductance (L) by Phasor Diagram Method
6. Measurement of Capacitance (C) by Phasor Diagram Method
7. To Study Charging and Discharging of a Condenser Through a Resistor (RC Circuit)
8. Study of Growth of Current in CR Circuit.
9. Study of Parallel Combination of capacitors.
10. Study of Series combination of capacitors.
11. Study of mixed combinations of capacitors.
12. To determine the permittivity of free space.

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Compute electric fields using Coulomb's law and Gauss's law.
2.	Analyse electric field, electric potential and energy in electrostatic systems.
3.	Understand the effect of electrostatic fields on conductors and dielectrics.
4.	Calculate capacitance of parallel plate capacitor.
5.	Understand the basic concept of electric current.

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B. Sc. Semester-V Discipline Specific Core Course (DSC-10)-PHYSICS - Paper-II (BPH5T10) (Magnetostatics and Magnetism)			
DSC-10	Hours: 02Th +02 Pr = 04 Hours / week Total Teaching Hours Th=30 & Pr =30	Marks: 100 SEE = 80 & CIE = 20	Credits : 2Th + 1Pr = 03
	Magnetostatics and Magnetism (TH)		
Unit-I Fundamentals of Magnetostatics	Magnetic field and magnetic induction: Magnetic field vector $\vec{B}$ and magnetic field intensity H, comparison between E and B fields, Lorentz force equation, Force on a current-carrying conductor in uniform magnetic field, Motion of a charged particle in uniform magnetic field (qualitative and simple formulas). Biot-Savart law: Statement and physical significance, applications of Biot-Savart law to determine magnetic field due to current carrying straight wire & circular loop.		8 Hrs
Unit-II Magnetic field and Potential	Ampere's circuital law: Statement and proof (integral form only), applications of Ampere's circuital law to determine magnetic field due to current carrying long straight conductor (wire), solenoid & toroid. Magnetic flux and flux density: Gauss's law for magnetism integral form ($\oint \vec{B} \cdot d\vec{S} = 0$) and differential form ($\Delta \cdot \vec{B} = 0$) (conceptual only). Magnetic potential: Definition only, relation between $\vec{B}$ and $\vec{A}$ (conceptual) and Physical significance. Comparison between electric potential (V) and magnetic potential ($\vec{A}$).		8 Hrs
Unit-III Magnetic dipole moment and field measurements	Magnetic dipole: Magnetic dipole moment of a current loop, Torque on a magnetic dipole in a uniform magnetic field, potential energy of a magnetic dipole. Magnetic field measurements: Magnetic energy stored in an inductor, Energy density of magnetic field, Magnetic moment of atoms (qualitative idea), Bohr Magneton (Definition only) and comparison between electric and magnetic dipoles. Relations: (i) B, H and M (scalar form), (ii) χ , H and M (iii) μ_r and χ .		7 Hrs
Unit-IV Principle and Applications of Magnetism	Electrical: Transformer, magnetic sensors. Principle of Spintronics and its application, Principle and Applications of magnetic materials in Technology and Computing: Data storage devices and magnetic recording, Medical and Healthcare: MRI, Hyperthermia & Drug Delivery. Transportation: Maglev trains using magnetic levitation. Industrial and Household; Navigation and Safety, Energy generation. Magnetism in particle accelerators.		7 Hrs

References:

1. Brijlal and Subramanyam – Electricity and Magnetism (S. Chand Publishing)

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Unit-IV: Principle and Applications of Magnetism	Electrical: Transformer, magnetic sensors. Principle of Spintronics and its application, Principle and Applications of magnetic materials in Technology and Computing: Data storage devices and magnetic recording. Medical and Healthcare: MRI, Hyperthermia & Drug Delivery. Transportation: Maglev trains using magnetic levitation. Industrial and Household; Navigation and Safety, Energy generation. Magnetism in particle accelerators.	7 Hrs
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References:

1. Electricity and Magnetism by Edward M. Purcell & David Morin, Berkeley Physics Series, Vol. 2.
2. Electricity and Magnetism by Brijlal and Subramanyam, S. Chand Publishing.
3. Electricity and Magnetism by D. C. Tayal, Himalaya Publishing House.
4. Electricity and Magnetism by A. S. Mahajan and A. A. Rangwala, Tata McGraw-Hill.
5. Fundamentals of Magnetism and Electricity by D. N. Vasudeva, S. Chand Publishing.
6. University Physics with Modern Physics by H.D. Young, R.A. Freedman, A. Lewis Ford, Addison-Wesley.

Practical Course Code BPH5P10

Teaching Hours = 30 (Marks CIE=50)

Pr Hrs : 2 Hrs/ week Credits = 1

1. To determine (i) the horizontal component of Earth's magnetic field and (ii) magnetic moment of the magnet using a vibration magnetometer.
2. To study the variation of magnetic field along the axis of a current carrying circular coil.
3. To determine the magnetic flux density between the pole pieces of an electromagnet.
4. To determine angle of dip (inclination) using Earth inductor.
5. To plot a hysteresis curve (B – H curve) for a given specimen of ferromagnetic material using a deflection magnetometer.
6. Study of hysteresis curve of a transformer core and determination of core losses in a transformer using C.R.O. or digital setup.
7. To verify Biot–Savart law using a circular coil.
8. To study and identification of Dia-, Para- and Ferromagnetic materials using bar magnet.
9. To determine the magnetic field at the center of a circular coil using a compass.
10. To determine the magnetic moment of a permanent magnet using the deflection magnetometer (Tan-A position and Tan-B position).
11. To compare the magnetic moments of two bar magnets using a deflection magnetometer.
12. To study magnetoresistance in a given material.
13. To trace the magnetic field lines of a bar magnet using iron filings and compass needle.
14. To study magnetic shielding using soft iron.
15. To study Vibration Sample Magnetometer (VSM) graph of various ferrite materials.

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Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Understand the origin and nature of magnetic fields produced by steady currents.
2.	Apply Biot–Savart and Ampere’s laws to simple geometries.
3.	Understand magnetic dipoles and energy in magnetic fields.
4.	Analyze Earth’s magnetic field parameters and apply experimental methods.
5.	Explain magnetic behaviour of materials using microscopic ideas.
6.	Appreciate the role of magnetism in Earth sciences and modern technology.



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B. Sc. Semester-V
Discipline Specific Core Course (DSC-11)-PHYSICS
Electronic Devices and Circuits

Course	Name of Course	Theory Course Code	Practical Course Code
DSC-11	Electronic Devices and Circuits	BPH5T11	BPH5P11
Credits (Th+ Pr))= 2+1 = 3	Total Theory Teaching Hours = 30 Total Practical Teaching Hours = 30 Marks SEE = 80 IA = 20 Total = 100	Th 2 Hrs/ week	Pr : 2 Hrs/week
	Electronic Devices and Circuits		
Unit-I Semiconductor Physics, Diodes and their applications	Semiconductors: Intrinsic and extrinsic semiconductors (Qualitative), Trivalent and pentavalent doping, Drift current and diffusion current. PN junction diode: construction and working, Forward and reverse bias characteristics. Rectifiers: half-wave and full-wave (centre-tapped and bridge) Zener diode: construction, working and characteristics Zener diode as voltage regulator. Application of diodes as clipper and clamper.		8
Unit-II Bipolar Junction Transistor (BJT)	Transistor: NPN and PNP, Working principle of BJT, Transistor as amplifier and switch. Transistor biasing: fixed and self-bias. Transistor configurations: CB, CE and CC, Input and output characteristics, RC-coupled amplifier (frequency response), Emitter follower and applications,		7
Unit-III FET, MOSFET and UJT	Field Effect Transistor (FET): construction and working, Comparison between FET and BJT, FET characteristics and applications. MOSFET: types, working and characteristics, MOSFET as a switch (UJT): construction, working and characteristics, UJT as relaxation oscillator.		7
Unit-IV Oscillators, Power Electronics	Transistor oscillators: Introduction to feedback, (basic concept) Condition for oscillations (Barkhausen criterion). LC oscillators: Hartley and Colpitts, RC phase shift oscillator, Crystal oscillator. Unijunction Transistor SCR: construction, working and V-I characteristics, SCR as a switch and controlled rectifier. DIAC and TRIAC: construction, working and applications,		8

Reference Books:

1. Electronic Devices and Circuits Millman, J. and Halkias, C. C. Tata McGraw-Hill Education, New Delhi, (2016).
2. Electronic devices and circuits by J. Millman & C. Halkias, Tata McGraw-Hill Education, New Delhi
3. A Textbook of Electronics by B.L. Theraja, S. Chand & Co. Ltd. Delhi

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4. Principles of Electronics by V. K. Mehta and Rohit Mehta, S. Chand & Company Ltd., New Delhi.
5. Electronic Devices and Circuits by Allen Mottershead, PHI Learning Pvt. Ltd., New Delhi.
6. Electronic Devices and Circuits by Y. N. Bapat, Central Techno Publications, Nagpur.
7. Electronic Devices by Thomas L. Floyd, Pearson Education.
8. Electronic Devices and Circuits – Laboratory Manual by David A. Bell, PHI Learning Pvt. Ltd., New Delhi.
9. Experiments in Electronics by S. V. Subramanyam, S. Chand & Company Ltd.
10. Basic Electronics Laboratory Manual by U. A. Bakshi, and A. P. Godse, Technical Publications, Pune.

Practical Course Code BPH5P11

(Electronic Devices and Circuits)

Teaching Hours = 30 (Marks SEE+CIE=25+25=50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

1. To plot I-V characteristics of a PN junction diode in forward and reverse bias and determine cut-in voltage.
2. To study I-V characteristics of Zener diode and determine Zener breakdown voltage.
3. To study line and load regulation of Zener regulated power supply.
4. To study the performance of a half-wave rectifier with and without a simple capacitor filter.
5. To study full-wave rectifier (centre-tapped or bridge) with and without filter.
6. To plot input, output and transfer characteristics of a transistor in CE mode.
7. To plot input output and transfer characteristics of a transistor in CB mode.
8. To study the operation of CE amplifier and determine voltage gain.
9. To study the emitter follower circuit and determine its voltage gain and impedance characteristics.
10. To plot drain and transfer characteristics of JFET and determine FET parameters.
11. To study the common source FET amplifier.
12. To study the characteristics of UJT and determine intrinsic stand-off ratio.
13. To study UJT as a relaxation oscillator and determine frequency of oscillation.
14. To study I-V characteristics of SCR.
15. To study characteristics of LDR / LED / Photo diode / Photo transistor.

