K.K. UNIVERSITY

NALANDA, BIHAR - 803115

School of Applied Sciences

Bachelor of Physics (B.Sc.)

(Three Years Full Programme)

2023-2024

SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

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Nalanda - 803115 (Bihar)

B.Sc. PHYSICS

Programme/Course Structure

(For total credits: 138)

Year	Semester	Course Code	Course Title	L	T	P	C
1	1	BSPH 1101	Mathematical Physics-I	3	1	0	4
		BSPH 1102	Mechanics	3	1	0	4
		BSPH 1101-P	Practical I- Mathematical Physics-I	0	0	3	3
		BSPH 1102-P	Practical II- Mechanics	0	0	3	3
		BSMT-S 1101	Maths - I	3	0	0	3
		BSCH-S 1101	Chemistry - I	3	0	0	3
		BSCH-S 1101-P	Practical – Chemistry - I	0	0	2	2
		HNL 1101	Hindi - I	2	0	0	2
			Total	**14**	**2**	**10**	**24**
	2	BSPH 1201	Electricity and Magnetism	3	1	0	4
		BSPH 1202	Waves and Optics	3	1	0	4
		BSPH 1201-P	Practical-I- Electricity and Magnetism	0	0	3	3
		BSPH 1202-P	Practical II- Waves and Optics	0	0	3	3
		BSMT-S 1201	Maths - II	3	0	0	3
		BSCH-S 1201	Chemistry - II	3	0	0	3
		BSCH-S 1201-P	Practical – Chemistry - II	0	0	2	2
		ENL 1201	English - I	2	0	0	2
			Total	**14**	**2**	**10**	**24**
2	3	BSPH 2101	Mathematical Physics-II	3	1	0	4
		BSPH 2102	Thermal Physics	3	1	0	4
		BSPH 2101-P	Mathematical Physics-II	0	0	3	3
		BSPH 2102-P	Practical: Thermal Physics	0	0	3	3
		BSMT-S 2101	Maths - III	3	0	0	3
		BSCH-S 2101	Chemistry - III	3	0	0	3
		BSCH-S 2101-P	Practical – Chemistry - III	0	0	2	2
		HNL 2101	Hindi - II	2	0	0	2
			Total	**14**	**2**	**10**	**24**
	4	BSPH 2201	Mathematical Physics-III	3	1	0	4
		BSPH 2202	Elements of Modern Physics	3	1	0	4
		BSPH 2201-P	Practical: Mathematical Physics-III	0	0	3	3
		BSPH 2202-P	Practical: Elements of Modern Physics	0	0	3	3
		BSMT-S 2201	Maths - IV	3	0	0	3
		BSCH-S 2201	Chemistry - IV	3	0	0	3
		BSCH-S 2201-P	Practical – Chemistry - IV	0	0	2	2
		ENL 2201	English - II	2	0	0	2
			Total	**14**	**2**	**10**	**24**
		BSPH 3101	Quantum Mechanics And Applications	3	1	0	4
		BSPH 31102	Solid State Physics	3	1	0	4
		BSPH 3103	Digital Systems and Applications	3	1	0	4

3	**5**	BSPH 3101-P	Quantum Mechanics And Applications	0	0	3	3
		BSPH 3102-P	Solid State Physics	0	0	3	3
		BSPH 3103-P	Digital Systems and Applications	0	0	3	3
			Total	**9**	**3**	**9**	**21**
	6	BSPH 3201	Electromagnetic Theory	3	1	0	4
		BSPH 3202	Statistical Mechanics	3	1	0	4
		BSPH 3203	Analog Systems And Applications	3	1	0	4
		BSPH3 201-P	Practical: Electromagnetic Theory	0	0	3	3
		BSPH 3202-P	Practical: Statistical Mechanics	0	0	3	3
		BSPH 3203-P	Practical: Analog Systems And Applications	0	0	3	3
			Total	**9**	**3**	**9**	**21**

Total Credits: 138 (Six Semesters)

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SEMESTER – I

Year	Semester	Course Code	Course Title	L	T	P	C
1	1	BSPH 1101	Mathematical Physics-I	3	1	0	4
		BSPH 1102	Mechanics	3	1	0	4
		BSPH 1101-P	Practical I- Mathematical Physics-I	0	0	3	3
		BSPH 1102-P	Practical II- Mechanics	0	0	3	3
		BSMT-S 1101	Maths - I	3	0	0	3
		BSCH-S 1101	Chemistry - I	3	0	0	3
		BSCH-S 1101-P	Practical – Chemistry - I	0	0	2	2
		HNL 1101	Hindi - I	2	0	0	2
			Total	**14**	**2**	**10**	**24**

Mathematical Physics-I

Course Code: BSPH - 1101

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the diverse interdisciplinary mathematical applications and techniques of physics.
2. Evaluate the role of Calculus, mathematical series, and perfect and partial differential equations, to solve the problem of physics.
3. Apply the above intuitive methods to find the general solution of various exact and non-exact differential equations.
4. Understand the physical quantities like scalars and vectors, and their use in solving the problem based on the operator method.
5. Demonstrate the physical quantities-based problems, theories and fields, and integrals.
6. Understand the coordinate representation of different types of systems, shapes, and bodies.

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Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	LECTURE HOURS	WEEK ALLOTMENT
Unit I	**Calculus:** Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). First Order Differential Equations and Integrating Factor. **Second Order Differential equations:** Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of Existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. **Calculus of functions of more than one variable:** Partial derivatives, exact and inexact differentials. Integrating factors, with a simple illustration. Constrained Maximization using Lagrange Multipliers.	**20**	**1-4**
Unit II	**Vector Calculus:** Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product, and their interpretation in terms of area and volume respectively. Scalar and Vector fields.	**20**	**5-10**

	Vector Differentiation: Directional derivatives and normal derivatives. The gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl, and Laplacian in Spherical and Cylindrical Coordinates. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. The notion of infinitesimal line, surface, and volume elements. Line, surface, and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes's Theorems and their applications (no rigorous proofs).		
Unit III	**Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl, and Laplacian in Cartesian, Spherical, and CylindricalCoordinate Systems. **Dirac Delta function and its properties:** Definition of Dirac delta function. Representation as the limit of a Gaussianfunction and rectangular function. Properties of Dirac delta function.	**20**	**11-14**

