Program: BSc (Physics)

Program Code: SBR0203

Batch: 2018-21

Department of Physics

School of Basic Sciences and Research

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

School of Basic Sciences and Research

Vision of the School

Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish center of excellence for ecologically and socially innovative research.**
4. **To strengthen interinstitutional and industrial collaboration for skill development and global employability.**

Vision of Physics Department

To be recognized for quality education, innovation and socially relevant research by nurturing students and faculty to be good citizens to address the challenges faced by society through critical thinking and innovations anchored in physical sciences.

Mission of Physics Department

1. **To provide education of global standards and nurturing young minds for fulfilling career and entrepreneurship in scientific research, applied fields, and advancing technologies.**
2. **To encourage faculty and students for research in core and interdisciplinary fields.**
3. **To establish collaborations with national and international centres of excellence in physical sciences and interdisciplinary fields.**

Programme Educational Objectives (PEO)

PEO1: To foster a strong foundation in theoretical and applied physics principles and theories to make students become globally competitive physicists.

PEO2: To develop strong interest in physics by cultivating critical thinking and problem-solving skills in students so that they are motivated to pursue research and higher education in physics.

PEO3: To emphasize on the interdisciplinary nature of physics and to integrate knowledge of other relevant disciplines to address a wide variety of problems through physics.

PEO4: To train the students to design, execute record and analyse the results of physics experiments in line with physics principles and theories.

PEO5: To create a sense of ethical responsibility among students towards the use of scientific knowledge for the benefit of humanity.

Program Outcomes (PO's)

PO1: Proficiency — Students will demonstrate proficiency in physics principles and concepts supported by sound understanding of underlying mathematical concepts and experimental results.

PO2: Knowledge — Students will demonstrate knowledge of classical mechanics, optics, electromagnetism, quantum mechanics, nuclear physics, astrophysics, materials, statistical physics, electronics, biophysics, fluid mechanics, thermal physics, mathematics, calculus, physical chemistry, organic chemistry, inorganic chemistry, computer programming and be able to apply this knowledge to analyze a variety of physical phenomena.

PO3: Skills — Students will show that they have learned laboratory skills, enabling them to take measurements in a physics laboratory and analyze the data to draw valid conclusions.

PO4: Communication — Students will be capable of oral and written scientific communication and will prove that they can think critically and work independently.

PO5: Research — Students shall have ability to take up higher education or work on interdisciplinary research problems

PO6: Responsibility — Students shall have a clear understanding of professional and ethical responsibility

Teaching Scheme

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: I

S. No.		Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1.		PHB114	Mechanics & props of matter	3	1	0	4
2.		BCH101	Physical Chemistry 1	3	1	0	4
3.		MSM101	Foundation course in Maths	3	1	0	4
4.		CSE115	Introduction to 'C' programming (2-0-0)	2	0	0	2
5.		FEN101/ FEN103	Functional English Beginners I/ Intermediate I (LTP: 0-0-2)	0	0	2	1
Practical							
6.		PHB151	Physics Lab-1	0	0	2	1
7.		BCH151	Chemistry Lab-1	0	0	2	1
8.		CSP115	Computer Lab	0	0	4	2
9.		ENP102	English Lab-1	0	0	2	1
TOTAL CREDITS							**20**

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: II

S. No.		Course Code	Course	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1.		PHB115	Optics	3	1	0	4
2.		BCH102	Organic Chemistry 1	3	1	0	4
3.		MSM105	Applied Mathematics-1	3	1	0	4
4.		PHB117	Thermal Physics	3	1	0	4
5.		EVS106	Environmental Studies	3	0	0	3
Practical							
6.		PHB152	Physics Lab-2	0	0	2	1
7.		BCH152	Chemistry Lab-2	0	0	2	1
TOTAL CREDITS							**21**

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: III

S. No.		Course Code	Course	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1.		PHB218	Solid state Physics	3	1	0	4
2.		BCH201	Inorganic Chemistry 1	3	1	0	4
3.		MSM204	Calculus II	3	1	0	4
4.		PHB219	Electricity and magnetism	3	1	0	4
5.		PHB229	Radiation Science	2	1	0	3
6.		OPExxx	Open Elective	2	0	0	2
Practical							
7.		PHB251	Physics Lab-3	0	0	2	1
8.		BCH251	Chemistry Lab-3	0	0	2	1
9.		CCU401	Community Connect	0	0	2	2
TOTAL CREDITS							**25**

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: IV

S. No.		Course Code	Course	Teaching Load			Credits	
				L	T	P		
THEORY SUBJECTS								
1.		PHB221	Classical mechanics & relativity	3	1	0	4	
2.		PHB222	Mathematical physics	3	1	0	4	
3.		PHB228	Electromagnetic Theory	3	1	0	4	
4.		PHB224	Basic electronics	3	1	0	4	
5.		PHB225	Nuclear Physics	3	1	0	4	
Practical								
6.		PHB254	Physics lab – 4	0	0	3	2	
7.		PHB255	Physics lab – 5 (Electronics)	0	0	3	2	
TOTAL CREDITS							**24**	

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: V

S. No.		Course Code	Course	Teaching Load			Credits	
				L	T	P		
THEORY SUBJECTS								
1.		PHB332	Quantum mechanics	3	1	0	4	
2.		PHB333	Elective (Applied optics)	3	1	0	4	
3.		PHB334	Oscillations & waves	3	1	0	4	
4.		PHB335	Analog electronic devices	3	1	0	4	
5.		PHB336	Statistical mechanics	3	1	0	4	
Practical/ Project								
6.		PHB366	Physics lab – 6	0	0	2	2	
7.		PHB367	Physics lab – 7	0	0	2	2	
8.		PHB371	Dissertation 1				3	
TOTAL CREDITS							**27**	

Program Structure Template
School of Basic Sciences & Research
B. Sc. (H) Physics
Batch: 2018-2021

TERM: VI

S. No.		Course Code	Course	Teaching Load			Credits	
				L	T	P		
THEORY SUBJECTS								
1.		PHB337	Renewable energy	3	1	0	4	
2.		PHB338	Atomic & molecular physics	3	1	0	4	
3.		PHB320	Instrumentation	3	1	0	4	
4.		PHB340	Digital electronics	3	1	0	4	
5.		PHB341	Particle & astrophysics	3	1	0	4	
Practical/ Project								
6.		PHB368	Physics lab – 8	0	0	3	2	
7.		PHB369	Physics lab – 9	0	0	3	2	
8.		PHB372	Dissertation 2				3	
TOTAL CREDITS							**27**	
GRAND TOTAL							**144**	

Course Templates

Theory Subjects

PHB114 Mechanics and properties of matter

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2018-19**
Branch: Physics		**Semester: I**
1	Course Code	PHB114
2	Course Title	Mechanics and properties of matter
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	• To make the students familiar with use of vector algebra to study mechanics. • To understand and appreciate the rotational and harmonic motion. • To know the elasticity of matter and bending of beams in different situation. • To understand the concept surface tension and viscosity.
6	Course Outcomes	After the completion of this course, the student will be able to **CO1:** understand the concept of motion, work, energy, momentum and frame of references **CO2:** appreciate real life applications of rotational mechanics and simple harmonic motion. **CO3:** use of moment of force and properties of matter to describe the elasticity and beam bending. **CO4:** understand the cause of capillarity, and surface tension and explain the of real life observations based on it **CO5:** understand the cause of viscosity and explain the real-life observations based on it. **CO6:** appreciate mechanics with vector algebra and can apply it on real life problems
7	Course Description	This course is designed to make students proficient in mechanics, especially rotational mechanics with vector treatment. They also learn about certain properties of matter like elasticity, surface tension and viscosity.
8	Outline syllabus	
	Unit 1	**Motion, Work, Energy and Momentum**
	A	Review of Vector Algebra, Concept of work, power and energy; Law of conservation of energy; Conservative forces
	B	Conservation law of momentum; Centre of mass; Collision of bodies
	C	Centre of mass frame of reference, Laboratory frame of reference
	Unit 2	**Simple Harmonic Motion**
	A	Equation of Simple Harmonic Motion; Energy of a Harmonic Oscillator. Compound Pendulum
	B	Rigid body-Translational and rotational Motion, angular momentum, torque; Moment of Inertia-Radius of gyration

	C	Parallel and perpendicular theorems of Moment of Inertia, moment of inertia of disk, sphere, and rectangular lamina		
	Unit 3	**Elasticity & Bending of beams**		
	A	Hooke's Law, Stress - Strain Diagram - Elastic moduli - Relation between elastic constants		
	B	Poisson's Ratio – Determination of Poisson's ratio; Work done per unit volume in a strain		
	C	Bending of beam; Bending moment, Cantilever		
	Unit 4	**Surface Tension**		
	A	Surface Tension: Definition and dimensions of surface tension; Excess of pressure over curved surfaces		
	B	Application to spherical and cylindrical drops and bubbles		
	C	Variation of Surface tension with temperature, Jaegar's method		
	Unit 5	**Viscosity**		
	A	Streamline Flow; Bernoulli's Theorem; Co-efficient of viscosity and its dimensions		
	B	Rate of flow of liquid in a capillary tube - Poiseuilles' formula		
	C	Variation of viscosity of a liquid with temperature		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Mechanics, D.S.Mathur, S.Chand & Co. (Text Book) 2. Properties of matter, D.S.Mathur, S.Chand & Co.		
	Other References	3. Berkeley Physics Course, Volume I, Mechanics,C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moye; McGraw-Hill 4. Mechanics , H.S.Hans and S.P.Puri, Tata McGraw-Hill (2003) 5. Physics (5th Edn.) - Principles with applications, Douglas C. Giancoli, Prentice Hall. 6. Physics (5th Edn.), John D. Cutnell & Kenneth W. Johnson, John Willey & Sons, Inc.		

PHB115 Optics

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2018-2019**
Branch: Physics		**Semester: II**
1	Course Code	PHB115
2	Course Title	Optics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	This course provides the knowledge of fundamental concepts of optics and understanding of wave and optics phenomena, with emphasis on everyday effect.
6	Course Outcomes	After the completion of this course, the student will be able to **CO1:** Apply the laws and concepts of geometrical optics to find cardinal points and solve a variety of numerical problems. **CO2:** Understand the concepts and phenomena of wave optics and analyze the intensity variation of light due to interference. **CO3:** Understand the concepts of diffraction and analyze the intensity variation of light due to single slit, double slits and N-slits diffraction. **CO4:** Understand mean of resolution and working of telescope and microscope. **CO5:** Understand optical phenomena in terms of electromagnetic wave properties including polarization of light and its applications. **CO6:** Apply conceptual understanding and mathematical methods to solve the problems.
7	Course Description	This course provides students with an understanding of optical phenomena based on the wave description of light. The geometrical optics and principles of polarization, interference and diffraction and optical devices that use these properties of light will be described.
8	Outline syllabus	
	Unit 1	**Geometrical Optics**
	A	Cardinal Points of an Optical System (six points), Newton's formula
	B	Nodal slide, Coaxial Lens System(equivalent focal length and cardinal points)
	C	Huygens Eyepiece, Ramsden Eyepiece and their cardinal points
	Unit 2	**Interference**
	A	Introduction, Coherent sources, Concept of spatial and temporal coherence, Interference of light
	B	Division of wave front: Young's Double slit experiment and Fresnel's bi-prism
	C	Division of amplitude: Interference in thin films, wedge shaped films, Newton's rings.
	Unit 3	**Diffraction**