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16. To study clipper and clamper circuits using PN junction diode and observe output waveforms.

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Explain the basic concept of semiconductors and the operational characteristics of PN junction and Zener diodes.
2.	Understand the operation of rectifiers and simple filters.
3.	Understand the working of BJT and its applications.
4.	Understand the working of oscillators.
5.	Understand the working of power electronic devices.

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B. Sc. Semester-V ^{12A} Discipline Specific Elective Course (DSE-1A)-PHYSICS - Paper-XII			
Course	Name of Course	Theory Course Code	Practical Course Code
DSE-1A ^{12A}	Digital Electronics and Microprocessor	BPH5T12A	BPH5P12A
Credits (Th + Pr) = 3+1 = 4	Total Theory Teaching Hours = 45 Marks SEE = 120 IA = 30 Total = 150	Th Hrs/W: 3 Hrs/W	Pr Hrs/W: 2 Hrs/W
Unit-I: Number System and Boolean Algebra	Number system: Decimal, Binary, Octal and Hexadecimal, Inter-conversions between number system, binary numbers addition, subtractions using 1's and 2's complement method. Binary Codes: BCD codes and Gray Codes, ASCII, EBCDIC Code, interconversion between Gray and binary codes. Boolean Algebra: Boolean Laws and its applications, Verification of Boolean Laws, De-Morgan's theorems with Proofs.	11 Hrs	
Unit-II: Logic Gates and its applications	Positive and negative logic, Logic Gates: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR (Logic diagram, symbols and truth table), NAND and NOR gates as universal gates, Conversion of universal gates to other gates. Combinational logic optimization techniques, Binary Half adder, Full adder, Half Subtractor, full subtractor. K Map	11 Hrs	
Unit-III: Sequential Circuits and Flipflops	Sequential Circuits: Astable, Monostable and Bistable Multivibrators, Flip-Flops: S-R Flip-flop, J-K Flip-flop, D-Flip-flop, T – Flip-flop, JK Master-slave flipflops. Counters : 4 Bit Up counter, 4 bit-Down Counter (3-bit) , Decade (Mod 10) Counter. Shift register and its types (SI, SO), Multiplexers (1:4), Demultiplexers (4:1).	11 Hrs	
Unit-IV: 8085 Microprocessor	8085 Microprocessor: Introduction, Main features of 8085, PIN diagram and architecture of 8085 microprocessor, Internal register organization, Address and Data bus, multiplexing, Flags, Instruction set, Simple programming.	12 Hrs	

References

1. Digital Principal and Applications by A. P. Malvino and D. P. Leach, Tata MacGraw Hill.
2. Digital Fundamentals by Thomos L. Flyod, Pearson Education India.
3. Fundamentals of Digital Circuits by Anand Kumar, PHI learning PVT Ltd.
4. Microprocessor Architecture Programming and Architecture with 8085 by Ramesh S. Gaonkar, Prentice Hall Publication.

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5. Introduction to Microprocessors by Aditya P. Mathur, Tata-McGraw, New Delhi.
6. Fundamentals of Microprocessor by Bedari Ram, Dhanpat Rai Publication.

Practical Course Code BPH5P12A
(Digital Electronics and Microprocessor)

Teaching Hours = 30 (Marks CIE = 50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

1. To study different logic gates and verification of its truth table.
2. To verify De Morgan's theorems.
3. To construct and verify logic structure from a given Boolean Expression.
4. To study and verify Half adder and Full adder using logic gates.
5. To study and verify Half Subtractor and Full subtractor using logic gates.
6. To study 4 bit parallel binary adder operation (IC 7486).
7. To study S-R Flipflop, CKRS and D flipflops.
8. To study J-K and JKMS flipflops.
9. To realize and verify the operation of basic gates from Universal logic gates.
10. To study the conversion of binary to BCD codes and vice-versa.
11. Design and implement circuits to convert Binary to Gray code.
12. Design circuit for conversion of Binary to decimal, Octal and Hexadecimal numbers.
13. Assembly language programming using 8085 microprocessor Kit.
14. Microprocessor program based on arithmetic group.
15. Microprocessor program based on logical group.
16. Study of Mod-10 (Decade) Counter.
17. Study of Shift resistor (SI, SO).

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Understand the basic requirement of digital electronics
2.	Describe the use of Boolean algebra for circuit operations
3.	Elaborate the use of Flip flops as memory in data processor
4.	Simplify logical expressions using Boolean algebra.
5.	Understand the basics and working of 8085 microprocessors.

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B. Sc. Semester-V^{12B} Discipline Specific Elective Course (DSE-1B)-PHYSICS - Paper-XII			
Course	Name of Course	Theory Course Code	Practical Course Code
DSE-1B ^{12B}	Digital Electronics and Microprocessor <i>OPTO-ELECTRONICS & DEVICES</i>	BPH5T12B	BPH5P12B
Credits (Th + Pr) = 3+1 = 4	Total Theory Teaching Hours = 45 Marks SEE = 120 IA = 30 Total = 150	Th Hrs/W: 3 Hrs/W	Pr Hrs/W: 2 Hrs/W
Unit-I: Fundamental of Semiconductor	Review of Types of Semiconductors-Intrinsic, Extrinsic, Majority and Minority Carriers, Energy band in Solids-Valence and Conduction band, Bandgap, Direct and indirect band gap, Carrier generation and recombination mechanism in semiconductor, Radiative and Non-radiative recombination; Optical processes in Semiconductors: Absorption, Emission (spontaneous & stimulated), Luminescence, Optical absorption coefficient, Photoconductivity, Quantum efficiency (internal and external).	11 Hrs	
Unit-II: Optoelectronic Devices-I (Light Detecting Devices)	Principle of photo detection; LDR : Theory, working principle, Applications; PN Junction Photodiode : Structure, Working principle, Applications; PIN Photodiode : Structure, Working principle, Advantages of PIN Photodiode, Applications; Phototransistors : Structure and Working Principle, Modes of Operation, Circuit Configuration, Types of Phototransistors, Performance Parameters, Characteristics, Advantages, Applications; Photovoltaic Device (Solar Cell) : Principle, Construction, Working, Characteristics, Application.	11 Hrs	
Unit-III: Optoelectronic Devices-II (LED & LCD)	Light-Emitting Diode (LED) : Introduction, Theory, Construction, Working, I-V Characteristics of LED, Different coloured LEDs, Applications; O-LED : Construction, Working, Applications; Laser Diode : Introduction, construction, working, Advantage and Disadvantage, Application; Liquid Crystal Display (LCD) : structure, working and application, Types of LCD (Dynamic scattering mode, Field effect mode), Advantages & Disadvantages, Applications.	11 Hrs	

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Unit-IV: Optocoupler & Optoelectronic sensors	Optocoupler: Introduction, LED photodiode optocoupler, LED phototransistor optocoupler, Advantage, Disadvantage, Application; Image sensors: CCD (Charge Coupled Devices) and CMOS image sensors, Working principle and pixel architecture of CCD & CMOS, Noise sources in image sensors, Performance parameters: (Resolution, Dynamic range, Frame rate), Applications of CCD & CMOS; Emerging optoelectronic sensors: UV optoelectronic sensor, Gas and chemical optoelectronic sensors, LiDAR (introductory); Applications of optoelectronic sensors (Medical diagnostics, Industrial, Environmental monitoring, Consumer electronics).	12 Hrs
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Reference books

1. Semiconductor Devices - Physics and Technology by S.M. Sze, Wiley, New York.
2. Semiconductor Optoelectronics: Physics and Technology by- J. Singh, McGraw Hill.
3. Semiconductor Optoelectronic Devices by P. Bhattacharya, Pearson Education,
4. Optoelectronics: An Introduction to Materials and Devices, by J. Singh, Tata McGraw Hill.
5. Modern Physics by R. Murugesan & K. Sivaprasath, S. Chand Publication.
6. Optoelectronics and Photonics: Principles and Practices by S. O. Kasap, Pearson.
7. Optoelectronics and fiber optics communication by C. K. Sarkar, D.C. Sarkar. New Age International Pvt Ltd.
8. An Introduction to Optoelectronic Sensors. Edited by: Giancarlo C Righini (CNR, Italy).

Practical Course Code BPH5P12B (Optoelectronics and Devices)

Teaching Hours = 30 (Marks CIE = 50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

1. To study the I-V characteristic and determine the turn-on (knee) voltage for various colours (Red, Green, Blue) LEDs.
2. Study of Photo-Detectors.
3. Study of I-V Characteristics of solar cell to calculate the open circuit voltage, short circuit current and fill factor.
4. Study the reverse-biased characteristics of a photodiode under different light intensities
5. Determine the sensitivity of a photodiode at different wavelengths of light.
6. To study and plot the characteristics of Photo transistors.
7. To study and plot the characteristics of LDR.

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8. Determine the resistance of LDR by varying the intensity of incident light (distance from light source)
9. Design and test a circuit to turn on/off a load using an LDR based on light levels.
10. To study and plot the characteristics of Photovoltaic cell
11. To study and plot the characteristics of Opto-coupler.
12. To measure the numerical aperture of optical fiber using semiconductor diode laser.
13. Study the power output of a solar cell by measuring its V-I characteristics under varying load resistance and light intensity.
14. Study the input-output characteristics of an opto-coupler to measure current transfer ratio.