Useful links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLVLoWQFkZbhUuEA7hqM_nb0chQnGQprS5&si=_0LXnnCBZ3gSLqlN

https://youtube.com/playlist?list=PLU6SqdYcYsfJz9FAzbgocIjlkw4NXAar-&si=DL-Mtf9obZnnAmPM

Books Recommended:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical Methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

Mechanics

Course Code: BSPH - 1102

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the fundamental dynamics of systems.
2. Evaluate and apply the dynamical law to solve the problem related to inertial and non-inertial frames.
3. Understand the role of work, energy, and potential in physics.
4. Apply the concept of work, energy, and potential to solve the problem related to conservative and non-conservative systems, rotational and vibrational dynamical systems.
5. Understand the core needs of a planetary system including gravitational force, energy, and momentum.
6. Understand the special theory of relativity under interdisciplinary physics “Classical Mechanics”.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT

Unit I	**Fundamentals of Dynamics:** Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of the rocket.	**15**	**1-3**
Unit II	**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force is the gradient of potential energy. Work & Potential Energy. Work done by non- conservative forces. Law of conservation of Energy. **Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.	**18**	**4-7**
Unit III	**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical, and spherical bodies. The kinetic energy of rotation. Motion involving both translation and rotation. **Elasticity:** Relation between Elastic constants. Twisting torque on a Cylinder or Wire. **Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.	**15**	**8-11**
Unit IV	**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its	**15**	**12-13**

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	solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts. **Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy, and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.		
Unit V	**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. **Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency, and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy- Momentum Four Vector.	**18**	**13-15**

Useful links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLvyl1YgaAepJQ4rqZpRzJS4gD7muINmNM&si=hU-t9cttJ8VYCbuz

https://youtube.com/playlist?list=PLkECWNr1MOgciH8ye_naTd7TZ8D9Aru4Q&si=WwfdCD_5GIozS7sP

https://youtube.com/playlist?list=PL3iiM3Tp4NySd_uEcnqOrdychB50AkQW&si=B6gcrP7Yetec6JPP

https://youtube.com/playlist?list=PLF_7kfnwLFCFS0k0WNHuTvjRxJFKQK5qr&si=scQjUUQTBPz5YD8R

https://youtube.com/playlist?list=PLo0z5T1vb4yfAU3PjKK_di9m47FFlVru&si=Om4u4BbnA4j42T7Q

Books Recommended:

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol. 1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday, and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles, and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M.Sands, 2008, Pearson Education.
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

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Practical-I

Course Code: BSPH – 1101-P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better

problem solvers and good analysts.

Syllabus details:

1. Measurements of length (or diameter) using a vernier caliper, screw gauge, and traveling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the motion of spring and calculate (a) spring constant, (b) g, and (c) modulus of rigidity.
5. To determine the moment of inertia of a flywheel.
6. To determine g and velocity for a freely falling body using the digital timing technique.

Useful links:

https://youtu.be/P79nYATnumo?si=4qlEkHN0FzdJ-YVn

https://youtu.be/DDL__rg2vbg?si=8DEsZ2bNiGp2x8c-

https://youtu.be/G63rLJYJbJk?si=xdm-vLdkPOg13AWg

Practical-II

Course Code: BSPH – 1102-P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better

problem solvers and good analysts.

Syllabus details:

1. To determine the coefficient of viscosity of water by capillary flow method (Poiseuille's method).
2. To determine the Young's Modulus of a wire by optical level method.
3. To determine the modulus of rigidity of a wire by Maxwell's needle.
4. To determine the elastic constants of a wire by Searle's method.
5. To determine the value of g using a bar pendulum.
6. To determine the value of g using Kater's pendulum.

Useful links:

https://youtu.be/PT1ZWLBBHmk?si=zAEnobRmkBRwdgBc

https://youtu.be/jKlZbT7cjt4?si=rR9BxDRde9X_vJ_k

https://youtu.be/WMQZWBi7fbE?si=oHjkjEzl42VZdAyj

https://youtu.be/YoF7RuBZIpM?si=DbC7Dv1YTG7z7Gtn

MATHEMATICS –I

Course Code: BSMT-S- 1101

UNIT	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	Real-valued functions are defined on an interval, the limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions on closed intervals. Statement of the existence of inverse function of a strictly monotone function and its continuity.	**15**	**1-3**
Unit II	Derivative – its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and decreasing functions. Relation between continuity and derivability. Differential – application in finding approximation. Successive derivative – Leibnitz's	**15**	**4-7**
Unit III	Matrices of Real Numbers: Equality of matrices. Addition of Matrices. Multiplication of a matrix by scalar. Multiplication of matrices _ Associative properties. Transpose of matrix – Its properties. The inverse of a non-singular matrix. Elementary operations on Skew – Symmetric matrices. Scalar matrix. Orthogonal matrix. Elementary operations on matrices. The rank of a matrix: Determination of rank either by considering minors or by the sweep-out process.	**15**	**8-11**

	Consistency and solution of a system of linear equations with not more than 3 variables by matrix method.		

CHEMISTRY - I

Course Code: BSCH-S -1101

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Physical Chemistry** **Gaseous State** (a) Kinetic Theory of gases, Derivation of the kinetic gas equation, deduction of gas law, calculation of gas constants, and kinetic theory. (b) Types of solids, crystal forces, the law of constancy of angles, seven crystal systems, law of rational indices, Bragg's Law, Lattice energy, Born-Haber cycle	15	1-3
	Thermochemistry (a) Heat in chemical reactions, Reaction enthalpy, standard enthalpy changes. (b) Hess Law, Kirchoff Law (c) Bond energy and determination		
	Ionic Equilibrium (a) Ionic Product of water, pH, pK_a, pK_b, pK_w (b) Buffer solution, Idea of buffer solution in everyday life. (c) Solubility product and it application in salt analysis. (d) Specific conductance, Molar conductance, Equivalent		

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	conductance.		
Unit II	**Inorganic Chemistry** **Atomic Structure and Bonding** (a) Features of H-spectra and Bohr's theory. (b) Shapes of orbital's and their labeling, idea of quantum number (c) Pauli's Exclusion Principle, Hund's rule, Aufbau Principle (d) Electronic configuration of elements (e) Idea of ionic and covalent bonds, Ionization potential, Electro negativity, Electron affinity, Fajan's rule **Chemistry of the following elements** Li, Sn, Fluorine, Chlorine, Iodine	**15**	**4-7**
Unit III	**Organic Chemistry** **Structure and Mechanism** (a) Hybridization, bond angle, bond length, idea of bonds. (b) Inductive effect, electrometric effect, mesmeric effect (c) Bond fission and products.	**15**	**8-12**

CHEMISTRY –I Lab

Course Code: BSCH –S- 1101 (P)

PRACTICAL	
1.	Inorganic chemistry Volumetric Analysis (a) Acidimetric and alkalimetry (b) Use of Potassium permanganate and potassium dichromate (c) Iodometry
2.	Note book and Viva voce.