	A	Introduction, Fresnel and Fraunhoffer diffraction,		
	B	Fraunhoffer diffraction due to single slit, double slit		
	C	n slits diffraction, Plane diffraction grating		
	Unit 4	**Resolving power**		
	A	Resolving power, Rayleigh criteria		
	B	Resolving power of diffraction grating		
	C	Resolving power of microscope, telescope		
	Unit 5	**Polarization**		
	A	Phenomenon of polarization, Production of polarized light by reflection, refraction, Brewster's law, Malus law,		
	B	Nicol prism, Polarization by double refraction Retardation plates (Quarter and half wave plates), production and analysis of circularly and elliptically polarized light		
	C	Optical activity and Fresnel's theory of optical rotation, specific rotation, polarimeter		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Optics by Brijlal and Subrahmanyam 2. Optics by Vasudeva		
	Other References	3. Optics by A. K.Ghatak 4. Principles of Optics, B.K. Mathur, New Global Printing Press, Kanpur 5. Fundamentals of Optics - F.A. Jenkins and H.E. White ((McGraw Hill) 6. Principles of Optics, M. Born and E. Wolf, Sixth Edition, Pergamon Press, Oxford		

PHB117 Thermal Physics

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2018-19**
Branch: Physics		**Semester: II**
1	Course Code	PHB117
2	Course Title	Thermal Physics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To make students aware of concept of heat, temperature and heat flow. To teach students the thermodynamics of various engines To impart the knowledge of entropy and second law of thermodynamics. To differentiate the ideal gas from real gas behavior. To learn to derive and use thermodynamic equations.
6	Course Outcomes	After the completion of this course, the student will be able to CO1: understand the importance of Zeroth law and concept of temperature. CO2: appreciate second law of thermodynamics and understand the thermodynamics of engines. CO3: know the concept of entropy and second law of thermodynamics. CO4: differentiate real gases from ideal gases and will know special properties of real gases. CO5: understand Maxwell's thermodynamic equations and will be able to apply them on some real life problems. CO5: appreciate the laws of thermodynamics and will understand how the things behave thermodynamically. CO6: apply thermodynamic principle on various practical and research problems.
7	Course Description	This course is designed to teach students the basic laws of thermodynamics, thermodynamic potentials and behaviour of ideal and real gases.
8	Outline Syllabus	
	Unit 1	**Zeroth and first law of thermodynamics**
	A	Thermodynamic Equilibrium; Zeroth Law of Thermodynamics and Concept of Temperature
	B	Work and Heat Energy; First Law of Thermodynamics; Applications of First Law
	C	General Relation between Cp and Cv; Work Done during Isothermal and Adiabatic Processes.
	Unit 2	**Second law of thermodynamics**
	A	Limitations of first law of thermodynamics, Reversible and Irreversible Processes
	B	Heat Engines; Carnot Cycle; Carnot Engine and its Efficiency; Refrigerator and its Efficiency; Otto engine

	C	Kelvin-Planck and Clausius Statements and their Equivalence; Carnot Theorem; Second Law of Thermodynamics; Thermodynamic Scale of Temperature		
	Unit 3	**Entropy**		
	A	Entropy of a State; Clausius Theorem; Clausius Inequality; Second Law of Thermodynamics in terms of Entropy		
	B	Entropy of a Perfect Gas; Entropy Changes in Reversible and Irreversible Processes; Principle of Increase of Entropy		
	C	Third Law of Thermodynamics; Temperature-Entropy Diagrams		
	Unit 4	**Real gases**		
	A	Behavior of Real Gases; Deviations from the Ideal Gas Equation; The Virial Equation; Andrew's Experiments on CO_2 Gas		
	B	Critical Constants; Continuity of Liquid and Gaseous State; Vapour and Gas; Boyle Temperature; Van der Waal's Equation of State for Real Gases; Values of Critical Constants; P-V Diagrams		
	C	Joule-Thomson Porous Plug Experiment; Joule-Thomson Effect for Real and Van der Waal Gases; Temperature of Inversion; Phase transformation		
	Unit 5	**Thermodynamic Equations**		
	A	Extensive and Intensive Thermodynamic Variables; Thermodynamic Potentials U; H; F and G; Their Definitions		
	B	Properties and Applications; Derivations of Maxwell's Relations; Applications of Maxwell's Relations: (1) Clausius Clapeyron equation; (2) Values of Cp-Cv; (3) Tds Equations		
	C	(4) Joule-Kelvin Coefficient for Ideal and Van der Waal Gases; (5) Energy Equations (6) Cooling due to Adiabatic demagnetization; Approach to Absolute Zero		
	Mode of Examination	Theory		
	Weightage Distribution	CA 30%	MTE 20%	ETE 50%
	Text Book/s	Heat and thermodynamics by Brijlal and Subrahmanyan, S.Chand $ co.		
	Other References	1. A Treatise on Heat ; Including Kinetic Theory of Gases; Thermodynamics and Recent Advances in Statistical Thermodynamics By Meghnad Saha; B; N; Srivastava (Indian Press; 1958) 2. Heat and Thermodynamics; An Intermediate Textbook By Mark Waldo Zemansky; Richard Dittman (McGraw-Hill; 1981) (Text Book) 3. Thermal Physics by Garg; Bansal and Ghosh (Tata McGra-Hill; 1993)		

PHB218 Solid State Physics

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: III**
1	Course Code	PHB218
2	Course Title	Solid State Physics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	This course provides an opportunity to develop knowledge and understanding of the key principles and applications of physics of solids including theoretical description of crystal and electronic structure, lattice dynamics and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors)
6	Course Outcomes	After the completion of this course, the student will be able to **CO1:** Demonstrate knowledge for crystal structures of solids, different physical mechanisms involved in crystal binding and lattice dynamics. **CO2:** Understand the theory of X-ray diffraction, use the lattice structure of crystalline materials both in real space and in reciprocal space (k-space) and be able to transform between these two spaces. **CO3:** Knowledge of fundamental principles of conductor, semiconductors, and insulators on the basics of band theory and be able to estimate the charge carrier mobility and density. **CO4:** Explain atomistic mechanism of thermal properties of solids. **CO5:** Explain the physical principles for different types of electric and magnetic phenomena in solid materials (like e.g. dielectricity, superconductivity, paramagnetism, diamagnetism, ferromagnetism etc). **CO6:** Apply physics principles and mathematical methods in solid state physics to explain crystal structure and various physical, electrical, thermal and magnetic properties of materials.
7	Course Description	This course provides the basic understanding of crystal structure, symmetry, electrical, thermal, dielectric and magnetic properties of materials and their technological applications.
8	Outline syllabus	
	Unit 1	**Crystal Structure and Bonding**
	A	Bonding in solids- ionic, covalent, metallic, Van der Waals and hydrogen bonding.
	B	Crystalline and amorphous solids, Crystal Lattice, Unit Cell, Miller Indices and Miller Planes, Bravais lattice

	C	Simple crystal structure (SC, BCC, FCC), Atomic packing fractions for Simple cubic(SC), BCC and FCC		
	Unit 2	**Reciprocal lattice**		
	A	X-rays Diffraction, Bragg law, Laue method, Rotating–crystal method		
	B	Scattering from lattice, Diffraction conditions		
	C	Reciprocal lattice, Ewald construction.		
	Unit 3	**Electrical properties of solids**		
	A	Electrical conductivity, classification of solids; conductors, semiconductors and insulators		
	B	intrinsic and extrinsic semiconductors, electrons and holes		
	C	Hall Effect		
	Unit 4	**Thermal properties of Solids**		
	A	Lattice vibration and phonons, vibrational modes of a 1-D lattice		
	B	Lattice heat capacity, Classical theory of specific heat		
	C	Thermal Conductivity, Thermoelectricity: Seebeck Effect and Peltier Effect.		
	Unit 5	**Dielectric and magnetic properties**		
	A	Dielectrics, dielectric polarization, polar and nonpolar dielectrics, relation between electric field and polarization.		
	B	Classification of magnetic materials: diamagnetism, paramagnetism, ferromagnetism, Magnetic Susceptibility, Curie law, Hysteresis Curve		
	C	Superconductivity, Type-I and type-II superconductors. Meissner effect.		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Solid State Physics: S.O. Pillai 2. Introduction to material science: Raghvan		
	Other References	3. Introduction to solid state physics: C. Kittel 4. Solid State Physics: A. J. Dekker		

PHB219 Electricity and Magnetism

School: SBSR		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics + Mathematics		**Semester: III**
1	**Course Code**	**PHB219**
2	**Course Title**	**Electricity and Magnetism**
3	**Credits**	**4**
4	**Contact Hours (L-T-P)**	**3-1-0**
	Course Status	**Compulsory**
5	**Course Objective**	This course aims to establish a foundation in electromagnetism and to make the students learn fundamental concepts of electricity, magnetism and circuit theory to use them in real life problems.
6	**Course Outcomes**	**On successful completion of this course students will /will be able to:** **CO1:** Understand Coulomb's Law of force, Electric field, Gauss Law and will solve problems based on it, Electric potential and electrostatic energy. **CO2:** Distinguish different types of capacitors and derive energy stored in a capacitor, force of attraction between capacitor plate. **CO3:** Learn magnetic effect of current, definition of **B**, magnetic flux density, Bio-Savart's Law, Ampere's Law, Gauss' Law in magnetism; Derive expression for magnetic force between two parallel conductors, Evaluate magnetic field along the axis of circular coil and solenoid. **CO4:** Explain electromagnetic induction, Faraday's law of induction, Lenz's law, self and mutual inductance; Evaluate energy stored in magnetic field, inductances in series and parallel combination. **CO5:** Acquire knowledge AC circuits, Kirchoff's laws for AC circuits, complex reactance and impedance, RC, RL, LC and LCR circuits (series and parallel). **CO6:** Evaluate electric and magnetic fields, potential, force and work using various laws; use Faradays laws in solving induction problems and learn the properties of basic circuit elements.
7	**Course Description**	This course describes the various laws related to electricity and magnetism laying foundation for advance courses such as electromagnetic theory. The course also provides an understanding of electromagnetic induction to further describe the properties of electrical circuits.

8	Outline Syllabus			
	Unit 1	**Electrostatics**		
	A	**Coulomb's Law:** Coulomb's Law of force, electrostatic field and intensity, electric flux.		
	B	**Gauss Law:** Gauss law and calculation of electric field using Gauss Law		
	C	**Potential**: Electric potential, equipotential surfaces, electrostatic energy and potential energy due to charge distribution		
	Unit 2	**Capacitor**		
	A	**Types of capacitors:** Different types of capacitors: parallel plate capacitor, spherical, cylindrical and guard ring capacitor.		
	B	**Energy stored:** energy stored in a capacitor, force of attraction between capacitor plate		
	C	**Capacitors with dielectrics:** capacitance of partially and completely filled dielectric		
	Unit 3	**Magnetic effect of current**		
	A	**Magnetic effect of current:** Magnetic effect of current, definition of **B,** magnetic force on a current carrying conductor, torque on a current loop in a uniform magnetic field.		
	B	**Bio Savart's Law:** magnetic flux density, Bio-Savart's Law, Magnetic force between two parallel conductors, Ampere's Law.		
	C	**Gauss Law in magnetism:** Gauss' Law in magnetism, Magnetic field along the axis of circular coil and solenoid.		
	Unit 4	**Electromagnetic Induction**		
	A	**Electromagnetic induction:** Faraday's Law of induction, Lenz's Law, induced emf and electric field		
	B	**Energy:** Energy stored in magnetic field.		
	C	**Inductance:** Self Inductance, Mutual inductance, inductances in series and parallel.		
	Unit 5	**Electrical Circuits**		
	A	**AC Circuits:** AC circuits, Kirchhoff's laws for AC circuits.		
	B	**Reactance:** Complex reactance and Impedance.		
	C	**Series and Parallel circuits:** RC, RL, LC and LCR circuits (series and parallel) excluding oscillations		
	Mode of Examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. David J Griffiths, "Introduction to electrodynamics" Pearson New International Edition 2. Halliday, Resnick and Walker, "Fundamentals of Physics Electricity and Magnetism" John Wiley 3. Matthew N O Sadiku, "Principles of Electromagnetics" 4. John David Jackson, "Classical Electrodynamics" John Wiley and Sons, Inc.		