Course Outcomes (COs)

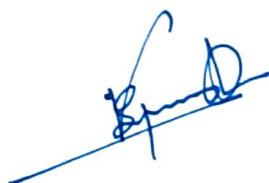
After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Analyze the fundamental physics of semiconductors, including energy band structures and carrier recombination mechanisms.
2.	Understand the operation and performance parameters of various light-detecting devices, such as LDRs, PIN photodiodes, and phototransistors.
3.	Explain the operating principles and characteristics of optoelectronic devices such as solar cells, LEDs, OLEDs, and laser diodes
4.	Describe the structure, working, and applications of display and isolation devices, including LCDs and optocouplers.
5.	Understand the working principles of modern optoelectronic sensors such as CCD, CMOS, UV sensors, gas sensors, and LiDAR.

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B. Sc. Semester-V Minor-5 -PHYSICS - Paper-V			
Course	Name of Course	Theory Course Code	Practical Course Code
Minor-5	Solid State Physics	BPH3T05	BPH3P05
Credits (Th + Pr) = 2+1 = 3	Total Theory Teaching Hours = 30 Marks SEE = 80 IA = 20 Total = 100	Th Hrs/W: 2 Hrs/W	Pr Hrs/W: 2 Hrs/W
Unit-I: Crystal structure	Introduction, Amorphous and Crystalline materials, lattices and basis, fundamental translation vector, Unit cell, Bravais lattices, Cubic crystal structures: SC, BCC and FCC unit cells, Crystal planes and Miller indices, Inter-planer distances, Bragg's law, Crystal structures- NaCl, diamond, CsCl, ZnS		7 Hrs
Unit-II: Crystal Bindings	Crystal Bindings: Classification of Crystals on the Basis of Bonding - Ionic, Covalent, Metallic, van der Waals (Molecular) and Hydrogen bonded. Crystals of inert gases, Attractive interaction (van der Waals London) & Repulsive interaction, Equilibrium lattice constant, Cohesive energy and Compressibility & Bulk modulus, Ionic crystals, Cohesive energy, Madelung energy and evaluation of Madelung constant.		7 Hrs
Unit III: Free electron theory & Band theory of solids	Free electron theory : Drude Lorentz model, Mean free path, Electrical and thermal conductivity, Wiedemann Franz law (Derivation), 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		8 Hrs
Unit IV: Magnetic Materials & Superconductivity	Magnetic materials: Introduction, Origin of magnetism, Types of magnetic materials, Langevin's theory of diamagnetism, Langevin's theory of paramagnetism, Ferromagnetism, Domain theory, Curie temperature, Hysteresis and energy loss, Antiferromagnetism, Neel temperature, Ferrimagnetisms, Soft and Hard magnetic materials, ferrites. Superconductivity: Introduction, Critical temperature, Critical magnetic field, Type-I and Type-II superconductors, Critical current, Meissner effect, Josephson effect & types, Applications of superconductivity, SQUID		8 Hrs

Reference Books:

1. Solid state physics, by S. O. Pillai
2. Solid state physics, by- A. J. Dekker
3. Solid State Physics, by- R. K. Puri, and V. K. Babbar
4. Solid State Physics, by- P. K. Palanisamy
5. Solid State Physics, by- M. A. Wahab

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6. Crystallography Applied to Solid State Physics A. R. Verma, O. N. Srivastava ; Publisher, New Age International, 1991
7. Solid State Physics, by- Gupta Kumar Pragati Publications.
8. Modern Physics, by- R. Mugadeshm.
9. Modern Physics, by- J. B. Rajam, S Chand Publications
10. Modern Engineering Physics by- S. L. Gupta and Sanjeev Gupta
11. Solid State Physics, by H.C. Gupta, Vikas Publishing House Pvt Limited.
12. Materials Science and Engineering , V. Raghavan, Prentice Hall of India Private Limited, New Delhi(2004).
13. Introduction to Solid State Physics ,Kittel, Willey Eastern Ltd (2003).
14. Solid state Physics, Rita John ,1st edition, TataMcGraw Hill publishers (2014).
15. Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003).

Practical Course Code BPH3P05 (Solid State Physics)

Teaching Hours = 30 (Marks SEE+CIE = 25+25 = 50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

Students should perform at least 06 Practical

1. Goniometric study of crystal faces using models.
2. To construct SC, BCC, FCC and to find packing fraction, coordination number.
3. To study the miller indices of the crystal planes in the unit cell of crystalline materials.
4. To determine lattice parameter 'a' of a unit cell of a cubic crystal using X-ray diffraction film.
5. To determine Hall coefficient and mobility of charge carriers in a semiconductor.
6. To determine the energy gap of a semiconductor using four probe methods.
7. To determine the energy gap of a semiconductor using PN junction diode in reverse bias mode.
8. Thermal conductivity of a metal rod using Forbes method.
9. To determine the permittivity of free space.
10. Thermal conductivity of a bad conductor by Lee's disc method.
11. To determine magnetic susceptibility of paramagnetic solution (FeCl_3) by Quincke's method.
12. Study the hysteresis curve of a transformer core and determine the losses in a transformer.
13. Determination of dielectric constant of a solid.
14. Identification of unknown element from a line emission spectra.

Reference and Text Books :

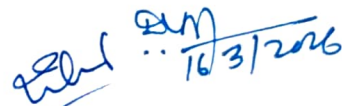
1. B.Sc. Practical Physics, by Harnam Singh and Dr. P. S. Hemne
2. B.Sc. Practical Physics, by C. L. Arora
3. Practical Physics by K. C. Telang
4. Practical Physics by CL Arora S Chand pub
5. University Practical Physics by DC Tayal S Chand Pub
6. Advanced Practical Physics by B. L. Worsnop and H. T. Flint

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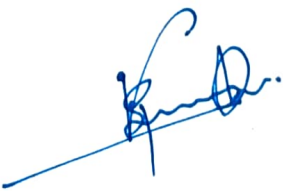
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7. Practical Modern Physics by R. K. Gupta and S. P. Gupta
8. Practical Physics by CL Arora, PS Hemne S Chand
9. A Textbook of Practical Physics, for B.Sc. Students, Balasubramanian S., Ranganathan R., Srinivasan M.N., S Chand pub
10. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann Educational Publishers
11. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
12. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication.

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Classify materials as amorphous or crystalline and explain crystal structures.
2.	Calculate unit cell properties like atomic packing fraction and density.
3.	Apply Bragg's Law to determine crystal structures and use Miller indices.
4.	Differentiate between polar and non-polar dielectrics and analyze polarization.
5.	Analyze magnetic properties and understand diamagnetism, paramagnetism, and ferromagnetism.
6.	Understand band theory to classify metals, semiconductors, and insulators.


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B. Sc. Semester-V Minor-6 -PHYSICS - Paper-VI			
Course	Name of Course	Theory Course Code	Practical Course Code
Minor-6	OPTICS	BPH3T06	BPH3P06
Credits (Th + Pr) = 2+1 = 3	Total Theory Teaching Hours = 30 Marks SEE = 80 IA = 20 Total = 100	Th Hrs/W: 2 Hrs/W	Pr Hrs/W: 2 Hrs/W
Unit-I: Geometric 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; Real and virtual images. Magnification. Image formation by refraction at a spherical boundary and by converging and diverging thin lenses. Derivation of the expression for the focal length of a thin lens.		7 Hrs
Unit-II: Interference	Interference of light- Introduction, 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- Parrot Interferometer and its application.		7 Hrs
Unit III: Diffraction	Diffraction of light- Introduction, 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, Plane diffraction grating, Resolving power of grating, Rayleigh's criterion for resolution.		8 Hrs
Unit IV: Polarization	Polarization- Introduction, Brewster's law, Polarization by scattering (concept only), Uniaxial and biaxial crystal, ordinary and extraordinary rays, Nicol prism, its application as an analyzer and polarizer, phase retardation plate (Half and Quarter wave), Double prism.		8 Hrs

References and Text books -

1. Physics for Degree students for B. Sc. Second year, by- C. L. Arora, Dr. P. S. Hemne.
2. Optics and Spectroscopy, by- R. Murugesan, Kiruthign Sivaprakash.
3. Optics, by- Brijlal and Subramayam, S Chand Publication
4. Optics, by- Ajay Ghatak, McGraw Hill Education India
5. A text book of optics, by- Dr. Subrahmanyam, Brijlal and M. N. Avadhanulu.
6. Optics, by- J. K. Sharma, K. K. Sarkar.
7. Fundamentals of optics, by- Jenkins and white.
8. Optics, by- D. P. Khandelwal.

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9. Electromagnetic field and waves, by- Paul Lorrain and Dale R. Corson.
10. Foundation of Electromagnetic theory, by- John R. Retitz, Fredrick, J. Milford.
11. Introduction to Modern Optics, Grant R. Fowles, Dover
12. Lasers, Anthony E. Siegman Photonics, Saleh Teich
13. Optics, Eugene Hecht, 2019, Pearson
14. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
15. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand Publication

Practical Course Code BPH3P06 (Optics)

Teaching Hours = 30 (Marks CIE = 50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

List of the experiments

1. To produce interference pattern using Lloyd's mirror and to determine the wavelength of sodium light.
2. To determine the focal length of a short focus convex lens by using an auxiliary lens.
3. To determine the refractive index of a material of prism by spectrometer.
4. To determine the dispersive power of a prism.
5. Study of polarization of light by reflection (Brewster's law).
6. To find R.I. of glass by using Brewster's law.
7. To determine the resolving power of a grating.
8. To study diffraction at straight edge and to determine the wavelength of monochromatic light.
9. To determine the resolving power of a telescope.
10. Study of wavelength of Monochromatic source (Sodium) light using plane diffraction grating.
11. To determine the wavelength of prominent lines of mercury by plane transmission grating.
12. To determine wavelength of sodium light using Fresnel Biprism.
13. To determine wavelength of sodium light using Newton's Rings
14. To determine the Resolving Power of a Prism.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint & H. T. Workshop, 1971, Asia Publishing House.
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. B.Sc. Practical Physics, by Harnam Singh and Dr. P. S. Hemne
5. B.Sc. Practical Physics, by C. L. Arora
6. Practical Physics by K. C. Telang
7. Practical Physics by CL Arora S Chand pub
8. University Practical Physics by DC Tayal S Chand Pub

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9. Advanced Practical Physics by B. L. Worsnop and H. T. Flint
10. Practical Modern Physics by R. K. Gupta and S. P. Gupta
11. Practical Physics by CL Arora, PS Hemne S Chand
12. A Textbook of Practical Physics, for B.Sc. Students, Balasubramanian S., Ranganathan R., Srinivasan M.N., S Chand pub
13. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann Educational Publishers
14. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication.