SEMESTER – II

Year	Semester	Course Code	Course Title	L	T	P	C
1	2	BSPH 1201	Electricity and Magnetism	3	1	0	4
		BSPH 1202	Waves and Optics	3	1	0	4
		BSPH 1201-P	Practical-I- Electricity and Magnetism	0	0	3	3
		BSPH 1202-P	Practical II- Waves and Optics	0	0	3	3
		BSMT-S 1201	Maths – II	3	0	0	3
		BSCH-S 1201	Chemistry - II	3	0	0	3
		BSCH-S 1201-P	Practical – Chemistry - II	0	0	2	2
		ENL 1201	English – I	2	0	0	2
			Total	**14**	**2**	**10**	**24**

Electricity and Magnetism

Course Code: BSPH - 1201

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the fundamental knowledge of electromagnetism.
2. Analyze the need for electromagnetism to explain the energy storage devices like capacitors.

3. Evaluate various properties and concepts of electricity and magnetism, by applying them to application-based study, including Biot-Savart law, Ampere's law, etc.
4. Understand the mechanism of current and electricity (basic electronics), through Kirchoff's model (or closed circuit model).
5. Apply the closed circuit law and network model to evaluate current and voltage from various circuits including, resistor, capacitor, inductance, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Electric Field and Electric Potential** **Electric field:** Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical, and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson's equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of the system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. The capacitance of a system of charged conductors. Parallel-plate	**15**	**1-3**

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	capacitor. The capacitance of an isolated conductor. Method of Images and its Application to (1) Plane Infinite Sheet and (2) Sphere. **Dielectric Properties of Matter:** Electric Field in Matter. Polarization,Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P, and D. Gauss' Law in dielectrics.		
Unit II	**Magnetic Field:** Magnetic force between current elements and definition of Magnetic FieldB. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	**15**	**4-6**
Unit III	**Magnetic Properties of Matter:** Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy is stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.	**15**	**7-9**
Unit	**Electrical Circuits:** AC Circuits: Kirchhoff's laws	**15**	**10-12**

IV	for AC circuits.Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.		
Unit V	**Network theorems:** Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to DC circuits. Ballistic Galvanometer: Torque on a Current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping.Logarithmic damping. CDR.	**15**	**13-15**

Useful links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLyNtcVp3QSXFKjsJBsgQjk2wdlWxNr6LY&si=hu91IbaPv9QlixK2

https://youtube.com/playlist?list=PLvyl1YgaAepLb1TJOU1JFq26OScZJr17e&si=aYlGm_OF_E8mUHH1

Books Recommended:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

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Waves and Optics

Course Code: BSPH - 1202

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the various properties of waves like superposition, interference, etc.
2. Explore and analyze the concept of superposition to apply a solution of normal mode of vibrations, stretch string, etc.
3. Understand the optics via the mechanism of light interference.
4. Understand the construction and working principle of various spectroscopes and interferometers.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Superposition of Collinear Harmonic oscillations:** Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **Superposition of two perpendicular Harmonic Oscillations:** Graphicaland Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. Wave Motion: Plane and Spherical Waves. Longitudinal and TransverseWaves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities.	**20**	**1-4**
Unit II	**Differential Equation:** The pressure of a Longitudinal Wave. EnergyTransport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. Velocity of Waves: Velocity of Transverse Vibrations of StretchedStrings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton'sFormula for Velocity of Sound. Laplace's Correction. **Superposition of Two Harmonic Waves:** Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of	**20**	**5-8**

	Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.		
Unit III	**Wave Optics:** Electromagnetic nature of light. Definition and properties of the wavefront. Huygens Principle. Temporal and Spatial Coherence. **Interference:** Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.	**20**	**9-12**
Unit IV	**Interferometer:** Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry- Perot interferometer. Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit. Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power ofa telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **Fresnel Diffraction:** Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of	**20**	**13-15**

	Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit, and a wire.		

Useful links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLF_7kfnwLFCHr4eZATw4YURnGNr6mwF5R&si=Wh308h2zr9dVzXUR

https://youtube.com/playlist?list=PL_A4M5IAkMac8lrmOeJ3yuiqPPNXxnh6Q&si=GRJel7Si9r_Nd-M6

Books Recommended:

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

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Practical -I

Course Code: BSPH 1201-P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**

   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.

2. **Skill Development:**

Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.

3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. Use a Multi-meter for measuring (a) Resistances, (b) AC and DC voltages, (c) DC current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC circuit.
3. To determine an unknown low resistance using a potentiometer.
4. To determine an unknown low resistance using Carey Foster's bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx).
7. To verify Thevenin and Norton's theorem.
8. To verify the Superposition and Maximum power transfer theorems.
9. To determine the inductance of a coil by Anderson's bridge.
10. To study the response curve of a series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q.

Useful links:

https://youtu.be/5MOtPOqC0jI?si=kca8r8R9Xev_rjAM

https://youtube.com/playlist?list=PLFGOC-ueNbIcGRG1tXYHDVh8ZM7xi9Wak&si=MSVvNZgYLV3Pua1G

https://youtu.be/PfBQEhLKDRc?si=je5bUna9Id81N7Be

Practical-II

Course Code: BSPH 1202 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**

   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.

2. **Skill Development:**

   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.

3. **Experimental Design and Execution:**

   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.

4. **Laboratory Techniques:**

   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with Schuster's focusing and determination of the angle of the prism.
5. To determine the refractive index of the material of a prism using a sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using a mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine the wavelength of sodium light using Fresnel Biprism.
9. To determine the wavelength of sodium light using Newton's rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped film.