		5. Joseph Edminister, “Schaum’s Outline of Electromagnetics”
	Other References	1. S Mahajan and Chaudhary, “Electricity, Magnetism and electromagnetic theory” TMH 2. D N Vasudeva, “Fundamentals of Electricity and Magnetism” S Chand and Company 3. K K Tewari, “Electricity and Magnetism” S. Chand

PHB229 Radiation Science

School: SBSR		**Batch:2018-2021**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics + Mathematics		**Semester: III**
1	**Course Code**	**PHB229**
2	**Course Title**	**Radiation Science**
3	**Credits**	**3**
4	**Contact Hours (L-T-P)**	**2-1-0**
	Course Status	**Compulsory**
5	**Course Objective**	Demonstrate broad knowledge and understanding of the scientific concepts underpinning radiation physics and including deeper knowledge of gamma rays, X-rays, radiation generators, radiation effects and radiation therapy.
6	**Course Outcomes**	**On successful completion of this course students will /will be able to:** **CO1:** In depth knowledge of different electromagnetic radiation and their uses in medical physics. **CO2:** Understand the concept of Electromagnetic waves, interaction of radiation with matter, Photoelectric effect, Compton effect and pair production. **CO3:** Deeper knowledge of x rays, their production and distribution in space. **CO4:** Acquire knowledge of different radiation generators as cyclotron, Betatron and Van De Graff Generator with their principle and applications. **CO5:** Study the radiation effect on chemical system, interaction of fres radicals and radiolysis water. **CO6:** Techniques to study the special propertiess of radiotherapy, dosimetry and percentage of depth dose.
7	**Course Description**	This course describes the different kind of electromagnetic radiation, their principal and uses in medical physics. This course will also provide them sufficient knowledge of different radiation generators, various types of sources used in radiotherapy and physical parameters of radiation dosimetry.
8	Outline Syllabus	

	Unit 1	**Interaction of radiation with matter**		
	A	Photoelectric effect, Compton effect		
	B	Pair-production, Attenuation		
	C	Scattering, absorption, Transmission		
	Unit 2	**X-Rays**		
	A	Electromagnetic waves - quantum theory of radiation, Physics of X-ray production, continuous spectrum,		
	B	The X-ray tube, Basics of X-ray Circuits		
	C	Distribution of X-rays in space, Quality of X- ray beam, Measurement of beam quality		
	Unit 3	**Radiation generators**		
	A	Cyclic generators: Principle and applications of Cyclotron, Synchro – Cyclotron		
	B	Betatron , Linear generators		
	C	Principle and applications of Klystron, magnetron, Van De Graff Generator		
	Unit 4	**Radiation effects**		
	A	Direct and Indirect effects of radiations, radiation chemical yields and G-values		
	B	Formation of free radicals, radiolysis of water, radiation effects on simple chemical systems		
	C	Interactions of free radicals with several solutes		
	Unit 5	**Radiation Therapy**		
	A	Various types of sources used in Radiotherapy and their properties; Physics of Photons, electrons, protons and neutrons in radiotherapy.		
	B	Physical parameters of dosimetry such as percentage depth dose		
	C	Special techniques in Radiotherapy such as SRS, SRT, IMRT, IGRT and Tomotherapy		
	Mode of Examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Fundamental of X-ray and Radium Physics - Joseph Selman. 2. Basic Medical Radiation Physics, Leonard Stanton, 3. Essentials of Nuclear Chemistry, H. J. Arnikar, 4th Edition Wiley Eastern. 4. Experimental Nuclear Physics, Emilo Gino Serge, John Wiley & Sons. 5. The physics of radiation therapy, Faiz M. Khan, 4th edition (2010), Lippincott, Williams and Wilkins, USA.		
	Other References	1. Introduction to health physics, Herman Cember and Thomas E. Johnson.		

CCU401 Community Connect

<table>
<tr><td colspan="2">SCHOOL: SBSR</td><td colspan="2">Batch :2018-2021</td></tr>
<tr><td colspan="2">Program: BSc</td><td colspan="2">Current Academic Year: 2019-20</td></tr>
<tr><td colspan="2">Branch: Physic</td><td colspan="2">Semester: III</td></tr>
<tr><td>1</td><td>Course Number</td><td colspan="2">Course Code: CCU 401/ Course ID: 30804</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="2">Community Connect</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="2">2</td></tr>
<tr><td>4</td><td>(L-T-P)</td><td colspan="2">(0-0-2)</td></tr>
<tr><td>5</td><td>Learning Hours</td><td colspan="2"><table><tr><td>Contact Hours</td><td>30</td></tr><tr><td>Project/Field Work</td><td>20</td></tr><tr><td>Assessment</td><td>00</td></tr><tr><td>Guided Study</td><td>10</td></tr><tr><td>Total hours</td><td>60</td></tr></table></td></tr>
<tr><td>6</td><td>Course Objectives</td><td colspan="2">1. Contribute to the holistic development of students by making them more aware of socially and economically disadvantaged communities and their specific issues
2. Provide more richer context to classrooms, so as to make them more effective laboratories of learning by aligning them to social realities beyond textbooks
3. Provide scope to faculty members to align their teaching and research goals by giving them ample opportunity to carry out community -oriented projects
4. Ensure that the community connect programs provides benefits to communities in tangible ways so that they may feel perceptibly better off post the interaction and involvement of the Sharda academic community
5. Provide ample opportunity for Sharda University academic community to contribute effectively to society and nation building</td></tr>
<tr><td>7</td><td>Course Outcomes</td><td colspan="2">After completion of this course students will be able to:
CO1: Students learn to be sensitive to the living challenges of disadvantaged communities.
CO2: Students learn to appreciate societal realities beyond textbooks and classrooms
CO3: Students learn to apply their knowledge via research, and training for community benefit
CO4: Students learn to work on socio-economic projects with teamwork and timely delivery</td></tr>
</table>

		CO5: Students learn to engage with communities for meaningful contribution to society
8	**Theme**	**Major themes for research:** 1. ***Survey and self-learning***: In this mode, students will make survey, analyze data and will extract results out of it to correlate with their theoretical knowledge. E.g. Crops and animals, land holding, labour problems, medical problems of animals and humans, savage and sanitation situation, waste management etc. 2. ***Survey and solution providing***: In this mode, students will identify the common problems and will provide solution/ educate rural population. E.g. air and water pollution, need of after treatment, use of renewable (mainly solar) energy, electricity saving devices, inefficiencies in cropping system, animal husbandry, poultry, pest control, irrigation, machining in agriculture etc. 3. ***Survey and reporting***: In this mode students will educate villagers and survey the ground level status of various government schemes meant for rural development. The analyzed results will be reported to concerned agencies which will help them for taking necessary/corrective measures. E.g. Pradhan Mantri Jan Dhan Yojana, Pradhan Mantri MUDRA Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal pension Yojana, Pradhan Mantri Awas Yojana, Pradhan Mantri FasalBima Yojana, Swachh Bharat Abhiyan, Soil Health Card Scheme, Digital India, Skill India Program,BetiBachao, BetiPadhao Yojana, DeenDayal Upadhyaya Gram Jyoti Yojana, Shyama Prasad Mukherjee Rurban Mission, UJWAL Discom Assurance Yojana, PAHAL,Pradhan Mantri Awas Yojana-Gramin, Pradhan Mantri Yuva Yojana, Pradhan Mantri Jan Aushadhi Yojana, Pradhan Mantri KhanijKshetra Kalyan Yojana, Pradhan Mantri Suraksha Bima Yojana, UDAN scheme, DeenDayal Upadhyaya Grameen Kaushalya Yojana, Pradhan Mantri Sukanya Samriddhi Yojana, Sansad Adarsh Gram Yojana, Pradhan Mantri SurakshitMatritva Abhiyan, Pradhan Mantri RojgarProtsahan Yojana, Midday Meal Scheme, Pradhan Mantri Vaya Vandana Yojana, Pradhan Mantri Matritva Vandana Yojana, and Ayushman Bharat Yojana.
9.1	**Guidelines for Faculty Members**	It will be a group assignment. There should be not more than 10 students in each group. The faculty guide will guide the students and approve the project title and help the student in preparing the questionnaire and final report. The questionnaire should be well design and it should carry at least 20 questions (Including demographic questions).

		The faculty will guide the student to prepare the PPT. The topic of the research should be related to social, economical or environmental issues concerning the common man. The report should contain 2,500 to 3,000 words and relevant charts, tables and photographs. **Plagiarism check of the report must**. ETE will conduct out of 100, divided in three parts (i) 30 Marks for report (ii) 30 Marks for presentation (iii) 40 Marks for knowledge. The student should **submit the report** to CCC-Coordinator signed by the faculty guide by …… The students have to send the hard copy of the **report and PPT**, and then only they will be allowed for ETE.
9.2	**Role of CCC-Coordinator**	The CCC Coordinator will supervise the whole process and assign students to faculty members. 1. PG- M.Sc.-Semester II - the students will be allocated to faculty member (mentors/faculty member) in odd term.
9.3	**Layout of the Report**	Abstract (250 words) a. Introduction b. Literature review(optional) c. Objective of the research d. Research Methodology e. Finding and discussion f. Conclusion and recommendation g. References Note: Research report should base on primary data.
9.4	**Guideline for Report Writing**	**Title Page: The following elements must be included:** • Title of the article; • Name(s) and initial(s) of author(s), preferably with first names spelled out; • Affiliation(s) of author(s); • Name of the faculty guide and Co-guide **Abstract:** Each article is to be preceded by a succinct abstract, of up to 250 words, that highlights the objectives, methods, results, and conclusions of the paper. **Text: Manuscripts should be submitted in Word.** • Use a normal, plain font (e.g., 12-point Times Roman) for text. • Use italics for emphasis. • *Use the automatic page numbering function to number the pages.* • *Save your file in docx format* (Word 2007 or higher) or doc format (older Word versions) **Reference list:** The list of references should only include works that are cited in the text and that have been published or accepted for publication. The entries in the list should be in alphabetical order.

		Journal article Hamburger, C.: Quasimonotonicity, regularity and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura Appl. 169, 321–354 (1995) Article by DOI Sajti, C.L., Georgio, S., Khodorkovsky, V., Marine, W.: New nanohybrid materials for biophotonics. Appl. Phys. A (2007). doi:10.1007/s00339-007-4137-z Book Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra. Kluwer, Boston (1992) Book chapter Broy, M.: Software engineering — from auxiliary to key technologies. In: Broy, M., Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, Heidelberg (2002) Online document Cartwright, J.: Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1 (2007). Accessed 26 June 2007 Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see www.issn.org/2-22661-LTWA-online.php For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list. EndNote style (zip, 2 kB) **Tables: All tables are to be numbered using Arabic numerals.** **Figure Numbering: All figures are to be numbered using Arabic numerals**.
9.5	**Format:**	**The report should be Spiral/ hardbound** The Design of the Cover page to report will be given by the Coordinator-CCC Cover page Acknowledgement Content Project report Appendices
9.6	**Important Dates:**	Students should prepare questionnaire and get it approved by concern faculty member and submit the final questionnaire within …….to CCC- Coordinator. Students will complete their survey work within …….. and submit the same to concern faculty member. (Each group should complete 50 questionnaires) The student should show the 1st draft of the report to concern faculty member within …….. and submit the same to concern faculty member. Faculty members should give required inputs, so that students can improve their project work and make the final report submission on …….. The students should submit the hard copy and soft copy of the report to CCC-Coordinator signed by the faculty guide within …….