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Describe fundamental principles of geometric optics, including Snell's Law and total internal reflection.
2.	Explain image formation by spherical boundaries and thin lenses.
3.	Analyze interference patterns in thin films for wavelength and refractive index measurements.
4.	Utilize interferometers to determine wavelength differences with precision.
5.	Apply polarization principles such as Brewster's law and Nicol prism.

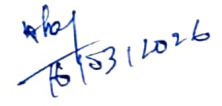
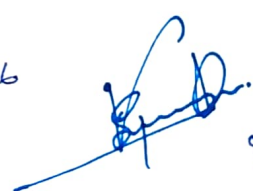
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B. Sc. Physics Semester-V Vocational Skill Course (VSC- 5) Course Code (BVS3P05) (Optical Instruments)			
VSC - 5 Practical		04 Hours / Week Total Teaching Hours = 60	Marks: 100 (SEE=50 , CIE=50) Credit: 02
(Any 10 experiments to be performed)			
Sr. No	Name of Experiment	Expected learning	
1	SPECTROMETER	To study the principle and working of a spectrometer. (Identify parts, align the collimator and telescope of a spectrometer and determine its least count.)	
2	SPECTROMETER	To study the absorption spectrum of KMnO_4 Solution using a Spectrometer (To determine region of dark band, angle of diffraction and wavelength.)	
3	PRISM	To study the basic Principle and Construction of Prism. (To observe refraction, dispersion, total internal reflection of light and to determine angle of minimum deviation.)	
4	PRISM	To study different prism. (Compare refractive indices and dispersive powers of different glass prisms.)	
5	TELESCOPE	To study the principle and working of a telescope. (Align the telescope for normal adjustment and determine its magnifying power, image orientation and aberration.)	
6	OPTICAL BENCH	To study the use of an optical bench for alignment of optical components. (Mount and align lenses/mirrors on the optical bench and observe image formation.)	
7	CONVEX AND CONCAVE LENS	To study Principle and working of convex and concave lens. (Adjust object and screen positions, record distances, and calculate focal length of convex and concave Lens.)	
8	PLANE TRANSMISSION GRATING	To study Principle and working of a plane transmission diffraction grating. (Calibrate the grating to normal incidence. Record the diffraction angles and determine the wavelength of prominent lines of mercury.)	
9	POLARIZER AND ANALYSER	To study the Principle of Polarizer and Analyser. (Use of Polarizer for producing plane-polarized light and analyser for observing changes in intensity of transmitted light)	
10	CALCITE CRYSTAL	To study the principle of double refraction using a calcite crystal. (Place a calcite crystal over a text or light source. Observe two images of the object due to ordinary and extraordinary rays.)	
11	SEXTANT	To study the principle and working of Sextant. (Determine the angle of elevation and height of a tower/building by using a Sextant (Trigonometry method)	



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12	LUX METER	To study the principle and working of Lux meter (To measure illumination of different sources (Mercury lamp, Sodium lamp and LASER light) using a Lux meter.)
13	LASER	To study the principle and working of LASER. (Direct a LASER beam to a simple prism at different angles and observe the critical angle, total internal reflection and refracted rays.)
15	LASER	To study the principle and working of Digital LASER distance meter. (To measure the distance of an object accurately using a digital laser distance meter.)
16	SPHERICAL MIRROR	To study the principle and working of Spherical mirrors. (To determine the image formation, focal length and reflection characteristics by using Spherical mirror)

References:

1. B. Sc. Practical Physics by Harnam Singh, S. Chand & Company Pvt Ltd.
2. Advanced Practical Physics, Vol- I & II by B. L. Worsnop & H.T. Flint, Asia Publishing House, India
3. Practical Physics, C.L. Arora, S. Chand & Company Pvt Ltd.
4. Practical Physics for Degree Classes by R.S. Sirohi, Wiley Eastern [India]
5. Optics- Theory and Experiments by Ajoy Ghatak & K. Thyagarajan, Tata McGraw Hill Education (India).
6. Optics and Optical Instruments by B.K. Johnson.
7. Optical Instrumentation by Satyajit Das.
8. A textbook of Optics by Subrahmanyam and Brij Lal, S. Chand & Company Pvt Ltd.
9. A Textbook of Optics by S.L. Kakani and K.C. Bhandari, Sultan Chand & Sons.
10. Fundamentals of Optics (Fourth Edition) by Francis A. Jenkins & Harvey E. White, McGraw Hill Primus Custom Publishing.

Course Outcomes (COs)

After completing this course, students will be able to:

Sr. No.	Course Outcomes
1.	Apply optical knowledge into real world applications such as optical inspection, basic lens analysis or functioning of optical tools.
2.	Apply the principle of optical systems to use and interpret measurements from instruments such as spectrometer, telescope, optical bench, sextant and Lux meter etc.
3.	Perform practical tasks and hands on skill with optical equipment.
4.	Assess focal length, magnification of optical instruments and compare experimental observations with theoretical predictions.

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B. Sc. Semester-VI Discipline Specific Core Course (DSC-13)-PHYSICS			
Course	Name of Course	Theory Course Code	Practical Course Code
DSC-13	Quantum Mechanics-I	BPH5T09	BPH5P09
Credits(Th+Pr) = 2+1 = 3	Total Theory Teaching Hours = 30 Marks SEE = 80 IA = 20 Total = 100	Th Hours 2 Hrs	Pr Hrs : 2 Hrs
	Quantum Mechanics-I TH		
Unit 1: Origin of Quantum Mechanics	Failure of classical: Black body radiation, photoelectric effect, Compton Effect, Planck's quantum theory, Bohr model of atom, The Franck and Hertz experiment, Stern-Gerlach experiment, Matter waves - De Broglie hypothesis, Davisson and Germer experiment. Concept of wave function, wave packet, phase velocity, group velocity and relation between them, Heisenberg's uncertainty principle with Electron diffraction experiment, different forms of uncertainty, non-existence of free electrons in the nucleus application of Heisenberg's uncertainty principle.		(08 Hr)
Unit 2: The Schrodinger equation	Wave function & Physical interpretation of wave function, Condition of physically acceptable wave function, Normalized and orthogonal wave function, Schrodinger time dependent equation, Schrodinger time independent equation, Probability current density, equation of continuity, and its physical significance, Eigen function and Eigen values, Expectation value, Ehrenfest's theorem (Only statements)		(7 hrs)
Unit 3: Operators in Quantum Mechanics	Definition of an operator, Hermitian Operator, Position (x), Momentum operator (p), angular momentum operator, and total energy operator (Hamiltonian), Commutation relation in quantum mechanics, Commutation relation between x and p, Kinetic energy operator (T), Hamiltonian operator (H), Commutator bracket using position, momentum and angular momentum operator, Concept of parity according to quantum mechanics, parity operator and its Eigen values, Applications of Operators in Quantum Mechanics		(8 hrs)
Unit 4: Applications of Schrodinger equation	Free particle, Step potential, Potential barrier. (Qualitative discussion), Potential Step and Potential Barrier, Quantum Mechanical tunnelling, Particle in infinitely deep potential well (one - dimension), Particle in Finite Potential Well (qualitative treatment), One-Dimensional Harmonic Oscillator, Expectation Values of Position and Momentum, Schrodinger's equation in spherical polar co-ordinate system, Rigid rotator (free axis)		(7 Hrs)

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Reference Books:

1. Eisberg, Robert M., and Robert Resnick. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles. Wiley, 1985. ISBN: 9780471873730.
2. Griffiths, David J. Introduction to Quantum Mechanics. Upper Saddle River, Pearson Prentice Hall, 2005. ISBN: 9780131118928
3. Feynman, Richard P., Robert B. Leighton, and Matthew L. Sands. The Feynman Lectures on Physics. Addison Wesley, 1989. ISBN: 9780201500646.
- 4 N. Zettili, Quantum Mechanics- Concepts and applications, Wiley publication, ISBN: 978-0-47002679-3
5. G Aruldas, Quantum Mechanics, Phi Learning Private Ltd., ISBN : 97881203363
6. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
7. Quantum Mechanics Theory and applications, Ajoy Ghatak, S. Lokanathan, 5th Ed, 2017, Trinity.
8. Quantum Mechanics, Gupta, Kumar, Sharma, Thirteenth Edn., 2011, Jai Prakash Nath Publications.
9. Advanced Quantum Mechanics, Satya Prakash, Reprint 2011, Kedar Nath Ram Nath Meerut.
10. Advanced Quantum Mechanics, B. S. Rajput, Ninth Edn., 2009, Pragati Prakashan.
11. Quantum Mechanics, S. P. Singh, M. K. Bagade, Kamal Singh, S. Chand & company Ltd, New Delhi

DSC- Quantum Mechanics-I

Practical Course Code BPH6P13

Teaching Hours = 30 (Marks SEE+CIE=25+25=50)

Pr Hrs : 2 Hrs/ week Credits = 1

Experiment List:

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the wavelength of H-alpha emission line of Hydrogen atom.
5. To determine the absorption lines in the rotational spectrum of iodine vapour.
6. To study the diffraction patterns of single and double slits using LASER/MASER
7. To measure the intensity variation of LASER/MASER using Photosensor & compare with incoherent source - Na.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. Determination of Planck's constant using photocell.
11. To determine value of e/m of an electron by Busch's helical beam method.
12. Verification of Schrodinger's equation using particle in one dimensional box using computer simulation (Virtual experiment).
13. To solve the Schrödinger equation for a particle confined in a 1D infinite potential well and study its energy eigenvalues and eigenfunctions.