Useful links:

https://youtu.be/QayPYBAdEsM?si=n6nz9TeZU6ymJzox

https://youtu.be/6O1d19Rd7ys?si=xZyJQY32rFPJrzQB

https://youtu.be/e4poHiwoTH8?si=GDZRWmlO1vwKdROj

MATHEMATICS –II

Course Code: BSMT-S- 1201

UNIT	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	Differential equations of first order and first degree: Statement of existence theorem. Separable, Homogeneous and Exact differential equations. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only).	**15**	**1-5**
Unit II	First order linear differential equation and Bernoulli Equation Integrating factor (Statement of relevant results only). Equations reducible to first order linear equations. Equations of first	**15**	**5-10**

	order but not of first degree. Clairaut's equation: General and singular solutions. Higher order linear equations with constant coefficients: Complementary function Particular Integral. Method of undermined coefficients, Symbolic operator D. Method of variation of parameters.		
Unit III	Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.	**15**	**11-15**

CHEMISTRY –II

Course Code: BSCH –S- 1201

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Physical Chemistry** **Chemical Kinetics** (a) Rate of reaction, order, and molecularity. (b) Expression for the specific rate constant of first-order reaction. (c) Half-life period and Units	**15**	**1-5**
	Colligative Properties (a) Osmosis and its determination. (b) Vapor Pressure		

	(c) Raoult's law of lowering vapor pressure (d) Relation between osmotic pressure and lowering of vapor pressure.		
Unit II	**Inorganic Chemistry** Principles involved in the volumetric and gravimetric estimation of Cu and Fe. Isotopes: Brief idea of detection and separation, Radiocarbon dating .	**15**	**6-10**
Unit III	**Organic Chemistry** **Nomenclature** (a) IUPAC Nomenclature of aliphatic and aromatic compounds Chemistry of monohydric alcohol and Grignard reagent Idea of purification of compounds, Chromatography	**15**	**11-15**

CHEMISTRY – II Lab

Course Code: BSCH –S- 1201

PRACTICAL	
1.	Organic chemistry Detection of nitrogen sulfur and halogen in organic compounds Detection of the following functional group of organic compounds (a) OH (Phenolic) (b) CHO(c) = O (d) COOH (e) NH_3 and NO_2
2.	Note book and Viva voce.

ENGLISH - I

Course Code: ENL-1201

I. Prose:

1. The Bet — Anton Chekov
2. Socrates and the Schoolmaster — F. L. Brayne
3. An Astrologer's Day — R. K. Narayan
4. The Gift of the Magi — O' Henry
5. With the Photographer — Stephen Leacock

II. Spoken Communication:

1) Meeting People, Exchanging Greetings and Taking Leave
2) Introducing Yourself
3) Introducing People to Others
4) Answering the Telephone and Asking for Someone
5) Dealing with a Wrong Number
6) Taking and Leaving Messages

7) Making Inquiries on the Phone

8) Calling for Help in an Emergency

III. Grammar and Vocabulary: Articles, prepositions, modal auxiliaries, antonyms, synonyms, and one-word substitutes.

IV. Written Communication: Summarizing

SEMESTER – III

Year	Semester	Course Code	Course Title	L	T	P	C
2	**3**	BSPH 2101	Mathematical Physics-II	3	1	0	4
		BSPH 2102	Thermal Physics	3	1	0	4
		BSPH 2101-P	Mathematical Physics-II	0	0	3	3
		BSPH 2102-P	Practical: Thermal Physics	0	0	3	3
		BSMT-S 2101	Maths – III	3	0	0	3
		BSCH-S 2101	Chemistry - III	3	0	0	3
		BSCH-S 2101-P	Practical – Chemistry - III	0	0	2	2
		HNL 2101	Hindi – II	2	0	0	2
			Total	**14**	**2**	**10**	**24**

Mathematical Physics - II

Course Code: BSPH - 2101

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the use of periodic functions in mathematical physics.
2. Identify, analyze, and interpret the periodic sine and cosine functions.
3. Apply periodic function methods to find the solution of Fourier series.
4. Understanding the various differential equations in series form such as Bessel's, Legendre, Laugree, etc.
5. Apply the mathematical concept of exact and non-exact differential equations to find the general solution.
6. Understand the concept of error estimation through the Gamma function for various periodic functions.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Fourier Series**: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier	**20**	**1-4**

	coefficients. Complex representation of Fourier series. Expansion of functions with the arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.		
Unit II	**Frobenius Method and Special Functions:** Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.	**20**	**5-10**
Unit III	Some Special Integrals: Beta and Gamma Functions and the Relation between them. Expression of Integrals in Terms of Gamma Functions. Error Function (Probability Integral). Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Partial Differential Equations: Solutions to partial differential equations,using separation of variables: Laplace's Equation in problems of rectangular, cylindrical, and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes.	**20**	**11-15**

Useful links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLU6SqdYcYsfK_FysPwDqaoUKhTqms_aEg&si=sLN-p-faYvnuEaRN

https://youtube.com/playlist?list=PLNsg8byHMYYiLhuif1nd9b_shRkIQ0DK8&si=FldFXFagKVurKmXi

Books Recommended:

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
- Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books.

Thermal Physics

Course Code: BSPH - 2102

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand thermodynamics as the logical consequences of the postulates of thermal physics.

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2. Apply the concepts and laws of thermal physics to solve problems like gases, potential, Maxwell's equations, and real gas problems.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Introduction to Thermodynamics** Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.	**15**	**1-3**
Unit II	**Entropy**: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. The entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of	**15**	**4-6**

	Thermodynamics. Unattainability of Absolute Zero.		
Unit III	**Thermodynamic Potentials**: Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties, and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.	**15**	**7-9**
Unit IV	**Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, Tds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during AdiabaticProcess. **Kinetic Theory of Gases** Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS, and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.	**15**	**10-12**

Unit V	**Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapor and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule'sExperiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.	**15**	**13-15**

Use links:

https://www.csirnetphysics.in/?m=

https://youtube.com/playlist?list=PLF_7kfnwLFCFPfN4TGeJt1PQpJd3MG6Zz&si=GsY-4M0-LMXxyYY-

https://youtube.com/playlist?list=PL9RcWoqXmzaK6AHCCyL_J6gqc02RN-w-D&si=-ElV8s97r8e_FQB_

Books Recommended:

- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

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Practical - I

Course Code: BSPH 2101-P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To determine the wavelength of (1) Na source and (2) spectral lines of Hg source using a plane diffraction grating.
2. To determine the dispersive power and resolving power of a plane diffraction grating.
3. To provide students the capacity to refine the mathematical abilities required to tackle issues in advanced physics classes.
4. The student must comprehend the fundamentals of integral transforms, Laplace transforms, coordinate systems, and Dirac delta functions.
5. To study the response curve of a parallel LCR circuit and determine (a) Anti-resonant frequency and (b) Quality factor Q.
6. Measurement of charge and current sensitivity and CDR of ballistic galvanometer.
7. Determine a high resistance by leakage method using a ballistic galvanometer.
8. To determine the self-inductance of a coil by Rayleigh's method.
9. To determine the mutual inductance of two coils by the absolute method.