		The students should submit the soft copy of the PPT to CCC-Coordinator signed by the faculty guide within …… **The final presentation will be organized on ……...**
9.7	**ETE**	**The students will be evaluated by panel of faculty members on the basis of their presentation on ……**

10	**Course Evaluation**	
10.01	**Continuous Assessment**	**60%**
	Questionnaire design	**20 Marks**
	Report Writing	**40 Marks**
10.02	**ETE (PPT presentation)**	**40%**

PHB221 Classical Mechanics and Relativity

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: IV**
1	Course Code	PHB221
2	Course Title	Classical Mechanics and Relativity
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To know about the concepts of Mechanics of single particle, system of particles, Constraints, Generalised Coordinates. 2. To explain the concepts concept of virtual work, de-Alembert's principle, Lagrange's equation, Basis of variation, Applications of calculus of variation, Generalized momenta. 3. To get introduced about the concept of Hamiltonian and Hamilton's equations of motion, Inertial frames, Galilean Transformation. 4. To analyze the concept of Michelson Morley experiment, postulates of special theory, Lorentz transformations, Velocity addition, etc.
6	Course Outcomes	**CO1:** Learn the basic concepts of Mechanics of single particle, system of particles in vector form, centre of mass, Conservation of linear momentum, energy and angular momentum, Constraints. **CO2:** Understand the concepts Generalised Coordinates, virtual work, de-Alembert's principle, Lagrange's equation, Applications of the Lagrange's equations. **CO3:** Able to explain the Basis of variation, derivation of Lagrange's equation, Applications of calculus of variation. **CO4:** Figure out the Generalized momenta, Hamiltonian and Hamilton's equations of motion. **CO5:** State the concepts of Inertial frames, Galilean Transformation, Michelson Morley experiment, postulates of special theory, Lorentz transformations. **CO6:** Analyze the concepts of Constrained motion, Lagrangian Formalism, Calculus of Variation, The Hamilton's Equation of Motion, Special Theory of Relativity
7	Course Description	This course is about describing the concepts of Constrained motion, Lagrangian Formalism, Calculus of Variation, The Hamilton's Equation of Motion, Special Theory of Relativity
8	Outline syllabus	
	Unit 1	**Elementary Principles and Constrained motion**
	A	Mechanics of single particle, system of particles in vector form, centre of mass
	B	Conservation of linear momentum, energy and angular momentum
	C	Constraints, Classification of constraints.

	Unit 2	**Lagrangian Formalism**		
	A	Generalised Coordinates, virtual work, de-Alembert's principle		
	B	Lagrange's equation		
	C	Applications of the Lagrange's equations (simple harmonic oscillator, simple pendulum, compound pendulum, double pendulum, Atwood's machine)		
	Unit 3	**Calculus of Variation**		
	A	Basis of variation, derivation of Lagrange's equation		
	B	Applications of calculus of variation		
	C	shortest path between two points, bead sliding on a curved path, surface due to revolution around an axis		
	Unit 4	**The Hamilton's Equation of Motion**		
	A	Generalized momenta, Hamiltonian and Hamilton's equations of motion		
	B	Application (Simple Harmonic Oscillator, simple pendulum, compound pendulum)		
	C	Phase space		
	Unit 5	**Special Theory of Relativity**		
	A	Galilean Transformation, Michelson Morley experiment		
	B	postulates of special theory, Lorentz transformations		
	C	Velocity addition, Length contraction, Time dilation, relativity of mass, mass energy relationship		
	Mode of examination	Theory/Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Classical Mechanics by H.Goldstein, Narosa Publishing Home, New Delhi. 2. Classical Mechanics by N.C.Rana and P.S.Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.		
	Other References	3. Introduction to Classical Mechanics by R.G.Takawale and P.S.Puranik, Tata Mc-Graw Hill Publishing Company Limited, New Delhi. 4. Classical Mechanics by J.C.Upadhyaya, Himalaya Publishing House.		

PHB228 Electromagnetic Theory

School: SBSR		**Batch : 2018-21**
Program: B.Sc.		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: IV**
1	Course Code	PHB228
2	Course Title	Electromagnetic theory
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	This course provides the knowledge of fundamental theory and concepts of Electromagnetic waves, transmission lines and propagation, reflection, and transmission of plane waves in different media and interface.
6	Course Outcomes	CO1: Able to interpret vector calculus operators and their application in electromagnetic. CO2: Understanding the concepts of displacements current and Analyze the Maxwell's equations in differential and integral form. CO3: Use Maxwell's equations to describe the propagation of electromagnetic waves in different media, nature of EM waves and can apply complex Poynting theorem to calculate average power. CO4: Understanding and solving the reflection and transmission of EM waves at normal and oblique incidence in linear media and conducting media. CO5: Understand the basic concepts of transmission lines, waveguides and calculate the characteristic impedance, attenuation constant and phase constant of different transmission lines. CO6: Apply conceptual understanding and mathematical methods to solve the problems.
7	Course Description	
8	Outline syllabus	
	Unit 1	
	A	Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance
	B	Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss's divergence theorem
	C	Stoke's theorem, Laplace's and Poisson equations. The Uniqueness Theorem.
	Unit 2	
	A	Ampere's law and concept of Displacement current
	B	Equation of continuity
	C	Maxwell's equations in differential form and integral form
	Unit 3	
	A	EM wave equation and their solutions; Propagation of plane EM waves in free space
	B	Propagation of plane EM waves in dielectrics and conductors
	C	Poynting theorem and energy conservation , Transverse nature of EM waves

	Unit 4			
	A	Polarization of EM wave		
	B	transmission at normal and oblique incidence in linear media and total internal reflection and Brewster angle		
	C	transmission at normal and oblique incidence in conducting media		
	Unit 5			
	A	Propagation of e.m. wave through transmission line		
	B	reflection coefficient, standing wave, characteristic impedance,		
	C	propagation constant, Introduction to waveguides		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Introduction to electromagnetics by Richard, Millford and Christi, Narosa Pub.		
	Other References	1. Introduction to Electrodynamics J. D. Griffith, PHI. 2. Electromagnetic waves- R. K. Shevgaonkar, TMH. 3. Schaum's outline on Electromagnetics-J. A. Edminister, TMH. 4. Electromagnetic Waves and Radiating System-Edward C. Jordan, K.G. Balmain, PHI. 5. Electromagnetics- J.D. Kraus, TMH. 6. Elements of Electromagnetics- N.N. Rao, Pearson		

PHB224 Basic Electronics

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: IV**
1	Course Code	PHB224
2	Course Title	Basic Electronics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To provide students an understanding of fundamentals of semiconductor physics and electronic devices. 2. To develop understanding of diodes, transistors and rectifiers. 3. To develop basic understanding of various junction diodes and their applications. 4. To provide knowledge of physics concepts related to electronics.
6	Course Outcomes	After the completion of this course, **CO1:** Students will show that they have learned fundamentals of semiconductors **CO2:** Students will understand various transport phenomenon in semiconductors **CO3:** Students will gain knowledge of various junction diodes and their I-V characteristics **CO4:** Students will have a clear understanding of applications of diode as rectifiers, filters, modulation and demodulation. **CO5:** Students will learn the concept of different types of transistors and their uses in on chip devices. **CO6:** Students will understand the basics of electronics along with their various applications and can learn how to use them in daily life.
7	Course Description	This course will provide knowledge of various phenomenon of semiconductors and their uses in diode formation and transistors.
8	Outline syllabus	
	Unit 1	**Semiconductor Fundamentals**
	A	Formation of energy band, Effective mass, Direct and indirect band gap.
	B	Fermi Dirac distribution function, Fermi energy, Donor and Acceptor level.
	C	Degenerate and non-degenerate semiconductors.
	Unit 2	**Transport Phenomena in Semiconductors**
	A	Mobility, conductivity, Carrier concentration (electrons and holes) in intrinsic semiconductor.
	B	Law of mass action. Variation of Fermi level with doping concentration and temperature.

	C	Drift and diffusion current. Einstein relation.		
	Unit 3	**Junction Diode**		
	A	Basic structure and formation of p-n junction, Energy band diagram, Formation of depletion region, Built in potential,		
	B	Behaviours of a p-njunction under bias, Diode equation and I-V characteristics of a p-n junction, Junction Capacitance.		
	C	Avalanche and Zener breakdown, Zener Diode and Voltage Regulation.		
	Unit 4	**Diode Applications**		
	A	Half-wave Rectifiers. Centre-tapped and Bridge full-wave rectifiers.		
	B	Calculation of Ripple Factor and Rectification Efficiency, filters – RC, LC, and pi.		
	C	Modulation and demodulation – elementary theory of AM, FM, Demodulation of AM (diode detector).		
	Unit 5	**Transistors**		
	A	Introduction to transistors, Basic structure of n-p-n and p-n-p transistors.		
	B	Characteristics of CB, CE and CC Configurations.		
	C	Physical mechanism of current Flow. Active, Cutoff and Saturation Regions, Current gains α and β, Relation between α and β, applications of transistors.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Solid State Electronic Devices- B. Streetman, Pearson Education. (Text book) 2. Electronic Devices and Circuit Theory- Robert Boylestad and Louis Nashelsky, Prentice Hall. (Text book)		
	Other References	1. Integrated Electronics- Millman - Halkias, Tata Mc Graw Hill 2. Donald A Neaman Semiconductor Physics and Devices, Tata Mc Graw Hill		

PHB225 Nuclear Physics

School: SBSR		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: IV**
1	**Course Code**	**PHB225**
2	**Course Title**	**Nuclear Physics**
3	**Credits**	**4**
4	**Contact Hours (L-T-P)**	**3-1-0**
	Course Status	**Compulsory**
5	**Course Objective**	This course aims: 1. To explore nuclear matter 2. To introduce students to the concepts governing nuclear models 3. To explain nuclear decay and radioactivity 4. To learn about various detectors
6	**Course Outcomes**	**Upon successful completion of this course students will /will be able to:** **CO1:** Explain the properties of nucleus and illustrate how to measure radius of the nucleus; Describe various models of the nucleus **CO2:** Evaluate half-life, mean lifetime, activity of the decaying nucleus **CO3:** Explain the theory behind alpha beta and gamma decay **CO4:** Compare different types of nuclear reactions and learn about nuclear fission and fusion and their reactors **CO5:** Explain the concept of nuclear detection and differentiate various counters **CO6:** Acquire relevant knowledge about nuclear physics to apply it to the real-life problems.
7	**Course Description**	This course illustrates in depth the composition and properties of nucleus, nuclear forces, different models depicting the nucleus, laws governing radioactivity, nuclear decay, types of nuclear reactions and introduces to the concept nuclear detection.
8	Outline Syllabus	
	Unit 1	**Nuclear Structure**
	A	**Structure:** Nuclear Composition- basic concepts of neutrons, protons, electrons, atomic number, isotopes, atomic mass unit; Experimental procedure to measure nuclear size- Rutherford scattering formula
	B	**Properties:** Properties of the Nucleus- charge, mass, size of the nucleus, angular momentum, spin, parity and magnetic moment, nuclear forces; Stable Nuclei- odd-even effect, pairing of

		nucleons, N-Z diagram; Binding Energy of the Nucleus- binding energy per nucleon;		
	C	**Models**: Nuclear Models- (i) The Liquid-Drop Model- volume effect, surface effect, Coulomb repulsion effect, symmetry effect, semi-empirical binding-energy formula (Weizackers's-Bethe mass formula) (ii) The Shell Model- evidences, theory, energy level diagram, spin-orbit interaction, magic numbers		
	Unit 2	**Radioactivity**		
	A	**Discovery:** Discovery of radioactivity; Types of radioactive decay		
	B	**Laws:** Radioactivity- the laws of radioactive decay, half-life, mean lifetime, Activity; Natural Radioactivity and Radioactive Dating (^{14}C, ^{40}K)		
	C	**Series:** Radioactive Series		
	Unit 3	**Nuclear Decay**		
	A	**Alpha decay:** The Decay Processes- (i) Alpha Decay- disintegration energy (Q-value calculation), alpha-particle energy, Gamow's theory/tunnel theory of alpha decay, Geiger-Nuttal Law and alpha particle spectra		
	B	**Beta Decay:** Beta Decay- negative and positive beta decay, electron capture, Q-value calculation, beta ray spectra, neutrino hypothesis, non-conservation of parity in beta decay		
	C	**Gamma Decay:** Gamma Decay- gamma rays, internal conversion, recoil of nucleus.		
	Unit 4	**Nuclear Reactions**		
	A	**Laws:** Introduction; Conservation Laws in Nuclear Reactions- disintegration energy or Q-value, exothermic and endothermic reactions, threshold energy;		
	B	**Fission:** Nuclear Fission; Fission in Liquid Drop Model; Chain Reactions; Nuclear Reactors;		
	C	**Fusion:** Nuclear Fusion; Fusion Reactors and their uses		
	Unit 5	**Nuclear Radiations and Detectors**		
	A	**Detection-Counters:** Introduction, Concepts to radiation detection, GM Counter and Bubble Chamber, Scintillation Counter;		
	B	**Radiation Hazard:** Radiation Hazards, Radiation protection and covering.		
	C	**Benefits:** Beneficial uses of Radiation- tracing, materials analysis, radiation therapy, food preservation, etc.;		
	Mode of Examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Concepts of Modern Physics-Arthur Beiser (Tata McGraw Hill Education) 2. Nuclear Physics-Alex E S Green (Tata McGraw Hill Education)		