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14. To numerically solve the Schrödinger equation for a finite potential well and determine bound state energies using computer simulation.

15. To solve the Schrödinger equation for a quantum harmonic oscillator and verify quantized energy levels using computer simulation.

Course Outcomes (COs)

After successful completion of this course, the student will be able to:

Sr. No.	
1.	CO1: Explain the experimental evidence that led to the failure of classical physics and the emergence of quantum mechanics, including blackbody radiation, photoelectric effect, Compton effect, and matter waves.
2.	CO2: Interpret the physical significance of wave-particle duality and apply Heisenberg's uncertainty principle to simple quantum systems.
3.	CO3: Formulate and solve the time-dependent and time-independent Schrödinger equations for one-dimensional quantum systems under appropriate boundary conditions.
4.	CO4: Analyze standard quantum mechanical problems such as particle in a box, potential step, potential barrier, and harmonic oscillator using the Schrödinger equation.
5.	CO5: Evaluate expectation values of physical observables and relate eigenvalues and eigenfunctions to measurable quantities.
6.	CO6: Apply operator formalism in quantum mechanics, including commutation relations and Hermitian operators, to understand measurement and observables.

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B. Sc. Semester-VI Discipline Specific Core Course (DSC-14)-PHYSICS - Paper-II (BPH6T14) (Classical Mechanics)			
DSC-14	Hours: 02Th +02 Pr = 04 Hours / week Total Teaching Hours Th=30 & Pr =30	Marks: 100 SEE = 80 & CIE = 20	Credits : 2Th + 1Pr = 03
	Classical Mechanics (TH)		
Unit-I: Advanced Newtonian Mechanics & Systems of Particles	Review of Newton's laws in inertial and non-inertial frames, Galilean transformations, Fictitious forces, Dynamics of a system of particles, Centre of mass and motion of COM, Conservation of linear momentum, Variable mass systems (rocket motion – basic treatment).		(7 Hrs)
Unit-II: Lagrangian Mechanics	Degrees of freedom, Constraints and generalized coordinates, Principle of virtual work, D'Alembert's principle (Statement only), Lagrange's equations of motion, Applications to: Particle in a conservative force field, Simple pendulum, Motion on inclined plane, Atwood machine, Particle under gravity. Cyclic coordinates and conservation laws, Advantages of Lagrangian formulation over Newtonian mechanics		(8 Hrs)
Unit-III: Rotational Dynamics & Rigid Body Motion	Angular momentum and torque, Inertia tensor (qualitative idea), Principal moments of inertia, Euler's equations (elementary treatment), Motion of rigid bodies: Rolling motion, Gyroscopic motion (precession – qualitative), Conservation of angular momentum and applications.		(8 Hrs)
Unit-IV: Central Force Motion & Gravitation	Central force and its properties, Two-body central force problem, Reduction to one-body problem, Motion under inverse square law, Effective potential, Planetary motion, Kepler's laws from Newton's law of gravitation, Gravitational field and potential, Motion of satellites, Escape velocity, Applications in astrophysics (qualitative).		(7 Hrs)

References

Sr. No.	Title of the Book	Author(s)	Publication	Year of pub
1	Classical Mechanics	Herbert Goldstein, Charles P. Poole, John L. Safko	Pearson Education	2002
2	Introduction to Classical Mechanics: With Problems and Solutions	David Morin	Cambridge University Press	2008
3	Classical Mechanics	John R. Taylor	University Science Books	2005

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4	Mechanics (Course of Theoretical Physics Vol. 1)	L. D. Landau and E. M. Lifshitz	Butterworth-Heinemann / Elsevier	1976
5	Mechanics	D. S. Mathur	S. Chand & Company	2014
6	Classical Mechanics	N. C. Rana and P. S. Joag	Tata McGraw-Hill	1991
7	Analytical Mechanics	Fowles & Cassiday	Thomson Brooks/Cole	2005
8	Mechanics	Berkeley Physics Course – Vol. 1 (Charles Kittel, Walter Knight, Malvin Ruderman)	McGraw-Hill	2004
9	Mechanics	Keith R. Symon	Addison-Wesley	1971
10	Introduction to Mechanics	Daniel Kleppner and Robert Kolenkow	Cambridge University Press	2014
11	Classical Mechanics	S. L. Gupta, V. Kumar, H. V. Sharma	Pragati Prakashan	2012
12	Engineering Mechanics (Dynamics)	J. L. Meriam and L. G. Kraige	Wiley	2018
13	Mechanics	A. P. French	W. W. Norton & Company	1971
14	Theoretical Mechanics	M. R. Spiegel	Schaum's Outline Series, McGraw-Hill	1998
15	Problems and Solutions on Mechanics	Yung-Kuo Lim	World Scientific Publishing	1990

Practical Course Code BPH6P14

Teaching Hours = 30 (Marks CIE=50)

Pr Hrs : 2 Hrs/ week Credits = 1

List of Experiments

1. To verify Newton's Second Law of Motion using a trolley and pulley arrangement.
2. To study motion in a non-inertial frame and determine the effect of pseudo (fictitious) force using an accelerating platform or lift model.
3. To verify the law of conservation of linear momentum using collision of two trolleys (or air track).
4. To determine the centre of mass of an irregular lamina by suspension method.
5. To study the dynamics of a system of particles using coupled masses and pulleys.

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6. To study variable mass system (rocket motion model) using water rocket or balloon propulsion experiment.
7. To verify Lagrange's equation for a simple pendulum by comparing with Newtonian approach.
8. To determine acceleration due to gravity using Atwood machine.
9. To study motion on an inclined plane using generalized coordinates and verify Lagrange's equation.
10. To verify the principle of virtual work using a lever or pulley system.
11. To study cyclic coordinates and conservation of momentum using rotating platform experiment.
12. To determine the moment of inertia of a flywheel about its axis of rotation.
13. To determine the moment of inertia of a rigid body (disc or ring) using torsional pendulum.
14. To study rolling motion of a solid cylinder and hollow cylinder and compare their accelerations.
15. To study gyroscopic motion (precession) and verify conservation of angular momentum using a gyroscope.
16. Determination of 'g' using Kater's pendulum.
17. Determination of coefficient of restitution using collision apparatus.
18. Study of rolling motion on an inclined plane and verification of energy conservation using Tracker software.
19. Determination of moment of inertia of a rigid body using bifilar suspension.
20. To study motion under central force using a conical pendulum (effective potential idea).
21. Verification of parallel and perpendicular axis theorems.
22. Error analysis and graphical interpretation of rotational motion data.

Course Outcomes

On successful completion of the course, students will be able to:

Sr. No.	Expected Course Outcome
1.	Analyse motion in inertial and non-inertial frames using Newton's laws, Galilean transformations, and fictitious forces.
2.	Formulate and solve equations of motion for constrained systems using Lagrange's equations and apply them to simple mechanical systems.
3.	Evaluate rotational motion of rigid bodies using concepts of torque, angular momentum, and conservation principles.
4.	Solve problems related to central force motion, including planetary motion, satellite motion, and escape velocity using effective potential and inverse square law.
5.	Demonstrate understanding of conservation laws (linear and angular momentum, energy) and apply them to real physical systems and qualitative astrophysical applications.

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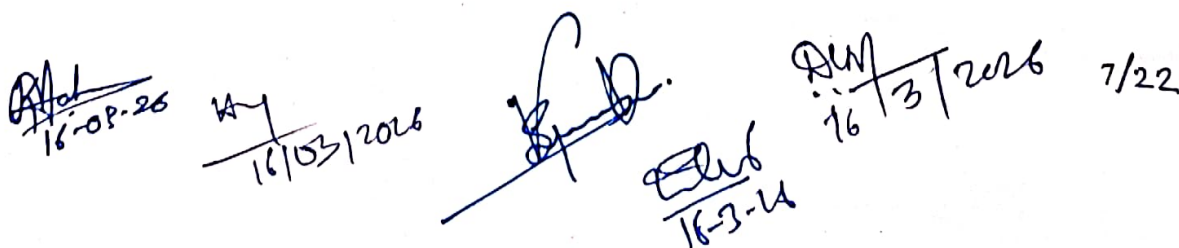
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B. Sc. Semester-VI Discipline Specific Core Course (DSC-15)-PHYSICS - Paper-II (BPH6T15) (Atomic and Molecular Physics)			
DSC-14	Hours: 02Th +02 Pr = 04 Hours / week Total Teaching Hours Th=30 & Pr =30	Marks: 100 SEE = 80 & CIE = 20	Credits: 2Th + 1Pr = 03
	Atomic and Molecular Physics (TH)		
Unit-I Fundamentals of Atomic Structure (Basic)	Vector Atom Model: Concept of spatial quantization and electron spin; Stern-Gerlach experiment (Principle and conceptual outcome). Quantum Numbers: Introduction to the four quantum numbers (n, l, m_l, m_s); Pauli's Exclusion Principle. Coupling Schemes: L-S (Russell-Saunders) coupling and j-j coupling schemes; Spectral terms and notation ($^{2S+1}L_J$); Selection rules for electric dipole transitions.		7 Hrs
Unit-II Atomic Spectra and Interaction with Fields (Intermediate)	Alkali Spectra: Fine structure of Sodium D-lines; Spin-orbit interaction (qualitative). Effect of Magnetic Field: Normal and Anomalous Zeeman Effect (Physical explanation and vector model diagrams); Landé g-factor. Paschen-Back & Stark Effects: Qualitative description of the Paschen Back effect (strong field) and Stark effect (electric field splitting).		7 Hrs
Unit III Molecular Physics and Spectroscopy (Advanced)	Molecular Spectra: Difference between atomic and molecular spectra; Born-Oppenheimer approximation. Rotational Spectra: Rigid rotator model; Energy levels (E_J) and spectrum of diatomic molecules; Determination of bond length. Vibrational Spectra: Simple Harmonic Oscillator model; Vibrational energy levels; Anharmonicity and Morse potential (qualitative). Raman Effect: Rayleigh vs. Raman scattering; Stokes and Anti-Stokes lines; Quantum theory of Raman effect.		8 Hrs
Unit IV Electronic Transitions & Modern Applications	Electronic Spectra: Potential energy curves; Franck-Condon Principle (vibrational intensity distribution). Advanced Raman Applications: Use of Raman spectroscopy in chemical "fingerprinting," Material Science (Graphene/Carbon nanotubes), and Biomedicine. Spin Resonance (Introductory): Principles of NMR (Nuclear Magnetic Resonance) and ESR (Electron Spin Resonance); Resonance conditions and Larmor precession. Hyperfine Structure: The influence of nuclear spin on atomic spectra (qualitative).		8 Hrs