Useful links:

https://youtu.be/QayPYBAdEsM?si=n6nz9TeZU6ymJzox

https://youtu.be/6O1d19Rd7ys?si=xZyJQY32rFPJrzQB

https://youtu.be/e4poHiwoTH8?si=GDZRWmlO1vwKdROj

Practical-II

Course Code: BSPH 2102 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To determine the Mechanical Equivalent of Heat, J. by Callender and Barne's constant flow method.
2. To determine the coefficient of thermal conductivity of Cu by Searl's apparatus.
3. To determine the coefficient of thermal conductivity of Cu by Angstrom's method.
4. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the temperature coefficient of resistance by platinum resistance thermometer (PRT).
6. To study the variation of thermo-emf of a thermocouple with a difference of temperature of its two junctions.
7. To calibrate a thermocouple to measure temperature in a specified range using (1) Null method, (2) direct measurement using Op-Amp difference amplifier and to determine neutral temperature.

Useful links:

https://youtu.be/9XeosJZ3mIc?si=p84IfesDhlRTGHAV

https://youtu.be/YhUha8c-B2I?si=5CyZuD2qzopO8B6L

https://youtu.be/8z9tSDmmwIw?si=YWLGaUXoMtKC8I17

MATHEMATICS –III

Course Code: BSMT-S- 2101

UNIT	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	Introduction of Group Theory: Definition and examples taken from various branches (example from number system, roots of Unit, 2x2 real matrices, non-singular real matrices of a fixed	**15**	**1-5**

	order). Elementary properties using the definition of Group. Definition and examples of sub-group – Statement of necessary and sufficient condition and its applications. Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub-field.		
Unit II	Concept of Vector space over a field: Examples, Concepts of Linear combinations, Linear dependence and independence of a finite number of vectors, Sub-space, concepts of generators, and basis of a finite-dimensional vector space. Problems on formation of the basis of a vector space (No proof required).	**15**	**5-10**
Unit III	Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix (simple problems). Algebra of linear transformations. Eigenvalues, eigenvectors, and characteristic equations of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.	**15**	**11-15**

CHEMISTRY –III

Course Code: BSCH –S- 2101

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Physical Chemistry** **States of Matter** (a) Van der Waals equation, critical constants, collision frequency, mean free path. (b) Idea of lattice planes, stoichiometric and non-	**18**	**1-5**

	stoichiometric defects in simple ionic solid		
	Thermodynamics (a) Extensive and Intensive system. (b) First and second law of thermodynamics (c) Carnot cycle		
Unit II	**Inorganic Chemistry** **Atomic structure and bonding** Atomic structure and bonding (a) De Broglie waves (b) Schrodinger wave equation (c) The idea of overlap and hybridization (d) Metallic bonding (e) Double salts and complex salts (f) Werner's theory	**18**	**6-10**
	Introduction to the transition metal complex Variable oxidation states, magnetism		
Unit III	**Organic Chemistry** **Structure and Mechanism** (a) Different types of isomerism (b) Elementary and nucleophilic substitution at saturated carbon	**18**	**11-15**
	Natural Products (a) Carbohydrates (b) Elementary idea of Alkaloids and Terpenoids		

CHEMISTRY – III Lab

Course Code: BSCH-S - 2101

PRACTICAL	
1.	Inorganic chemistry Qualitative inorganic analysis of mixtures containing Acid and Basic radicals Basic radicals : Pb^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Cr^{3+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Mg^{2+}, Na^{+}, K^{+}

	Acid radicals: CO_3^{2-}, SO_3^{2-}, S^{2-}, SO_4^{2-}, NO_2^-, NO_3^-
2.	Note book and Viva voce.

SEMESTER – IV

Year	Semester	Course Code	Course Title	L	T	P	C
2	**4**	BSPH 2201	Mathematical Physics-III	3	1	0	4
		BSPH 2202	Elements of Modern Physics	3	1	0	4
		BSPH 2201-P	Practical: Mathematical Physics-III	0	0	3	3
		BSPH 2202-P	Practical: Elements of Modern Physics	0	0	3	3
		BSMT-S 2201	Maths - IV	3	0	0	3
		BSCH-S 2201	Chemistry - IV	3	0	0	3
		BSCH-S 2201-P	Practical – Chemistry - IV	0	0	2	2
		ENL 2201	English - II	2	0	0	2

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	Total	**14**	**2**	**10**	**24**

Mathematical Physics – III

Course Code: BSPH - 2201

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the role of complex analysis to solve the problem of physics.
2. Analyze and evaluate the application of complex analysis in analytic and singular functions.
3. Understand various integral transformations that can be used to find solutions of Laplace transformation and integral transformation.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Complex Analysis** Brief Revision of Complex Numbers and their Graphical	**20**	**1-4**

	Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected regions. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.		
Unit II	**Integrals Transforms:** Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transform (translation, change of scale, complex conjugation, etc.). Three-dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.	**20**	**5-10**
Unit III	Laplace Transforms Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.	**18**	**11-15**

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLU6SqdYcYsfKwY6IPDCshf1kKlk1CCd7d&si=53ewhOZ4YogBkfhr

https://youtube.com/playlist?list=PLNKD1qB9ppttQLUfgB-lmdENDJuV1nODX&si=PKr2KLTRDNwC5-DT

Books Recommended:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press.
- Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications.
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press.
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill.
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940,Jones & Bartlett.