		3. Introductory Nuclear Physics-David Halliday (Asia Publishing House) 4. Concepts of Nuclear Physics- B L Cohen (Tata McGraw Hill Education) 5. Nuclear Physics-J B Rajam (S Chand Publishing Co.)
	Other References	6. Nuclear Physics- S N Ghoshal (S Chand Publishing Co.) 7. Nuclear Physics-D C Tayal (Himalayan Publishing House) 8. Concept of Nuclear Physics- S P Kuila 9. Nuclear and Particle Physics-S L Kakani & Shubhra Kakani

PHB332 Quantum Mechanics

School: School of Basic Sciences and Research		**Batch:2018-21**
Program: B. Sc		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: V**
1	Course Code	PHB332
2	Course Title	Quantum Mechanics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To study the basic principles of quantum mechanics. 2. Explain the operator formulation of quantum mechanics. 3. Students learn the concept of wave function. 4. To study role of uncertainty in quantum physics. 5. Student will learn Schrodinger equation and their applications.
6	Course Outcomes	After the completion of this course students will be able to: CO1: Pinpoint the historical aspects of development of quantum mechanics. CO2: Understand the idea of wave particle duality. CO3: understand the uncertainty relations and its applications. CO4: explain the postulates of quantum mechanics. CO5: solve the Schrödinger equation and describe the properties of a particle in simple potential wells. CO6: appreciate quantum mechanics with wave function approach and can apply it on real life problems.
7	Course description	This course develops concepts in quantum mechanics such that the behaviour of the physical universe can be understood from a fundamental point of view. It provides a basis for further study of quantum mechanics.
8	Outline Syllabus	
	Unit 1	**Introduction to modern physics**
	A	Need for Quantum Physics-Historical Overview: Inadequacy of classical physics
	B	origin of quantum theory, Blackbody radiation and Plank's hypothesis
	C	Photo electric effect, Compton Scattering, Pair production.
	Unit 2	**Wave Aspect of Particles**
	A	Matter waves: de-Broglie Hypothesis. Experimental evidence: Davission and Germer experiment, G.P. Thomson experiment
	B	Electron diffraction and wave-particle duality of matter and light, Quantization of Energy,
	C	Quantum mechanics on the basis of Bohr's theory; Sommerfield theory, Short comings of old quantum theory.
	Unit 3	**Uncertainty principle**

	A	Wave packets, Phase velocity and Group velocity, Superposition Principle		
	B	The Heisenberg Uncertainty Principle - Statement, interpretation and examples:		
	C	Non existence of electron in a nucleus, radius of Bohr's first orbit, binding energy.		
	Unit 4	**Basic features of Quantum Mechanics**		
	A	Basic postulates of Quantum Mechanics.		
	B	Wave functions, Probability Density, Observable and operators. Expectation values		
	C	Pauli's exclusion principle, Symmetric and anti-symmetric wave functions.		
	Unit 5	**Schrodinger Equation and Applications**		
	A	Equation of motion of matter waves: Time In-dependant Schrodinger equation, Time dependant Schrodinger equation		
	B	Potential well (infinite and finite), potential step,		
	C	Potential barrier, tunnelling and One dimensional Harmonic Oscillator.		
	Mode of Examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	**1.** Concepts of modern physics by A. Beiser **2.** Quantum Mechanics by A. Ghatak and S. Lokanathan, Macmillan India Ltd. **3.** Quantum Mechanics: Concept and Applications by Nouredine Zettili **4.** Introduction to quantum mechanics by D. I. Griffiths (Pearson Education) (IInd Edition)		
	Other References	**1.** Modern Quantum Mechanics by J.J. Sakurai and San Fu Tuan (Addison Wesley) **2.** Quantum Mechanics by L.I. Schiff (Mc Graw Hill) **3.** A Text book of Quantum Mechanics, P. M. Mathews and K.Venkatesan, Tata McGraw Hill **4.** Quantum Physics by R. Eisberg and R. Resnick (Wiley and Sons)		

PHB333 Applied Optics

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: V**
1	Course Code	PHB333
2	Course Title	Applied Optics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory
5	Course Objective	Lasers, optical fiber and holography and their applications have become integral part of our society. This course provides the knowledge of fundamental concepts and working principle of various laser, optical fiber and holography with their applications.
6	Course Outcomes	CO1: Provides the students a thorough understanding of the fundamentals of lasers and their unique properties. CO2: Knowledge of different lasers design and its various applications. CO3: Knowledge of basics of holography, construction and re-contraction of hologram and recording materials. CO4: Understanding of Interferometry and different types of hologram and its applications. CO5: Adequate knowledge of basic concepts of optical fibers, properties and industrial applications of optical fibers. CO6: Describe the basic laser physics, working of lasers, holography and theory of optical fibers.
7	Course Description	This course provides the basic understanding about the various laser systems and their applications. Provide knowledge about structure of optical fiber, light propagation in optical fiber, construction, reconstruction of hologram and their applications.
8	Outline syllabus	
	Unit 1	**Concepts of Laser**
	A	Introduction, coherent sources, Absorption, Spontaneous and Stimulated emission, Einstein's coefficients.
	B	Optical amplification, Population inversion and Optical pumping, Active components of laser
	C	Optical Resonators: Stable and unstable resonators, Threshold condition for laser action.
	Unit 2	**Types of Laser**
	A	Solid state laser (Ruby, Nd:Yag),
	B	gas laser (He-Ne, CO_2 laser)
	C	Semiconductor diode laser: Homo and Hetero junction, applications of lasers.
	Unit 3	**Holography**
	A	Introduction, basic principle of holography, Recording of hologram, Reconstruction of hologram, Hologram of a point source,
	B	Requirements in making hologram, Transmission and Reflection holograms, Plane and Volume holograms,

	C	Recording materials for holograms: silver halides, dichromatic gelatin, photoresist etc,		
	Unit 4	**Interferometry and Imaging**		
	A	Interferometry: Michelson interferometer, Fabry Perot interferometer,		
	B	Optical Data storage, Display, HOEs (Holographic optical elements),		
	C	Colour holography: Recording with multiple wavelength, White light holograms and acoustic holography		
	Unit 5	**Optical Fiber**		
	A	Introduction, Structure of optical fibers, light propagation through an optical fiber , parameters related to an optical fiber		
	B	Classification of optical fibers, attenuation, dispersion		
	C	Advantages and disadvantages of optical fiber, Introduction of optical fibre communication system..		
	Mode of examination	Class test (10) ,Assignments (10) and presentation (10)		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	An introduction to Lasers: Theory and Applications by M. N. Avadhanulu (Text book)		
	Other References	1. Lasers (Theory and Application) by K.Thyagarajan & A.K.Ghatak 2. Lasers and Non Linear Optics by B.B. Laud (New Age International, Second Edition) (text book) 3. Introduction to fiber by A.K. Ghatak& K. Thyagarajan 4. Optical fibre communications by John M. Senior (Second Edition)		

PHB334 Oscillations and Waves

School: SBSR		**Batch : 2018-2021**
Program: B.Sc.		**Current Academic Year: 2020-2021**
Branch: Physics		**Semester: 5th**
1	Course Code	PHB334
2	Course Title	Oscillations and Waves
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To develop an idea of superposition of waves and nature of oscillation 2. To know the brief detail of damping of oscillation and energy related to the system. 3. To know about the forced damping of waves and resonance of waves and to know about the wave motion and also about the coupled oscillation. 4. Deduce the classical, differential equations of waves and to learn about the modulation, propagation and dispersion of waves. 5. To understand the basics of acoustics of building and conditions of a good quality hall.
6	Course Outcomes	CO1: Learn the basics of waves and oscillation. CO2: Learn the superposition principle of waves and beat phenomenon and Lissajous Figures. CO3: learn about the damping of waves and about its energy. CO4: learn about forced oscillations and coupled oscillation CO5: learn about the idea of classical wave equation, propagation of waves in different media. CO6: learn about acoustics and able to apply course knowledge on mechanical and electrical systems.
7	Course Description	This course is designed for B.Sc. third year students. This course deals the basics of different types of oscillations and waves. It also describes the basic knowledge of the subject to electrical and mechanical systems.
8	Outline syllabus	
	Unit 1	**Superposition of Harmonic Oscillations**
	A	The superposition principle and linearity, Superposition of Two Collinear Harmonic Oscillations
	B	Superposition of Two Collinear Harmonic Oscillations: Oscillations having equal and different frequencies: Beats, Application of Beats,
	C	Superposition of two perpendicular harmonic oscillations: Oscillations having equal frequencies and different frequencies, Lissajous Figures.
	Unit 2	**Free Damped Oscillations (One degree of freedom)**
	A	Damping forces, Oscillation of systems with one degree of freedom,
	B	Energy of a weakly damped oscillator, Logarithmic Decrement, Relaxation time, Quality factor,
	C	Damped Oscillations of Mechanical impedances.
	Unit 3	**Forced Oscillations and Coupled Oscillations**

	A	Forced Oscillations, Forced Oscillations of one dimensional harmonic oscillator: Steady State – Amplitude		
	B	Coupled Oscillations, Two coupled pendulums, Normal Coordinates and Normal Modes		
	C	Transverse vibration of a string, Classical wave equation		
	Unit 4	**Wave Motion**		
	A	Differential equation of Wave motion, Wave velocities in continuous systems: Newton's Formula for velocity of sound		
	B	Modulations, Wave Groups and Pulses, Particle and Wave Velocities		
	C	Normal and Anomalous dispersion		
	Unit 5	**Acoustics**		
	A	Acoustics of building, Condition for a good hall		
	B	Reverberation time, Sabine's Reverberation formula		
	C	Absorption Coefficient measurement.		
	Mode of examination	Theory/Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988		
	Other References	1. Vibrations and Waves by A. P. French. (CBS Pub. & Dist., 1987) 2. Fundamentals of Waves & Oscillations by K. Uno Ingard (Cambridge University Press, 1988) 3. An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973) 4. Waves: Berkeley Physics Course (SIE) by Franks Crawford.		