References:

1. Concepts of Modern Physics, Arthur Beiser (Tata McGraw Hill).



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2. Introduction to Atomic Spectra, H.E. White (McGraw Hill).
3. Fundamentals of Molecular Spectroscopy, C.N. Banwell (Tata McGraw Hill).
4. Atomic and Molecular Physics, Raj Kumar (Campus Books).
5. Physics of Atoms and Molecules by Bransden & Joachain.
6. Atomic Physics (Modern Physics) by Dr. S.N. Ghoshal (S. Chand Publishing): Covers atomic structure, X-rays, and spectra.
7. Atomic and Molecular Physics by Dr. P.S. Tambade et al. (Nirali Prakashan)
8. Atomic and Molecular Physics by Raj Kumar (Campus Books)
9. Atomic and Molecular Spectroscopy by Mool Chand Gupta (New Age International)
10. Elements of Spectroscopy by Gupta (Pragati Prakashan)
11. Atomic and Molecular Physics by Shubham Rastogi (IFAS Publications)
12. Modern Atomic Physics by Vasant Natarajan
13. Molecular Structure and Spectroscopy by G. Aruldas (PHI Learning)
14. Fundamentals of Molecular Spectroscopy by Colin N. Banwell (Tata McGraw-Hill India)
15. A Student's Guide to Atomic Physics. By M. Fox, Cambridge University Press
16. Atomic Physics for Everyone by W. Raven, Springer Nature Switzerland
17. Atomic and Molecular Physics by Rajesh Srivastava (Narosa Publishing House)
18. Atomic and Molecular Spectroscopy by Mool Chand Gupta (New Age International)
19. Elements of Spectroscopy by Gupta, Kumar & Sharma (Pragati Prakashan)
20. Vibrational Spectroscopy: Theory and Applications by D.N. Sathyanarayana (New Age International)
21. Fundamentals of Molecular Spectroscopy by P.S. Sindhu (New Age International)
22. Molecular Structure and Spectroscopy by G. Aruldas (PHI Learning)
23. Applied Raman Spectroscopy: Concepts, Instrumentation, Chemometrics, and Life Science Applications (Ed. Vivek Kumar Singh, Elsevier)
24. Raman Spectroscopy: Advances and Applications by Dheeraj Kumar Singh, Ashish Kumar Mishra, et al. (Springer)
25. Elements of Spectroscopy by Gupta, Kumar & Sharma (Pragati Prakashan)
26. Journey Into Light: Life and Science of C.V. Raman by G. Venkataraman.

DSC Practical Course Code BPH6P15

Atomic and Molecular Physics

Teaching Hours = 30 (Marks SEE+CIE=25+25=50)

Pr Hrs : 2 Hrs/ week

Credits = 1

List of experiments: Perform any 6 experiments

~~Section 1: Basic Optical & Fundamental Constants (10 Experiments)~~

1. ~~Refractive Index of Glass: Use a spectrometer and a sodium lamp to find the refractive index (μ) of a glass prism.~~
2. ~~Dispersive Power: Measure the angular separation of Mercury spectral lines to calculate the Dispersive Power of a Prism.~~

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3. Newton's Rings: Determine the wavelength of Sodium light (λ) by measuring the diameters of interference rings.
4. Cauchy's Constants: Use a spectrometer to determine the Cauchy's Constants of a glass prism using multiple wavelengths.
5. Single Slit Diffraction: Determine the wavelength of a Laser source by analyzing the diffraction pattern width.
6. Polarization (Malus's Law): Verify the Law of Malus using two polaroids and a light intensity meter.
7. Inverse Square Law: Verify the intensity-distance relationship using a photodiode and a point light source.
8. Stefan's Law: Experimentally verify the Stefan-Boltzmann Law of radiation using a torch bulb filament.
9. Resolving Power: Determine the resolving power of a telescope or a transmission grating.
10. Brewster's Angle: Measure the angle of polarization to find the refractive index of a glass plate.

Section 2: Advanced Atomic & Molecular Spectroscopy (10 Experiments)

1. ~~11.~~ Rydberg Constant: Determine 'R' by measuring the wavelengths of the Balmer Series in a Hydrogen discharge tube.
2. ~~12.~~ Sodium Fine Structure: Measure the wavelength separation ($\Delta\lambda$) of the Sodium D-lines (Spin-Orbit splitting).
3. ~~13.~~ Franck-Hertz Experiment: Verify discrete energy levels and determine the Excitation Potential of Argon/Neon.
4. ~~14.~~ Planck's Constant: Determine 'h' using the ^{Photodiode} Photoelectric Effect or LED threshold voltage method.
5. ~~15.~~ Zeeman Effect: Observe the splitting of spectral lines in a magnetic field and determine the Bohr Magneton.
6. ~~16.~~ Absorption Spectrum of Iodine: Determine the dissociation energy of Iodine vapour through spectral band convergence.
7. ~~17.~~ ESR Spectroscopy: Determine the Landé g-factor of a free electron using an Electron Spin Resonance setup.
8. ~~18.~~ Specific Charge (e/m): Determine the $\frac{e}{m}$ ratio of an electron using the Magnetron or Thomson method.
9. ~~19.~~ Raman Spectrum Analysis: Calculate vibrational frequencies and force constants from provided Raman spectra of CCl_4 or Benzene.
10. ~~20.~~ Ionization Potential: Measure the ionization potential of Mercury using a gas-filled thyratron or diode.
11. Study of IR spectra (Band spectra) of polar diatomic molecule.
12. Identification of unknown element from line of emission spectra.

COURSE OUTCOMES

After completing this course, students will be able to:

Sr. No.	Course outcome
1.	Analyze the historical failures of classical physics and the necessity of quantum mechanical models.

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2.	Calculate spectral terms and predict the splitting of atomic lines in magnetic and electric fields.
3.	Distinguish between rotational, vibrational, and electronic transitions in molecules.
4.	Interpret Raman and IR spectra to determine the structural properties of diatomic and polyatomic molecules.
5.	Apply the principles of resonance spectroscopy (NMR/ESR) to understand modern diagnostic tools.

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B. Sc. Semester-VI Discipline Specific Elective Course (DSE-2A)-PHYSICS - Paper-II (BPH6T16A) (Analogue and Communication Electronics)			
DSE-2A	Hours: 03Th +02 Pr = 05 Hours / week Total Teaching Hours Th=45 & Pr =30	Th Marks: 150 SEE = 120 & CIE = 30	Credits: 4 3Th + 1Pr = 04
	Analogue and Communication Electronics (TH)		
Unit-I Operational Amplifier and Linear IC Applications	Introduction to differential amplifier, concept of differential and common-mode signals, (qualitative idea), Common Mode Rejection Ratio (CMRR), Operational Amplifier: Ideal and practical characteristics including open loop gain, input and output impedance, CMRR and slew rate. Concept of virtual ground. Op-amp configurations: Inverting amplifier, Non-inverting amplifier and Voltage follower with gain expressions. Op-amp applications: Integrator and Differentiator circuits, active low pass and high pass filters, comparator and zero-crossing detector. Introduction to IC 555		11 Hrs
Unit-II Principles of Analog Communication	Basic elements of a communication system with block diagram; concept of communication channel and bandwidth; baseband and passband signals; Basic block diagram of Transmitter; carrier signal and qualitative idea of modulation process. Amplitude Modulation (AM): Expression for AM wave, modulation index, frequency spectrum, sidebands, bandwidth, power relations, generation and envelope detection. Frequency Modulation (FM): Expression for FM wave, frequency deviation, modulation index, frequency spectrum, bandwidth using Carson's rule and comparison between AM and FM. Noise in communication systems: sources of noise, concept of signal-to-noise ratio, Demodulation and Concepts in demodulation (Qualitative) Types of wireless communication: Radio waves used for communications, standard frequency bands (VLF to EHF) with typical applications; basic principles of wireless systems such as radio, television, satellite, radar, cellular and Wi-Fi communication.		11 Hrs
UNIT-III Digital and Pulse Communication	Pulse modulation techniques: Pulse amplitude modulation (PAM), pulse width modulation (PWM) and pulse position modulation (PPM). Nyquist sampling theorem and aliasing. Pulse code modulation (PCM): quantization, block diagram of PCM system, advantages and limitations. Basic concepts and block diagram representation of digital modulation techniques such as amplitude shift keying (ASK), frequency shift keying (FSK) and phase shift keying (PSK).		11 Hrs
UNIT-IV Modern	Microwave communication: frequency range, line-of-sight propagation and applications. Introduction to rectangular waveguides, concept of wave propagation in waveguides, modes of propagation		12 Hrs

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Communicati on Systems	(TE and TM modes) (qualitative treatment only) and cutoff frequency (concept only). Radar communication: basic principle, radar equation (conceptual understanding), block diagram of radar system and applications. Satellite communication: geostationary satellites, basic components of satellite communication system and transponder. Mobile communication: cellular concept, frequency reuse and basic architecture of mobile communication system. Receiver Concepts and Circuits (Qualitative Treatment): Basic block diagram of receiver; RF amplifier, mixer, local oscillator, IF amplifier, detector and audio amplifier (functional understanding only).	
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Text Books/ Reference Books:

1. V. K. Mehta - Principles of Electronics, S. Chand and Co. Ltd., 2004.
2. Anokh Singh and Chopra A.K., Principles of communication Engineering, S. Chand and Co, 2013
3. J. S. Chitode, Digital Communications, 2020, Unicorn publications
4. Senior John. M, Optical Fiber Communications: Principles and Practice, 2009, Pearson Education.
5. B. L. Theraja - A Text Book of Electrical Technology.
6. John D. Ryder - Electronic fundamentals and Applications.
7. Malvino - Electronic Principles, Tata McGraw Hill.
8. Bagde and S. P. Singh - Elements of Electronics.
9. M. I. Skolnik, Introduction to Radar Systems, McGraw-Hill.
10. Dennis Roddy, Satellite Communications, McGraw-Hill.
11. D. C. Agrawal and A. K. Maini, Satellite Communication, Wiley India.
12. Michael O. Kolawole, Satellite Communication Engineering, CRC Press.
13. A. K. Maini, Digital and Analog Communication Systems, Wiley India.
14. Samuel Y. Liao, Microwave Devices and Circuits, Pearson Education.
15. T. S. Rappaport, Wireless Communications: Principles and Practice, Pearson Education.
16. William C. Y. Lee, Mobile Cellular Telecommunications, McGraw-Hill.
17. David M. Pozar, Microwave Engineering, Wiley.
18. Simon Haykin, Communication Systems, Wiley India.
19. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017.
20. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford Press.