Elements of Modern Physics

Course Code: BSPH - 2202

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.

3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the concept of quantum theory and its importance.
2. Apply Schrodinger's wave equations for non-relativistic particles.
3. Understand radioactive processes like alpha, beta, gamma decay, and nucleus stability.
4. Understand the fundamentals of atomic and nuclear physics and the principles and properties of lasers.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	Planck's quantum, Planck's constant, and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson- Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and the relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions. Position measurement- gamma-ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving	**18**	**1-3**

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	Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle-application to virtual particles and range of interaction.		
Unit II	Two slit interference experiment with photons, atoms, and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities, and normalization; Probability and probability current densities in one dimension. One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunneling in one dimension across a step potential & rectangular potential barrier.	**18**	**4-6**
Unit III	Size and structure of the atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model, and magic numbers. **Radioactivity:** Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta-decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma-ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.	**15**	**7-9**
Unit IV	Fission and fusion- mass deficit, relativity, and generation	**15**	**10-12**

	of energy; Fission - nature of fragments and emission of neutrons. **Lasers:** Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.		

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLpRsN577rTzZ6XpdysX_qUmpImQsCopR5&si=hAlkcYVoLhK3QaN-

https://youtube.com/playlist?list=PLkECWNr1MOgc4D24GlSc04dHh5d8FYbTC&si=7PAnsJe6yb_BNSYa

Books Recommended:

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Practical - I

Course Code: BSPH - 2201

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

Scilab-based simulation experiments based on Mathematical Physics problems like:

1. Solve differential equations: $dy/dx = e^{-x}$ with y= 0 for x = 0 $dy/dx+e^{-x}y = x^2$
$d^2y/dt^2 +2\ dy/dt = -y\ d^2y/dt^2 + e^{-t}dy/dt = y$

2. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

3. Calculation of least square fitting manually without giving weightageto error. Confirmation of least square fitting of data through

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the computer program.

4. Evaluation of trigonometric functions e.g. *sin θ,* Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.

5. Integral transform: FFT of $e^{!!!}$

Useful links:

https://youtu.be/UkZmROLRzRA?si=-LxaDd3r-LONdVIv

https://youtube.com/playlist?list=PLU6SqdYcYsfIuZVt20v-eNZBfFLENrM1F&si=za8Dcf6m2LtYjsm3

Practical - II

Course Code: BSPH 2202 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. Measurement of Planck's constant using black body radiation and photo-detector

2. Photo-electric effect: photocurrent versus intensity and wavelengthof light; maximum energy of photo-electrons versus the frequency of light.

3 To determine the work function of the material of filament of directly heated vacuum diode.

4. To determine the Planck's constant using LEDs of at least 4 different colors.
5. To determine the wavelength of the H-alpha emission line of the Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapor.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To set up the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of the laser source using diffraction of a single slit.
12. To determine the wavelength of the laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laserusing plane diffraction grating

Useful links:

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

MATHEMATICS –IV

Course Code: BSMT-S- 2201

UNIT	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	Sequence of real numbers: Definition of bounds of a sequence and monotone sequence. Limit of a sequence. Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application.	**18**	**1-4**
Unit II	Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle is applied to infinite series (application only). Series of positive terms: Statements of comparison test. D. Alembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.	**18**	**5-10**
Unit III	Real-valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchys' from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sinx, cosx, $(1+x)^n$, log (1+x) with restrictions wherever necessary. Application of the principle of Maxima and minima for a function of a single variable in geometrical, physical, and other problems.	**18**	**10-15**

CHEMISTRY – IV

Course Code: BSCH-S- 2201

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Physical Chemistry** **Ionic Equilibrium** (a) Oswald's dilution law (b) Salt Hydrolysis (c) Theory of acid-base indicator	15	1-4
	Chemical Kinetics (a) Second-order reaction, expression of rate constant. (b) Effect of temperature on reaction rate (c) Arrhenius equation		
Unit II	**Inorganic Chemistry** (a) Chemistry of Group 4 elements (b) Idea of Major pollutants in environments	15	5-8
	Chemistry of Fe, Cr, and Ni compounds		
Unit III	**Organic Chemistry** Structure of Benzene and benzene Diazonium chloride	15	8-12
	Brief idea of Polymers, resins, drugs		

CHEMISTRY –IV Lab

Course Code: BSCH-S- 2201P

PRACTICAL	
1.	Organic chemistry Preparation of Organic compounds by using the following reactions: (a) Acetylation of Aniline (b) Oxidation of benzaldehyde (c) Hydrolysis of esters
2.	Note book and Viva voce.

ENGLISH – II

Course Code: ENL-2201

I. Short Stories

1. Maupassant - The Necklace
2. O. Henry - The Last Leaf
3. Catherine Mansfield - A Cup of Tea
4. R.K. Narayan - Selvi
5. MR Anand - The Lost Child
6. Jhumpa Lahiri - The Interpreter of Maladies
7. Shashi Deshpande - Hear Me Sanjaya!

II. Pieces of Prose

a. James Bryce - Some hints of Public Speaking

b. C.E.M. .Toad - A Dialogue on Civilization

c. Hill - Principles of good writing

d. Bapsi Sidhwa - Why do I write?

e. Jawahar Lal Nehru - The Reawakening of India

f. Subhash Chandra Bose - To Delhi, To Delhi

g. Dr. Rukhmabai - Purdah - The Need for its Abolition

III. Novel

Lord of the Flies - William Golding

SEMESTER – V

Year	Semester	Course Code	Course Title	L	T	P	C

3	**5**	BSPH 3101	Quantum Mechanics And Applications	3	1	0	4
		BSPH 31102	Solid State Physics	3	1	0	4
		BSPH 3103	Digital Systems and Applications	3	1	0	4
		BSPH 3101-P	Quantum Mechanics And Applications	0	0	3	3
		BSPH 3102-P	Solid State Physics	0	0	3	3
		BSPH 3103-P	Digital Systems and Applications	0	0	3	3
			Total	**9**	**3**	**9**	**21**

Quantum Mechanics and Applications

Course Code: BSPH - 3101

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the basic principle of quantum mechanics and its formalism.
2. Understand the Schrodinger equation, Heisenberg's uncertainty principle, and Pauli's principle.
3. Evaluate and analyze the bound state of quantum systems like simple harmonic oscillators, hydrogen atoms, and H-like atoms.
4. Understand the impact of magnetic fields on quantum systems.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT

Unit I	**Time-dependent Schrodinger equation** Time-dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum, and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **Time-independent Schrodinger equation** Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time-dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.	**15**	**1-3**
Unit II	**General discussion of bound states in an arbitrary potential** Continuity of wave function, boundary condition, and the emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energylevels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle. **Quantum theory of hydrogen-like atoms**	**15**	**4-6**

	Time-independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.		
Unit III	**Atoms in Electric & Magnetic Fields** Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External Magnetic Fields** Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).	**15**	**7-9**
Unit IV	Many electron atoms: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin-orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).	**15**	**10-14**

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLLFRJm7-ej7RK58iIz2eMM30hJABFfCF8&si=JEGdcgVce-eAU55-

https://youtube.com/playlist?list=PL0KRvN5Kp6y8OxV0CnxkRR0ACAJ_2F3cj&si=jP7DW0zxB8VCZCAQ

Books Recommended:

- A Textbook of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill.
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer.
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.

Solid State Physics

Course Code: BSPH - 3102

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand crystallography to explain the atomic distribution of material.
2. Explore the material dielectric and magnetic properties for particular applications.
3. Understand the concept of band theory and superconductivity.
4. Analyze the nature of material through energy band theory.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Crystal Structure** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types ofLattices. Brillouin Zones.	**20**	**1-4**

	Elementary Lattice Dynamics Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye's theories of specific heat of solids. T^3 law		
Unit II	**Magnetic Properties of Matter** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of Dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **Dielectric Properties of Materials** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant.	**20**	**5-10**
Unit III	**Ferroelectric Properties of Materials** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop. **Elementary band theory** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N-type), and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.	**20**	**11-15**

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	Superconductivity Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).		

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PL0vbmKf7BZLPYukj_HEwJZmCxEPPPBOod&si=Fw4TTaLJxa_xWmcz

https://youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m&si=knwd0wSbAbeLKI0l

Books Recommended:

- Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India.
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer.

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Digital Systems and Applications

Course Code: BSPH - 3103

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the theoretical knowledge of digital electronics.
2. Apply the theoretical concept to design and prove the truth table of various logic gates.
3. Understand to design of combinational and sequential logic circuits.
4. Understand the program of the microprocessor.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Introduction to CRO** Block Diagram of CRO. Electron Gun, Deflection System, and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2)	**15**	**1-3**

	Measurement of Voltage, Current, Frequency, and Phase Difference. **Integrated Circuits** (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI, and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.		
Unit II	**Digital Circuits** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal, and Hexadecimal numbers. AND, OR, and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. **Boolean algebra** De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. The idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.	**15**	**4-6**
Unit III	**Digital Circuits** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal, and Hexadecimal numbers. AND, OR, and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.	**15**	**7-9**

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	Boolean algebra De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. The idea of Minterms and Maxterms. Conversion of a Truth Table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.		
Unit IV	**Boolean algebra** De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. The idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **Data processing circuits** Basic idea of Multiplexers, De-multiplexers, Decoders, and Encoders. **Optical Circuits** Binary Addition, Half and Full Adders. Half & Full Subtractors, 4-bit subtractor.	**15**	**10-12**
Unit V	**Sequential Circuits** SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. Shift registers Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out, and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). **Counters(4 bits)** Ring Counter. Asynchronous counters, Decade Counter.	**15**	**13-15**

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	Synchronous Counter.Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. **Intel 8085 Microprocessor Architecture** Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.Introduction to Assembly Language: 1 byte, 2 byte & 3 byte instructions.		

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm&si=b3gk3wD5nEkRM66H

https://youtube.com/playlist?list=PLBlnK6fEyqRiw-GZRqfnlVIBz9dxrqHJS&si=s_8B-YLgHgAucNVc

Books Recommended:

- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw.
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Ed., 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J. Tocci, N.S. Widmer, 2001, PHI Learning.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.

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Practical - I

Course Code: BSPH 3101 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. Study of electron spin resonance-determine magnetic field as a function of the resonance frequency.
2. Study of Zeeman effect: with an external magnetic field; Hyperfine splitting.
3. To show the tunneling effect in tunnel diode using I-V characteristics.
4. Quantum efficiency of CCDs.

Useful links:

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

Practical - II

Course Code: BSPH 3102 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. Measurement of Planck's constant using black body radiation and photo-detector.
2. Photo-electric effect: photocurrent versus intensity and wavelength of light; maximum energy of photo-electrons versus the frequency of light.
3. To determine the work function of the material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colors.
5. To determine the wavelength of the H-alpha emission line of the Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapor.

Useful links:

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

Practical - III

Course Code: BSPH 3103 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**
   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
2. To set up the Millikan oil drop apparatus and determine the charge of an electron.
3. To show the tunneling effect in tunnel diode using I-V characteristics.
4. To determine the wavelength of the laser source using diffraction of a single slit.
5. To determine the wavelength of the laser source using diffraction of double slits.
6. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.

Useful links:

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

SEMESTER – VI

Year	Semester	Course Code	Course Title	L	T	P	C
3	**6**	BSPH 3201	Electromagnetic Theory	3	1	0	4
		BSPH 3202	Statistical Mechanics	3	1	0	4
		BSPH 3203	Analog Systems And Applications	3	1	0	4
		BSPH3 201-P	Practical: Electromagnetic Theory	0	0	3	3
		BSPH 3202-P	Practical: Statistical Mechanics	0	0	3	3
		BSPH 3203-P	Practical: Analog Systems And Applications	0	0	3	3
			Total	**9**	**3**	**9**	**21**

Electromagnetic Theory

Course Code: BSPH - 3201

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the basic laws of electromagnetism.
2. Analyze and evaluate electric and magnetic fields for simple configurations and time-varying fields.
3. Understand Maxwell's equations in different forms and media, and apply them to solve problems.