PHB 335 Analog Electronic Devices

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: V**
1	Course Code	PHB335
2	Course Title	Analog Electronic Devices
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory /Elective/Open Elective
5	Course Objective	6. 1. To provide students an understanding of fundamentals of electrical circuits and theorems. 7. To develop understanding of the working principle of Bipolar junction transistor as a switch. 8. To demonstrate JFET and MOSFET and variety of special diodes used in electronic industry. 9. To provide knowledge of basics of operational amplifier and its applications.
6	Course Outcomes	After the completion of this course, **CO1:** Students will show that they have learned basics of electrical circuits with the help of variety of theorems. **CO2:** Students will gain knowledge of Biploar junction transistor and its various parameters **CO3:** Students will differentiate between JFET and MOSFET **CO4:** Students will learn the concept of different types of special diodes and their applications in research problems **CO5:** Students will have a clear understanding of fundamentals of operational amplifiers used in electronic industries. **CO6:** Students will get the deep insight of analog electronic devices useful in day to today life.
7	Course Description	This course will help students to know about the fundamentals of various analog devices.
8	Outline syllabus	
	Unit 1	**Electrical Circuits**
	A	Constant current source and constant voltage source, Conversion of voltage source into current source
	B	Thevenin's theorem, Norton's theorem, Superposition theorem
	C	Maximum power transfer theorem
	Unit 2	**Bipolar Junction Transistor**
	A	Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias, Single stage amplifier
	B	Practical circuit of transistor amplifier, DC and AC load lines analysis, Q point, h-parameter equivalent circuit

	C	Analysis of a single-stage CE amplifier using Hybrid Model, BJT as a switch		
	Unit 3	**JFET and MOSFET**		
	A	Construction of JFET, Idea of channel formation, Minimum channel width, Field dependent mobility, pinch-off, I-V curves,		
	B	Basic construction of MOSFET and its working, I-V characteristics and its similarity with JFET, Enhancement and depletion modes		
	C	Comparison of n channel and p channel MOSFET. Applications of JFET and MOSFET		
	Unit 4	**Special Diodes**		
	A	Metal Semiconductor junction (Schottky diode), Light emitting Diode, Photodiode		
	B	Semiconductor Laser diode, Solar cell, Tunnel Diode		
	C	Silicon-Controlled Rectifier		
	Unit 5	**Operational Amplifier**		
	A	Introduction to Op-amp, Properties of ideal amplifier		
	B	Inverting and non-inverting amplifier, CMRR		
	C	Applications of operational amplifier as Adder, Subtractor, Differentiator, Integrator		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Integrated Electronics- Millman - Halkias, Tata Mc Graw Hill. 2. Electronic Devices and Circuit Theory- Robert Boylestad and Louis Nashelsky, Prentice Hall.		
	Other References	1. Solid State Electronic Devices- B. Streetman, Pearson Education. 2. Semiconductor Device Fundamentals- Robert F. Pierret Addison Wesley Longman. 3. Semiconductor Physics and Devices by Donald A Neaman, Tata McGraw Hill		

PHB336 Statistical Mechanics

School: SBSR		**Batch: 2018-21**
Program: MSc		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: v**
1	**Course Code**	**PHB336**
2	**Course Title**	**Statistical Mechanics**
3	**Credits**	**4**
4	**Contact Hours (L-T-P)**	**3-1-0**
	Course Status	**Compulsory**
5	**Course Objective**	This course aims: 1. To establish an understanding of the basics of Statistical mechanics. 2. Students are made aware of the concept of phase space, ensembles and the types of ensembles. 3. To make students aware of partition function, Maxwell velocity distribution and Gibb's paradox. 4. To provide detailed understanding of black body radiation and its properties.
6	**Course Outcomes**	**Upon successful completion of this course, the student will be able to:** **CO1:** Acquire knowledge of phase space, entropy, classical and quantum statistics. **CO2:** Understand the concept of ensembles and their types and probability functions. **CO3:** Develop an understanding of Entropy of mixing and Gibb's paradox, Sackur Tetrode equation, Maxwell Boltzmann Statistics and partition function. **CO4:** Learn fundamentals of thermal radiation, black body radiation and its properties, Rayleigh jeans law, Planck's law of Radiation. **CO5:** Learn the concept of quantum statistics, Boson gas, fermions, B-E statistics and Fermi dirac statistics **CO6:** Understand, analyze and apply the concept of statistical mechanics to various problems which help to explain the behavior of large system.
7	**Course Description**	This course introduces the various concepts, methods and terminologies of statistical mechanics that are further used to develop the statistics for Bose-Einstein, Fermi-Dirac etc. Also to understand the concept of Radiation. Statistical Mechanics can be used to explain the thermodynamic behavior of large system.

8	Outline syllabus	
	Unit 1	**Introduction to Classical Statistics**
	A	Scope and aim of Statistical mechanics, Transition from thermodynamics to statistical mechanics, Classical and quantum statistics.
	B	Statistical approach to thermodynamic quantities: (Pressure, temperature, internal energy, Entropy)
	C	Entropy as a variable of state, Thermodynamic probability, Microscopic and Macroscopic states, Phase Space
	Unit 2	**Concepts of ensembles**
	A	Contact between statistical and thermodynamic quantities, Boltzmann relation for entropy
	B	Calculation of thermodynamic properties, Elementary concept of Ensemble: micro-canonical, canonical and grand-canonical ensembles
	C	Ω_0 as a function of energy, Calculation of Ω_{MB}.
	Unit 3	**Classical Statistics**
	A	Statistical approach to the laws of classical thermodynamics, Entropy of mixing and Gibb's paradox,
	B	Sackur Tetrode equation, Maxwell Boltzmann Statistics, Partition function,
	C	Maxwell velocity distribution and mean values
	Unit 4	**Theory of Radiation**
	A	Properties of Thermal Radiation; Blackbody Radiation; Kirchhoff's Law; Stefan-Boltzmann Law.
	B	Wien's Displacement law, Radiation Pressure, Rayleigh-Jean's Law, Ultraviolet Catastrophe,
	C	Planck's Quantum Postulates, Planck's Law of Blackbody Radiation, Experimental Verification.
	Unit 5	**Quantum Statistics**
	A	Quantum restrictions on translational, rotational and vibration forms of the energy, Calculation of Ω_{MB} and Ω_{BE},
	B	Distribution functions: Bose-Einstein (BE) Distribution Function, Fermi Dirac (FD) Distribution function
	C	Photon gas, Boson Gas, Applications of BE and FD distributions.
	Mode of examination	Theory/Viva
	Weightage Distribution	CA: 30% / MTE: 20% / ETE: 50%
	Text book/s*	1. Fundamentals of classical and statistical thermodynamics, Bimalendu N. Roy, Wiley 2. Heat thermodynamics and Statistical Physics, S. S. Singhal, J. P. Agrawal, Satya Prakash 3. Thermal Physics, S. C. Garg, R. M. Bansal, C. K. Ghosh, Tata McGraw-Hill 4. Heat and Thermodynamics, Zemanskay and Dittman, McGraw Hill 5. Statistical Mechanics, R.K. Patharia, Pergamin press, Oxford

	Other References	4. Thermodynamics and Statistical Mechanics, Greiner, Springer 5. Statistical and Thermal Physics: an introduction by S. Lokanathan and R.S. Gambhir.

PHB337 Renewable Energy

School: SBSR		**Batch :2018-21**
Program: B.Sc.		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: 6th**
1	Course Code	PHB337
2	Course Title	RENEWABLE ENERGY
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To know the importance of Physics and Materials Science. 2. To utilize the various synthesis procedure to develop materials. 3. To explain the practical application of materials in various area.
6	Course Outcomes	CO1: Learn the basics of Energy/Technology CO2: Understand the correlation between Applied science and Technology CO3: Apply the concept of Renewable energy and technology at certain levels. CO4: Develop renewable devices. CO5: Create the path to handle materials and devices. CO6: Expertise in various tools will make a bridge between industry and students and Find out the platform for employment in high tech industries
7	Course Description	Renewable energy power generation has grown as a result of clean energy policies in many countries. The fastest growing of these green energy sources is solar power and wind power. Hydro power is the largest alternative energy source but geothermal power, biomass power and tidal power are starting to make strides in the market.
8	Outline syllabus	
	Unit 1	**Fossil fuels and Alternate Sources of Energy**
	A	Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources
	B	An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation
	C	Geothermal energy tidal energy, Hydroelectricity. Environmental issues and Renewable sources of energy, sustainability
	Unit 2	**Solar Energy**
	A	Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy
	B	Solar water heater,flat plate collector, solar distillation, solar cooker, solar green houses, solar cell
	C	Need and characteristics of photovoltaic (PV) systems, PVmodels and equivalent circuits, and sun tracking systems
	Unit 3	**Wind and Ocean Energy**

	A	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines		
	B	Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices		
	C	Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy,Osmotic Power, Ocean Bio-mass		
	Unit 4	**Geothermal and Hydro energy**		
	A	Geothermal Energy: Geothermal Resources, Geothermal Technologies		
	B	Hydro-Energy: Hydropower resources, hydropower technologies		
	C	Environmental impact of hydro power sources.		
	Unit 5	**Piezoelectric Energy harvesting**		
	A	Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity		
	B	Piezoelectric parameters and modelling piezoelectric generators		
	C	Piezoelectric energy harvesting applications		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi		
	Other References	1. Solar energy - M P Agarwal - S Chand and Co. Ltd. 2. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 3. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, 4. Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy		

PHB338 Atomic and Molecular Physics

School: SBSR		**Batch: 2018-21**
Program: BSc (Physics)		**Current Academic Year: 2020-21**
Branch:		**Semester: VI**
1	Course Code	PHB338
2	Course Title	Atomic and Molecular Physics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To know concept of atomic particle and structure of an atom. 2. To understand the orbital and spin motion of an electron in an atom. 3. To know the concept of pauli principle and coupling. 4. To understand the concept of molecular spectra and scattering mechanism concept of pauli principle and coupling.
6	Course Outcomes	After the completion of this course, the student will be able to **CO1:** To understand the electron discovery and different atomic models **CO2:** To know the hydrogen atom spectra and the relativistic corrections for the energy levels of the hydrogen atom. **CO3:** To explain the observed dependence of atomic spectral lines on externally applied electric and magnetic fields. **CO4:** To understand the importance of spin orbit interactions. **CO5:** State and justify the selection rules for various optical spectroscopies in terms of the symmetries of molecular vibrations, Raman Spectra and Raman Scattering. **CO6:** To understand the concepts and potential applications of atomic and molecular physics and successfully apply the theoretical techniques presented in the course to practical problems.
7	Course Description	Atom and molecule are the fundamental unit for all matters in universe. Matter, whatever the states, is made of atoms. The properties of all matters are governed by the electronic structure of atom and molecule. They have individual properties like electronic, magnetic and optical properties, which are quite different from the collective properties of matter made of atoms and molecules. This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field. The course contains description of atomic models, atomic spectra, energy levels of hydrogen atom and other heavier atoms, effect of magnetic and electric field on the energy spectra, spin orbit interactions, molecular spectra, Raman spectra and Raman Scattering.
8	Outline syllabus	
	Unit 1	
	A	Elementary particles of atom; Atom radius; electron's discovery
	B	Thomson model, Rutherford model, Bohr's model, Somerfield model

	C	Bohr's postulates, Bohr's theory of hydrogen atom, Somerfield correction.		
	Unit 2			
	A	Electron Angular Momentum, Space Quantization, Electron Spin and Spin Angular Momentum.		
	B	Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment		
	C	Total Angular Momentum of an electron, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).		
	Unit 3			
	A	Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions		
	B	Fine structure, Spin orbit coupling, Spectral Notations for Atomic States, Total Angular Momentum		
	C	Vector Model, L-S and J-J couplings, Hund's Rule, selection rules, Spectra of Hydrogen and Alkali Atoms (Na etc.).		
	Unit 4			
	A	Born-Oppenhiemer approximation, potential energy curve		
	B	Introduction to rotational and vibrational spectra of a molecule		
	C	Introduction to electronic spectra of a molecule, energy levels and Selection rule.		
	Unit 5			
	A	Rayleigh scattering		
	B	Raman scattering, Raman Effect		
	C	Characteristics of Raman Lines, Stoke's and Anti-Stoke's Lines.		
	Mode of examination	Theory/Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Introduction to Atomic Spectra: H.E. White. 2. Atomic and Molecular Spectra, Raj Kumar, Kedar Nath and Ram Nath. Delhi.		
	Other References	3. Physics of Atoms and Molecules: Bransdenand Joachain. 4. Introduction to Atomic Spectra: HG Kuhn. 5. Fundamentals of Molecular Spectroscopy, IVth Edition, Colin N. Banwell and Elaine M. McCash,Tata McGraw Hill Publishing Company Limited, New Delhi. (Text Book)		

PHB320 Instrumentation

School: School of Basic Sciences and Research		**Batch : 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2020-2021**
Branch: Physics		**Semester: VI**
1	Course Code	PHB320
2	Course Title	Instrumentation
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To provide students an understanding of fundamentals of various measurement techniques and errors along with the working principle of digital and analog instruments. To demonstrate CRO, variety of transducers and sensors used in physics, material sciences, chemistry, nanotechnology and electronics. To provide knowledge of various mechanical pumps in line with physics principles and theories.
6	Course Outcomes	After the completion of this course, CO1: Students will show that they have learned basic measurements techniques and errors CO2: Students will differentiate among digital and analog instruments used in daily life CO3:Students will gain knowledge of CRO to analyze input output signals CO4: Students will have a clear understanding of fundamentals of various transducers and sensors used in professional and scientific community. CO5: Students will learn the concept of different types of mechanical pumps and their uses in research problems. CO6: Students have complete knowledge of various instruments used in laboratories and day to day life.
7	Course Description	This course provides basic knowledge of various instruments used in scientific laboratories and the measurement errors encountered during experiments.
8	Outline syllabus	
	Unit 1	**Measurement and Errors Analysis**
	A	Instruments accuracy, precision, sensitivity and resolution range, Errors in measurements
	B	Statistical analysis – T test and chi2 test
	C	Units and Standards of Measurements, Fundamental and Derived Units, Hierarchy of Standards.
	Unit 2	**Analog and Digital Instrumentation**
	A	Galvanometer (moving coil, and moving magnet), Voltmeter and ammeter - Principle and working, Impedance and sensitivity, measurement of high/ low voltage, AC and DC options.