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B. Sc. Semester-VI
Discipline Specific Elective Course (DSE-2A)-PHYSICS (BPH6T16B)
(Analog Electronics and Communication Systems)
Credits = 01 (Examination/ Evaluation = CIE = 50 Marks)
Total Teaching Hours 30 (2 lectures per week)

List of Experiments

1. To study the characteristics of Op. Amp. IC 741 and verify inverting and non-inverting amplifier configurations.
2. Study of Op. Amp. as an Inverting and Non-Inverting amplifier.
3. Study of Op. Amp. as an Adder and Subtractor.
4. To design an integrator circuit using Op. Amp. and
5. To design a differentiator circuit using Op. Amp. and verify its response.
6. To construct and determine the cutoff frequency of an active low pass filter using Op-Amp.
7. To construct and determine the cutoff frequency of an active high pass filter using Op-Amp.
8. To study the working of Op-Amp as a comparator and zero-crossing detector.
9. To study the following mathematical operations using Operational Amplifier using virtual lab. (a) Addition, (b) Subtraction and (c) Multiplication/division by a constant.
10. To study IC 555 timer in astable mode and determine its frequency and duty cycle.
11. To study IC 555 timer in monostable mode and determine the pulse width.
12. To generate an amplitude modulated (AM) signal and determine its modulation index.
13. To study the detection of an AM signal using an envelope detector.
14. To study the diode as an AM detector.
15. To study of Frequency modulation using IC and determine its modulation index.
16. Study of FM detector using IC.
17. To study pulse amplitude modulation (PAM) and observe the sampled waveform.
18. To verify the sampling theorem and observe aliasing effect.
19. To study pulse code modulation (PCM) using a trainer kit.
20. To study basic digital modulation techniques (ASK/FSK) using a trainer kit.
21. To study signal transmission through optical fibre and observe attenuation characteristics.
22. Study of basic Satellite Communication system.
23. Study of 5G Smart phone and understanding 5G technology.
24. To perform the 5G-compliant waveform generation and testing in MATLAB (or any other) software.
25. To simulate and analyze the propagation characteristics of wireless signals in 5G networks using MATLAB (or any other) software.

Course Outcomes

After completion of this course, students will be able to:

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Sr. No.	Course outcome
CO 1.	Explain the working and applications of differential amplifiers, operational amplifiers, and IC 555 timer.
CO 2.	Describe the principles of analog communication including modulation techniques, bandwidth, guard band, and wireless frequency ranges.
CO 3.	Explain pulse and digital modulation techniques used in communication systems.
CO 4.	Describe the basic principles of modern communication systems, receivers, and antennas (qualitative understanding).

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B. Sc. Semester-VI Discipline Specific Elective Course (DSE-2B)-PHYSICS - Paper-II (BPH6T16B) (Astrophysics And Special Theory of Relativity)			
DSE-2B	Hours: 03Th +02 Pr = 05 Hours / week Total Teaching Hours: Th=45 & Pr=30	Th Marks: 150 SEE = 120 & CIE = 30	Credits: 4 = 3Th + 1Pr = 04
	Astrophysics And Special Theory of Relativity (TH)		
UNIT-I Fundamentals of Astrophysics	Introduction to Astrophysics: astronomical coordinate systems, the constituents of universe (Solar system, Galaxies: Types and structure), to measure size of a planet. To measure distance of a planet by parallax method, Mass of the sun and the planet, Structure of sun, Solar interior, surface temperature of sun, Solar luminosity, Stellar spectra.		11 Hours
UNIT-II Stellar Evolution and Cosmology	Birth of stars: Nebulae and protostars, Main sequence stars and energy production (nuclear fusion), Red giants, white dwarfs, neutron stars, and black holes, Supernovae and their importance Introduction to Cosmology: Big Bang theory, expanding universe, Hubble's law, The Milky way (shape, size, clusters), Cosmological theories of the universe (Concept only)		11 Hours
UNIT-III Foundations of Special Theory of Relativity	Inertial and non-inertial frames of reference, Galilean transformations and their limitations, Michelson-Morley experiment, Einstein's postulates of Special Relativity, Lorentz transformations (derivation), Length contraction and time dilation, Relativity of simultaneity		12 Hours
UNIT-IV Relativistic Mechanics	Velocity addition formula, Variation of mass with velocity, Mass-energy equivalence ($E = mc^2$), Relativistic momentum and energy, Twin paradox, Experimental verification of relativity, Applications of Special Relativity in modern physics		11 Hours

Reference books

1. The Great Universe, by- G. K. Sasidharan, S Chand publications.
2. University physics, by- H. D. Young, R. A. Freedman.
3. Astronomy structure of the universe, by- A. E. Roy, D. Clarke, Adam Hilger Pub.
4. Relativity: The Special and the General Theory by Albert Einstein
5. Nuclear Physics, by- S. N. Ghoshal.
6. Atomic and Nuclear physics, by- N. Subramanyam, Brijlal.
7. Introduction to Nuclear physics, by- H. A. Enge.
8. Introduction to Special Relativity by Robert Resnick
9. Fundamentals of Nuclear Physics by- R. Kohale, S.J. Dhoble, V. Chopra
10. Atomic and Nuclear physics, by- T. A. Littlefield, N. Thorley.
11. Introduction to special theory of Relativity, by- Shrivastava
12. Elements of special theory of Relativity, by- S. P. Singh and M. K. Bagde.
13. Introduction to theory of Relativity, by- P. G. Bergmann
14. Astrophysics for Physicists by- Arnab Rai Choudhuri
15. An Introduction to Modern Astrophysics- by Bradley W. Carroll and Dale A. Ostlie
16. Fundamentals of Astrophysics by Stan Owocki
17. Spacetime Physics by Edwin F. Taylor and John Archibald Wheeler

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Discipline Specific Elective Course (DSE-2B)-PHYSICS (BPH6P16B)
(Astrophysics And Special Theory of Relativity)

Credits = 01

Total Teaching Hours 30)

(2 lectures per week

List of Experiments

1. Study of Constellations (Identification of major constellations using a star chart or planetarium software (e.g., Stellarium).
2. Measurement of Solar Parameters (Estimation of the Sun's diameter using pinhole projection, Calculation of solar rotation (using sunspot data if available).
3. Hertzsprung–Russell (H-R) Diagram (Plot an H-R diagram using provided stellar data, Classify stars into main sequence, giants, and white dwarfs)
4. Study of Stellar Spectra (Identification of spectral lines using spectroscopic data, Classification into O, B, A, F, G, K, M types.)
5. Verification of Wien's Displacement Law (Use blackbody radiation simulation to find peak wavelength, Calculate surface temperature of stars)
6. Determination of Distance Using Parallax Method (Calculate stellar distances from parallax angle data, Understand limitations of the method.)
7. Kepler's Third Law (Verify using planetary orbital data, Determine mass of the Sun (approximate).
8. Study of Phases of the Moon (Observation/simulation of lunar phases and orbital period)
9. Resolving Power of Telescope (Experimentally determine resolving power and compare with theoretical value)
10. To produce interference pattern using Lloyd's mirror and to determine the wavelength of sodium light.
11. To determine the dispersive power of a prism.
12. Study of polarization of light by reflection (Brewster's law).
13. To find R.I. of glass by using Brewster's law.
14. To determine the resolving power of a grating.
15. To study diffraction at straight edge and to determine the wavelength of monochromatic light.
16. Study of wavelength of light using plane diffraction grating.
17. To determine the wavelength of prominent lines of mercury by plane transmission grating.

COURSE OUTCOMES

After this course the students will be able to

CO1: Explain astronomical coordinate systems, stellar properties, and the H-R diagram.

CO2: Describe stellar evolution processes and basic cosmological models.

CO3: Understand and derive Lorentz transformations and relativistic effects.

CO4: Apply relativistic mechanics concepts such as mass-energy equivalence and momentum.

CO5: Analyze experimental evidence supporting Special Theory of Relativity.