4. Analyze and evaluate charge and current distribution for different forms of media.
5. Analyze the propagation, reflection, transmission, and boundary conditions of plane waves.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Maxwell Equations:** Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density, and Angular Momentum Density. **EM Wave Propagation in Unbounded Media** Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, and skin depth. Wave propagation through dilute plasma, electrical conductivity ofionized gases, plasma frequency, refractive index, skin depth, and application to propagation through the ionosphere.	**15**	**1-3**
Unit II	**EM Wave in Bounded Media** Boundary conditions at a plane interface between two	**15**	**4-6**

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	media. Reflection & Refraction of plane waves at a plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence). **Polarization of Electromagnetic Waves** Description of Linear, Circular, and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly, and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light.		
Unit III	**Rotatory Polarization** Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of Optical Rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter. **Wave Guides** Planar optical waveguides. Planar dielectric waveguide. Condition of continuity at the interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission. **Optical Fibres**	**15**	**7-9**

	Numerical Aperture. Step and Graded Indices (Definitions Only).Single and Multiple Mode Fibres (Concept and Definition Only).		

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLgwJf8NK-2e4I_YltJja47CwZJkzNWK89&si=4KUscZHFPsFirOH3

https://youtube.com/playlist?list=PLpAS0uDkUOp8zJFWCFtgoFmZ77CHpsuVP&si=u5UaLAjX865iA_ks

Books Recommended:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
- Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
- Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning.
- Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill.
- Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning.
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer.

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Statistical Mechanics

Course Code: BSPH - 3202

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand how to connect statistical mechanics to other physics courses, such as thermodynamics, quantum mechanics, and solid-state physics.
2. Interpretate thermodynamical quantities and correlation functions for classical and quantum models.
3. Understand thermodynamic identities and use thermodynamic stability criteria for different systems.
4. Understand the application of statistical mechanics in condensed matter systems such as Bose and Fermi gases, superconductors, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Classical Statistics:** Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. **Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe.	**15**	**1-3**
Unit II	**Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe **Quantum Theory of Radiation:** Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates.	**15**	**4-6**

	Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's Law.		
Unit III	**Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose-Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas, and Thermodynamic functions of photon gas. Bose derivation of Planck's law. **Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.	**15**	**7-9**

Useful links:

https://www.csirnetphysics.in/?m=

https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PL_yoT1uNIKb5ECZhofT0WNdLYyw9gEhNA&si=WQ4gcg_t4htMnTRe

https://youtube.com/playlist?list=PLyTVFDODClZiqbL2doX45bhq6QGwebrid&si=0cpVG9cdpzeDRTWI

Books Recommended:

- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
- Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
- Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
- An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012

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Analog Systems and Applications

Course Code: BSPH - 3203

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. Understand the basics of analog modulation methods and communication systems.
2. Analyze, classify, and perform operations on various types of signals and systems.
3. Understand the transformation of signals and systems in the continuous and discrete time domain.
4. Understand to explain the spectral density of signals.
5. Analyze and evaluate bandwidth and power requirements for analog systems.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

UNITS	CONTENTS	Lecture Hours	WEEK ALLOTMENT
Unit I	**Semiconductor Diodes:** P and N-type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width, and Current for Step Junction. **Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.	**20**	**1-5**
Unit II	Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE, and CC Configurations. Current gains α and β Relations between α and β. Load Line Analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff, and Saturation Regions. Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. H-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using a Hybrid Model. Input and Output Impedance. Current, Voltage, and Power Gains. Classification of Class A,B & C Amplifiers.	**20**	**6-10**
Unit III	**Amplifiers** Transistor Biasing and Stabilization Circuits. Fixed Bias	**20**	**11-15**

	and Voltage Divider Bias. Transistor as 2-port Network. H-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using a Hybrid Model. Input and Output Impedance. Current, Voltage, and Power Gains. Classification of Class A, B & C Amplifiers. Coupled Amplifier: RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **Sinusoidal Oscillators** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. **Conversion** Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)		

Useful links:

https://www.csirnetphysics.in/?m=

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https://play.google.com/store/apps/details?id=csirnet.physics

https://youtube.com/playlist?list=PLU6SqdYcYsfKwY6IPDCshf1kKlk1CCd7d&si=53ewhOZ4YogBkfhr

https://youtube.com/playlist?list=PLNKD1qB9ppttQLUfgB-lmdENDJuV1nODX&si=PKr2KLTRDNwC5-DT

Books Recommended:

- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
- Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.

Practical - I

Course Code: BSPH 3201 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**

Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To verify the law of Malus for plane-polarized light.
2. To determine the specific rotation of sugar solution using a Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study the dependence of radiation on angle for a simple Dipole antenna.
5. To study the reflection and refraction of microwaves.
6. To study Polarization and double-slit interference in microwaves.

Useful links:

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

Practical - II

Course Code: BSPH 3202 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.
4. **Laboratory Techniques:**

Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

Use C/C^{++}/Scilab for solving problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law
   and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, and (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

Useful links:

https://youtu.be/QZN2oNRVai8?si=uvG4vGIcuW0KRPLK

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b

Practical - III

Course Code: BSPH 3203 - P

Program Outcomes:

1. Explore and comprehend the basic laws and principles that govern the physical world around us.
2. Identify the root causes to address core problems of physics.
3. Utilize the laws and principles to simplify physical phenomena and core problems.
4. Carry out simple experiments useful for everyday life.
5. Expand the scientific knowledge in modern physics to investigate how one field of physics may influence another.

Course Outcomes:

1. **Hands-on Experience:**
   Give students real-world experience in a variety of physics topics to help them retain the theoretical information they learned in class.
2. **Skill Development:**
   Gain and improve the practical knowledge and abilities needed to carry out research on physical science and experiments, including lab procedures.
3. **Experimental Design and Execution:**
   Enable students to design and execute the project/working model including planning, execution, data collection, and interpretation.

4. **Laboratory Techniques:**

   Introduce students to a variety of physics-related laboratory procedures, including magnetic field measurement, light absorption, and emission, light scattering, etc.

Objective of the Program:

The primary objective of this program is to teach students the fundamentals of physics and other topics revolving around it, including experiments and practicals, and help them to become better problem solvers and good analysts.

Syllabus details:

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as the voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of an RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for a given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt`s oscillator.

Useful links:

https://youtu.be/ryB36ixUp4w?si=jVyI0bBz3f8GGV_e

https://youtu.be/TOs8h_AiBJU?si=2DUErIB_1CEJlotj

https://youtu.be/sUAQaEqvjMI?si=Q_oksIRCOPJUgYKT

https://youtu.be/0YuB_x1_H70?si=Z46ZvygCTbaSyM5b