	B	Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments.		
	C	Multimeter: Principles of measurement, Specifications of a multimeter and its significance		
	Unit 3	**Cathode Ray Oscilloscope**		
	A	Block diagram of basic CRO, Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only), Front panel controls		
	B	Use of CRO for the measurement of voltage (dc and ac frequency, time period, Special features of dual trace),		
	C	Introduction to digital oscilloscope, probes, Digital storage Oscilloscope: Block diagram and principle of working.		
	Unit 4	**Transducers & Sensors**		
	A	Static and dynamic characteristics of measurement Systems.		
	B	Transducers and their characteristics, Temperature transducers. Thermocouples.		
	C	Sensors – definition and classification, LDR, Photo diode.		
	Unit 5	**Fundamental of Vacuum System**		
	A	Characteristics of vacuum: Mean free path. Applications of vacuum.		
	B	Measurement of Vacuum: Pressure gauges – Pirani and Penning Gauge.		
	C	Mechanical pumps, Rotary Vane Pumps, Diffusion & Molecular pump, pumping speed.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Industrial Instrumentation and Control; S. K. Singh; The McGraw-Hill. Electronic Instrumentation: Second Edition, H. S. Kalsi; The McGraw-Hill Electrical Measurements and Measuring Instruments (EMMI), A. K. Sawhney. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfrik and William D. Cooper.		
	Other References	Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd. Statistical Methods, S. P. Gupta		

PHB340 Digital Electronics

School: : School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: VI**
1	Course Code	PHB340
2	Course Title	Digital Electronics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. 1. To provide students an understanding of different number systems and their conversion. 2. To develop concepts of Boolean algebra and logic circuitry such as adders, subractors, encoders, decorder and parity checkers. 3. To provide knowledge of basics of flip flops used in sequential circuits.
6	Course Outcomes	After the completion of this course, **CO1:** Students will show that they have learned basics of number system. **CO2:** Students will gain knowledge of Boolean algebra and various switching functions. **CO3:** Students will learn the concept of different types of logic gates and their truth tables. **CO4:** Students will differentiate between different combinational circuits such as adders and subtractors. **CO5:** Students will have a clear understanding of Flip Flops used in electronic industries. **CO6:** Students will be able to know about concepts of digital circuits useful in electronic industry.
7	Course Description	This course will provide an in depth understanding of various digital electronic circuits such as logic gates, adder subtractors and flip flops.
8	Outline syllabus	
	Unit 1	**Number System**
	A	Binary, octal, hexadecimal and decimal number systems,
	B	Conversion among different number systems, Binary arithmatic,
	C	1's and 2's compliment of a binary number.
	Unit 2	**Boolean Algebra**
	A	De Morgan's Theorems, Boolean Laws, Simplification of logic circuit using Boolean algebra
	B	Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products (SOP) method and (2) Product of sums (POS) method
	C	Simplification of switching functions using Karough maps upto 4 variables
	Unit 3	**Logic Gates**

	A	Positive and negative logic, AND, OR, NOT (using diodes and transistors), Symbols and truth tables		
	B	NAND, XOR, NOR and XNOR Gates		
	C	NAND and NOR gates as universal gates		
	Unit 4	**Combinational Logic Circuits**		
	A	Half Adders and Full Adders and Subtractors (only up to Eight Bits)		
	B	Decoders, Encoders		
	C	Parity Checkers		
	Unit 5	**Sequential Circuits**		
	A	R-S, D, J-K Flip-Flops		
	B	Level Clocked and Edge Triggered Flip-Flops		
	C	Master-Slave JK Flip-Flop		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Digital Principle and Application: Malvino Leach.		
	Other References	1. Digital Electronics by R.P. Jain, 2. Digital Electronics by V K Puri, TMH 3. Digital Fundamentals, 3rd Edition by Thomas L.		

PHB341 Particle and Astrophysics

School: SBSR		**Batch: 2020-23**
Program: B.Sc.		**Current Academic Year: 2022-23**
Branch: Physics		**Semester: VI**
1	Course Code	PHB341
2	Course Title	Particle and Astrophysics
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	1. To know the basic interactions among particles and quantum numbers 2. To classify elementary particles on the basis of properties 3. To get introduced to particle accelerators and their working principle 4. To analyse the different types of cosmic rays present in the universe and to understand the celestial bodies of the universe
6	Course Outcomes	**CO1:** Learn the different types of interactions among particles **CO2:** Understand the existence of elementary particles **CO3:** Importance of particle accelerators for different application **CO4:** Study of different phenomena caused by cosmic rays **CO5:** Figure out different celestial body and their existence **CO6:** Understand the structure of sun and stellar energy source
7	Course Description	This course is concerned with the physical nature of stars and other celestial bodies, and the application of the laws and theories of physics to the interpretation of astronomical observations.
8	Outline syllabus	
	Unit 1	**Basic interactions in nature and Conservation laws**
	A	Four basic interactions in nature and their relative strength, examples of different types of interactions
	B	Feynman diagrams for basic electromagnetic, weak and strong interactions.
	C	Quantum numbers – mass, charge, spin, isotopic spin, intrinsic parity, hypercharge, strangeness, and conservation laws.
	Unit 2	**Elementary Particles**
	A	Classifications of elementary particles – hadrons and leptons,
	B	baryons and mesons
	C	elementary idea about quark structure of hadrons – octet and decuplet families
	Unit 3	**Particle Accelerators**
	A	Particle Accelerators**:** Van de Graff generator, Principle and working of Linear accelerators (LINAC)
	B	Principle and working of Cyclotron, Betatron
	C	Synchrotron, Large Hadron Collider
	Unit 4	**Cosmic Rays**
	A	Introduction and origin of primary cosmic rays; energy and charge spectrum, Secondary cosmic rays and its composition
	B	Variation in cosmic ray intensity, latitude effect, east-west effect, longitude effect, altitude effect.
	C	Geomagnetic and solar effects, van Allen belts, aurora

	Unit 5	**Astrophysics**		
	A	Structure of the Sun, sunspots, solar flares, stellar energy source, p-p and C-N cycles.		
	B	Stars and their temperatures and magnitudes, H-R diagram. Stellar evolution (hydrostatic and thermal equilibrium).		
	C	White dwarfs, Chandrashekhar mass limit, pulsars, neutron stars and black holes, Schwarzschild radius.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. H.A. Enge: Introduction to Nuclear Physics (Addison Wesley)		
	Other References	2. Robert C. Harymes: Introduction to space science (John Wiley and sons) 3. Segre: Nuclei and Particles 4. M.A. Pomerantz: Cosmic rays		

Practical Subjects

PHB151 Physics Lab 1

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2018-19**
Branch: Physics		**Semester: I**
1	Course Code	PHB151
2	Course Title	Physics Lab 1
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To provide students an understanding about fly wheel, compound pendulum. To provide students an understanding of gravity via simple pendulum and compound pendulum setups. To study bending of a beam via stress and strain. To understand the viscous nature of any liquid using Pouselli method.
6	Course Outcomes	**CO1:** Students will understand simple harmonic motion and its conditions of one dimension. **CO2:** Students will be able to understand the fly wheel structure and its different applications. **CO3:** Students will have a clear understanding about depression in a beam via loading it at its one end. **CO4:** Students will be able to handle travelling microscope, vernier calipers, screw gauge, stop watch also students will gain knowledge of manometer, capillary tube. **CO5:** Students will learn to measure the height of a building. **CO6:** Students will learn about modulus of rigidity of a material and moment of inertia also.
7	Course Description	This course deals with the basic concepts of mechanics. Students will be guided to use travelling microscope, vernier calipers, screw gauge, stop watch. This course deals with many different concepts of mechanics via simple experiments.
8	Outline syllabus	
	Unit 1	**Practical's related to gravity**
	A	To measure the acceleration due to gravity using a simple pendulum. And verify the relation. $T = 2\pi\sqrt{\frac{L}{g}}$
	b, c	(i) To determine the acceleration due to gravity (g) by means of a compound pendulum. (ii) To determine radius of gyration about an axis through the center of gravity for the compound pendulum.
	Unit 2	**Practical related to moment of inertia**

	A	To determine the moment of inertia of Flywheel about its axis of rotation.		
	b, c	To calculate Moment of inertia of different irregular shapes.		
	Unit 3	**Practical related to coefficient of viscosity of water**		
	a, b, c	To determine the coefficient of viscosity of water by Poiseuille's method.		
	Unit 4	**Practical related to measuring of height of a building**		
	a, b, c	To determine the height of a building by the help of a Sextant.		
	Unit 5	**Practical related to elasticity**		
	a	To determine Young's modulus of a material by the bending of abeam clamped at one end and loaded at one of its end by cantilever method.		
	b, c	To determine the modulus of rigidity of a material of a given wire with an inertia table (torsion pendulum) by dynamical method.		
	Mode of examination	Jury+Practical+Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	1. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing		
	Other References	2. B.Sc. Practical Physics- C L Arora, S. Chand Publishing 3. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.		

PHB152 Physics Lab 2

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2018-19**
Branch:Physics		**Semester: II**
1	Course Code	PHB152
2	Course Title	**Physics Lab 2 (Optics and Thermal Physics)**
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	1. To provide students an understanding of prism, Fresnel's biprism, and spectrometer. 2. To provide students an understanding of thermal conductivity. 3. To study the thermocouples and also to have knowledge of Stefan's law. 4. Students will learn about plane transmission grating and Newton's ring method.
6	Course Outcomes	After the completion of this course, CO1: Students will learn about the fundamentals of optics i.e. dispersion, diffraction, interference etc. CO2: Students will understand about bad conductor, good conductor and how to determine their thermal conductivity. CO3: Students will learn about thermocouples and their working. CO4: Students will learn about black body radiation through Stefan's law. They will also learn to determine the wavelength of light through plane diffraction grating and Newton's Ring method. . CO5: Students will gain knowledge of lenses and learn to determine the focal length of lenses. CO6: Students will be able to correlate theory and practical together through the experiments and get the clear understanding of the concepts behind them.
7	Course Description	This course will help students to have basic understanding of basics of Optics, Thermal conductivity and blackbody Radiation. It also helps them to understand the working of spectrometer, Newton's ring, plane diffraction grating and Nodal slides.
8	Outline syllabus	
	Unit 1	
	A	• To determine the dispersive power of a material of the prism and its angle using spectrometer. Also calculate speed of light in the given prism. • To determine wavelength of monochromatic light source (λ) by Fresnel's biprism
	B	
	C	
	Unit 2	
	A	

	B C	• To determine thermal conductivity of a bad conductor in form of a disc using Lee's method. • Calculate the thermal conductivity of copper by Searle's method		
	Unit 3			
	A B C	• To calibrate a thermocouple to determine the temperature of a given object. • To verify Stefan's law using radiation method.		
	Unit 4			
	A B C	• To determine the wavelength of prominent lines of mercury by plane diffraction grating. • To determine the wavelength of monochromatic light by Newton's Ring method.		
	Unit 5			
	A B C	• To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula.		
	Mode of examination	Practical/Viva		
	Weightage Distribution	CA 60%	MTE 0%	ETE 40%
	Text book/s*	4. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing 5. B.Sc. Practical Physics- C L Arora, S. Chand Publishing		
	Other References	1. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.		