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B. Sc. Semester-VI Minor-7 Course (Minor-7)- PHYSICS Course code BPH4T07 (LASERS AND OPTICAL FIBERS)			
DSC THEORY BPH3T05	Hours: 2 Hr Th Hours /Week	Theory marks = 100 SEE = 80 Marks CIE= 20 Marks	Credit: 2
DSC Practical BPH3P05	Hours/ week = 2 Hours	Practical Marks = 50 SEE = 25 Marks CIE= 25Marks	Credit: 1
Unit-I LASER and MASER	Introduction to LASER, Properties of LASER, Spatial and temporal coherence, purity of spectral line, Interaction of Radiation with Matter, , Einstein's co-efficient (derivation), Induced absorption, Spontaneous and stimulated emission, Population inversion, Active material, Optical pumping, Resonant cavity, Three level and four level laser system. MASERS,		8 Hrs
Unit-II Laser Types and Applications	Laser Types: Solid State laser (Ruby Laser) Construction and working of Ruby Laser, Gas laser (He-Ne Laser), Semiconductor Laser, Idea of Tuneable Lasers. Application of lasers: General Applications of Lasers in industry: Laser Printer, Bar Code reader, Optical reading and writing on CD and DVD, Laser Machining, drilling and cutting, defence, medicine-surgery, space, entertainment, Laser communications, Holography		7 Hrs
Unit-III Basic Principles of Fiber Optic	Basic Principles of Fiber Optics- Introduction, Basic structure, Total Internal reflection, Propagation of light in optical fiber, Acceptance angle and acceptance cone, Numerical aperture, Normalized frequency (V-number), Classification of Optical Fibers: Single mode and multimode fibers, Step indexed and Graded index fibers. Optical fiber losses (attenuation, absorption, scattering, bending, etc.), Dispersion in optical fiber, Pulse broadening.		8 Hrs
Unit-IV Applications of Optical Fibers	Applications of Optical Fibers : Fiber Optics Communication- Need of fiber optic communication, Optical fiber Communication System, Optical Sources, Optical Detectors Optical transmitters and receiver, Optical filters and Couplers, Optical amplifiers, Fiber optic sensors Medical Applications of optical Fibers: Medical Endoscopy, Military applications,		7 Hrs

Reference and Text Books

1. William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).
2. B. B. Laud,, "Lasers and Non-linear Optics", New Age International (P) Ltd., New Delhi.

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3. Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).
4. K. R. Nambiar, "Lasers: Principle, Types and Applications", New Age International (P) Ltd., New Delhi.
5. T. Suhara, "Semiconductor Lasers Fundamentals", Marcel Dekkar (2004).
6. A. K. Ghatak and K. Thyagarajan, "Laser: Theory and Applications", McMillan (2003).
7. Optical Fiber Communications – Gerd Keiser, Tata Mc Graw-Hill International edition, 4th Edition, 2008.
8. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.
9. R. Allen Shotwell, "An introduction to fiber optics".
10. Ghatak A K and Thyagarajan, "Introduction to Fiber Optics", K Cambridge University Press.
11. John M. Senior, "Optical fiber communication".
12. Joseph C Palais, "Fiber optic communication", 4th Edition, Pearson Education.
13. Govind P. Agrawal, "Fiber-Optic Communication Systems", John Wiley & Sons, Third edition (2002)
14. Senior J.M, —Optical Fibre Communication - Principles and Practicel, Prentice Hall of India, 1985.
15. Wilson J and Hawkes J.F.B, —Introduction to Opto Electronicsl, Prentice Hall of India, 2001.
16. Keiser G, —Optical Fibre Communicationl, McGraw Hill, 1995.
17. Arumugam M, —Optical Fibre Communication and Sensorsl, Anuradha Agencies, 2002.
18. John F. Read, —Industrial Applications of Lasersl, Academic Press, 1978.
19. Monte Ross, —Laser Applicationsl, McGraw Hill, 1968.
20. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
21. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.
22. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.

Reference Books

1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
2. Lasers: Fundamentals and Applications by K. Thyagarajan and Ajoy Ghatak
3. Fiber Optics and Optoelectronics by R.P. Khare
4. Optoelectronics and Fiber Optics Communication by C.K. Sarkar and D.C. Sarkar
5. An Introduction to Lasers: Theory and Applications by M.N. Avadhanulu
6. B.Sc. Practical Physics, by Harnam Singh and Dr. P. S. Hemne
7. B.Sc. Practical Physics, by C. L. Arora
8. Practical Physics by K. C. Telang
9. Practical Physics by CL Arora S Chand pub
10. University Practical Physics by DC Tayal S Chand Pub
11. Practical Modern Physics by R. K. Gupta and S. P. Gupta
12. Practical Physics by CL Arora, PS Hemne S Chand

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13. A Textbook of Practical Physics, for B.Sc. Students, Balasubramanian S., Ranganathan R., Srinivasan M.N., S Chand pub
14. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann Educational Publishers
15. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication.

B.Sc. Semester -VI
Discipline Specific Core Course (DSC)-PHYSICS BPH4P07
Practical / Laboratory-2

Credits=01

Hours = 30

[50 Marks] CIE = 50

List of the experiments-

1. To study the Snell's laws of reflection at optical boundaries by LASER
2. To study the laws of refraction at optical boundaries by LASER.
3. To find the wavelength of LASER light by plane diffraction grating
4. To study the diffraction of LASER light by a thin straight wire.
5. To study the LASER beam divergence
6. To study the attenuation of intensity of LASER light
7. To find the numerical aperture of optical Fiber
8. Determination of Acceptance Angle and Numerical Aperture of an optical fiber.
9. To study the Characteristics of LED.
10. To study the Characteristics of Photo Diode
11. Measurement of Losses in Optical Fibers
12. Determination of particle size using LASER source
13. To set-up and study communication system using optical fibre.
14. To determine the focal length of convex lens using LASER
15. Determining Wavelength of Laser Using a Ruler.

Course Outcomes

1. Understand LASER and MASER Fundamentals: Describe the basic principles and properties of LASER and MASER technologies.
2. Explain Coherence and Spectral Purity: Discuss spatial and temporal coherence and its importance in laser technology.
3. Differentiate Laser Types: Identify and compare different types of lasers, including solid-state, gas, and semiconductor lasers.
4. Evaluate Laser Applications: Discuss various applications of lasers in industries such as medicine, defence, and communications.
5. Comprehend Fiber Optics Principles: Explain the fundamental principles of fibre optics, including total internal reflection and numerical aperture.

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6. Classify Optical Fibers: Differentiate between single-mode and multimode fibres, as well as step-index and graded-index fibres.
7. Assess Optical Fiber Losses: Analyse the types of losses in optical fibres, including attenuation and dispersion.
8. Explore Fiber Optic Applications: Describe the applications of optical fibres in communication and medical fields, including endoscopy and sensing technologies.

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B. Sc. Semester-VI
Vocational Skill Course (VSC - 5) - PHYSICS Course Code (BVS6P08)
(Installation and Maintenance of Roof Top of Solar Panel) Systems

VSC-5 Practical	04 Hours /Week Total 60 Hours	Marks: 100 (SEE+CIE=50+50)	Credit: 02
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List of Experiments:

1. To study solar energy and the rooftop solar PV (Photovoltaic) system and understand its need.
2. To identify the components: solar panel, inverter, charge controller, battery, DC/AC cables, earthing, and mounting structure.
3. To study the types of solar PV panels and compare monocrystalline, polycrystalline, and bifacial (single-side and dual-side) panels based on efficiency, cost, and applications.
4. To determine the optimum tilt angle and orientation of rooftop solar panels.
5. To study a mounting structure for rooftop solar panels by calculating panel dimensions, spacing, height, and considering wind load effects.
6. To study different types of mounting structures—L-angle, C-channel, and pipe structures and identify the materials used in rooftop solar installations.
7. To calculate the required dimensions of mounting pipes and channels based on the load of solar panels and an appropriate safety factor.
8. To study the I-V and P-V characteristics of a solar panel.
9. To calculate the power output and efficiency of a solar panel using the panel area and solar irradiance.
10. To design series and parallel connections of solar panels and calculate the resulting voltage and current for different configurations.
11. To calculate the required solar plant capacity (in kW) based on the customer's needs/requirements.
12. To study of DC and AC wiring in rooftop solar PV systems.
13. To study earthing and lightning protection in solar PV systems and measure earth resistance to ensure safety.
14. To study and perform wiring of solar inverters (on-grid, off-grid, and hybrid) and understand their input-output connections and working principle.
15. To measure energy generation using a solar energy meter and monitor real-time voltage, current, power, and energy parameters.
16. To estimate the cost of a rooftop solar installation by preparing a detailed cost breakup of panels, inverter, mounting structure, wiring, and labour (Estimation of cost of the project).
17. Estimation of electricity bill savings and payback period of a rooftop solar PV system.

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18. To study the documentation, permissions and legal documents required for rooftop solar installation, including the application process for MSEB (MahaDiscom), MEDA, and local authorities.
19. To study of government subsidy schemes for rooftop solar PV systems.
20. To study of warranty and guarantee of solar PV system components.
21. To perform routine maintenance of the installed solar PV system including cleaning of solar panels.
22. To identify common faults in the solar PV system and check the operational efficiency.
23. To compare the energy production of each solar panel.
24. To study corrosion protection and structural safety of rooftop solar mounting structures with reference to galvanization, painting, rust protection methods, and life expectancy.

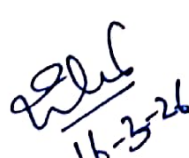
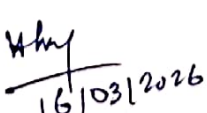
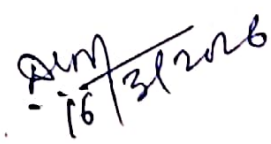
Course outcomes

After the completion of this course students will be able to

1. Understand complete rooftop solar PV system design including mechanical and electrical aspects.
2. Select suitable solar panels based on application, efficiency and cost.
3. Design proper mounting structures by considering angle, direction, height, and safety.
4. Perform accurate power, energy and efficiency calculations for real installations.
5. Estimate required solar capacity (kW) for homes, institutions and industries.
6. Acquaint with basic installation procedure and wiring of rooftop solar systems.
7. Evaluate energy generation, savings, and payback period for consumers.
8. Understand government policies, subsidies, and documentation procedures for solar projects.
9. Monitor performance and carry out routine maintenance of solar PV systems.
10. Work confidently as technician/assistant in rooftop solar installation and maintenance industries or start business related to solar panel system.

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4. Solar Power Engineering; B.H. Khan.
5. Photovoltaic Systems Engineering; Roger A. Messenger & Jerry Ventre.
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7. Handbook on Rooftop Solar PV Systems; Ministry of New and Renewable Energy (MNRE).

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