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: III**
1	Course Code	PHB251
2	Course Title	Physics Lab 3
3	Credits	2
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
6	Course Outcomes	On successful completion of the course the students will have: CO1: Knowledge of basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope. CO2: Use the concept of semiconductor to calculate the energy band, Hall coefficient and mobility of the semiconducting materials. CO3: Understand how to measure the susceptibility of paramagnetic solution. CO4: Understand how to measure the specific resistance of a wire and verification of Stefan's law. CO5: Knowledge and study of variation of magnetic field and LCR circuits. CO6: Apply the mathematical concepts/equations to obtain quantitative results and ability to conduct, analyze and interpret experiments.
7	Outline Syllabus	
	Unit 1	
	A B C	• To familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope. • To calculate the energy band gap of a semiconductor material using four probe method.
	Unit 2	
	A B C	• To study Hall's effect and determine the Hall coefficient, carrier density and the mobility of a semiconductor material.
	Unit3	
	A B C	• Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) • To determine the specific resistance of the material of a given wire using Carey Foster's bridge.

<table>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td rowspan="4"></td><td>Unit 4</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To verify Stefan’s law using electrical method.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td rowspan="4"></td><td>Unit 5</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To determine the variation of magnetic field along the axis of a current carrying coil and estimate the radius of the coil.
• To study the characteristics of a series RC Circuit.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td></td><td>Mode of Examination</td><td colspan="3">Practical/Viva</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MTE</td><td>ETE</td></tr>
<tr><td>60%</td><td>0%</td><td>40%</td></tr>
<tr><td></td><td>Text books</td><td colspan="3">6. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing.
7. B.Sc. Practical Physics- C L Arora, S. Chand Publishing.</td></tr>
<tr><td></td><td>Other References</td><td colspan="3">1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New</td></tr>
</table>

PHB254 Physics Lab 4

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch: Physics		**Semester: IV**
1	Course Code	PHB254
2	Course Title	Physics Lab 4
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	1. To gain practical knowledge of experiments related to classical mechanics, relativity and electromagnetic theory. 2. To understand hysteresis curve of magnetic material; to measure specific rotation of an optically active material. 3. To provide students an understanding various element used in electrical circuit. 4. To acquire knowledge of ultrasonic waves and to calculate its speed in a given medium and also to demonstrate them the working of all the experiments.
6	Course Outcomes	After the completion of this course students will/will be able to, **CO1:** Measure speed of light. **CO2:** Interpret hysteresis curve of magnetic material and obtain specific rotation of optically active material. **CO3:** Demonstrate series and parallel LCR. **CO4:** Calibrate voltmeter and ammeter. **CO5:** Determine self-inductance , capacitance etc.. **CO6:** Use equations/theoretical concept to verify the experimental results with ability to conduct, analyze and interpret experiments
7	Course Description	This course is designed to provide students with lab experience to interpret the results of various effects, study characteristics of LCR circuits in series and parallel and to analyze their result.
8	Outline Syllabus	
	Unit 1	
	A	• Find the speed of light using Michelson-Morley experiment.
	B	
	C	
	Unit 2	
	A	• To draw hysteresis curve (B-H curve) of a specimen in the form of a transformer on a C.R.O. And to determine its hysteresis loss • To find the specific rotation of cane- sugar solution by a polarimeter at room temperature, using Half shade polarimeter.
	B	
	C	

<table>
<tr><td rowspan="4"></td><td>Unit 3</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To study resonance effect in series and parallel LCR circuit and quality factor.
• To study the variation in current and voltage in a series LCR circuit. Also find the resonant frequency of the LCR circuit.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td rowspan="4"></td><td>Unit 4</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To convert a galvanometer into a voltmeter reading up to V volts and calibrate it.
• To convert a galvanometer into an ammeter reading up to I amperes and calibrate it</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td rowspan="4"></td><td>Unit 5</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To compare unknown capacitance using De Sauty bridge.
• To determine self inductance of a coil by Anderson’s bridge.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td></td><td>Mode of Examination</td><td colspan="3">Practical/Viva</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MTE</td><td>ETE</td></tr>
<tr><td>60%</td><td>0%</td><td>40%</td></tr>
<tr><td></td><td>Text books</td><td colspan="3">8. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing
9. B.Sc. Practical Physics- C L Arora, S. Chand Publishing</td></tr>
<tr><td></td><td>Other References</td><td colspan="3">1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New</td></tr>
</table>

PHB255 (Physics Lab-5)

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2019-20**
Branch:Physics		**Semester: IV**
1	Course Code	PHB255
2	Course Title	Physics Lab- 5 (Electronics)
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	1.To provide students an understanding of PN junction diode and zener diode. 2. To provide students an understanding of waveforms formed for half wave and full wave rectifiers. 3. To study waveforms of clipping and clamping circuits. 4. To study BJT in common base and common emitter circuits.
6	Course Outcomes	After the completion of this course, CO1: Students will show that they have learned fundamentals of semiconductor junction diodes and their V-I characteristics. CO2: Students will understand waveforms formed in half wave rectifier with and without filters. CO3: Students will have a clear understanding of how zener diode work as voltage regulator. CO4: Students will learn the concept of clipper and clamping circuits. CO5: Students will gain knowledge of characteristics of PNP BJT in different configurations. CO6: Students will be able to correlate theory and practical together and get the clear understanding of electronic circuits.
7	Course Description	This course will help students to have basic understanding of semiconductors and its applications in on chip devices. This lab work will help them to have hands on training on various instruments used in electronic industries.
8	Outline syllabus	
	Unit 1	
	A	• To draw the characteristic curve of a PN junction diode. • To trace the circuit of a Half Wave Rectifier circuit and determine efficiencies and ripple factors with capacitor and inductor filters.
	B	
	C	
	Unit 2	
	A	• To trace the circuit of a Full Wave Rectifier circuit and determine efficiencies and ripple factors with capacitor and inductor filters.
	B	
	C	
	Unit 3	
	A	
	B	

<table>
<tr><td></td><td>C</td><td colspan="3">• To study Zener diode characteristics and use Zener Diode as voltage regulator.
• To design various diode clipper circuits and to study their waveform.</td></tr>
<tr><td rowspan="4"></td><td>Unit 4</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To design clamping circuits, clamping positively and negatively at 0 V using diode and to study their waveforms.
• To study the characteristics curves of PNP BJT in common base and common emitter circuits.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td rowspan="4"></td><td>Unit 5</td><td colspan="3"></td></tr>
<tr><td>A</td><td colspan="3" rowspan="3">• To plot the wave shape of the electrical signal at the output point with and without filters (capacitor, inductor, single LC and pi) in a half wave rectifier and in a full wave rectifier.</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td></td><td>Mode of examination</td><td colspan="3">Practical/Viva</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MTE</td><td>ETE</td></tr>
<tr><td>60%</td><td>0%</td><td>40%</td></tr>
<tr><td></td><td>Text book/s*</td><td colspan="3">10. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing
11. B.Sc. Practical Physics- C L Arora, S. Chand Publishing</td></tr>
<tr><td></td><td>Other References</td><td colspan="3">2. Basic electronics and linear circuits – N N Bhargava, D C Kulshreshtha, S C Gupta, Tata McGraw-Hill publishing company Ltd.</td></tr>
</table>

PHB366 Physics Lab 6

School: School of Basic Sciences and Research		**Batch: 2018-21**
Program: B.Sc. (Hons)		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: V**
1	Course Code	PHB366
2	Course Title	Physics Lab- 6 (**Quantum and Oscillations of waves**)
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	**1.** To provide students an understanding of discrete nature of radiation by Planck's constant and Frank-Hertz experiment. **2.** To provide students an understanding of silicon solar cell. **3.** To study Lissajous figures by using CRO and transverse and longitudinal mode of vibrations by tuning fork. **4.** To study speed of ultrasonic waves in kerosene oil.
6	Course Outcomes	After the completion of this course, **CO 1:** Students will show that they have learned fundamentals of mercury vapor filled tubes and discrete energy levels. **CO 2:** Students will understand basics of solar cell and their characteristics. **CO 3:** Students will have a clear understanding cathode ray tube and measure e/m ratio. **CO 4:** Students will learn the concept of superposition of waves "Lissajous figures by using C.R.O". **CO 5:** Students will gain knowledge of longitudinal and transverse mode of vibrations by tuning fork. **CO 6:** Students will be able to correlate theory and practical together and get the clear understanding of waves and oscillations.
7	Course Description	This course will help students to have basic understanding of quantum mechanics and wave and oscillations. These experiments enable students to see various oscillators in action, investigate factors that affect their periodic time and represent the motion graphically. They are suitable for students at introductory and intermediate levels of study.
8	Outline syllabus	
	Unit 1	
	A	To determine the Planck's constant by measuring radiation in a fixed spectral range.
	B	
	C	

		To measure the excitation potential of mercury using the Franck-Hertz method.		
	Unit 2			
	A	To determine the value of the ratio of charge to mass (e/m) of an electron by Thomson's method using a cathode-ray tube. To study Solar cell characteristics.		
	B			
	C			
	Unit 3			
	A	Study of damping a bar pendulum and determination of coefficient of damping, relaxation time, and quality factor of a damped simple harmonic motion. To determine the frequency of an electrically maintained tuning fork using Melde's Apparatus. (i). Transverse mode of vibration (ii). Longitudinal mode of vibration		
	B			
	C			
	Unit 4			
	A	Calculate the speed of ultrasonic waves in kerosene oil. To determine unknown frequency or to compare the frequencies of two unknown signals with the method of Lissajous figures by using C.R.O.		
	B			
	C			
	Unit 5			
	A	To measure the phase difference between current and voltage in R-C and L-R circuits with the method of Lissajous figures by using a CRO. To determine the velocity of sound using resonance tube.		
	B			
	C			
	Mode of examination	Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing B.Sc. Practical Physics- C L Arora, S. Chand Publishing		
	Other References	1. Vibrations and Waves by A. P. French. (CBS Pub. & Dist., 1987) 2. Fundamentals of Waves & Oscillations by K. Uno Ingard (Cambridge University Press, 1988)		

PHB367 Physics Lab 7

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: V**
1	Course Code	PHB367
2	Course Title	Physics Lab 7
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	• To make the students familiar with the concepts of fiber optic communication systems, diffraction using laser. • To understand the concept of diffraction at a single slit, slit by using Laser. • To know how to determine wavelength of laser light using measuring scale, Verification of Thevenin and Norton theorem. • To explain the maximum power transfer theorem, transistor as a switch, Transistor as common emitter, Transistor as common base
6	Course Outcomes	CO1: Discuss the basic concepts concepts of fiber optic communication systems, diffraction using laser. CO2: To describe the diffraction at a single slit, slit by using Laser. CO3: To explain the laser light using measuring scale, Thevenin and Norton theorem CO4: To Discuss the maximum power transfer theorem, Make transistor as a switch CO5: To analyse the Configurations of Bipolar Junction Transistor. CO6: Able to explain about the concepts optic communication systems, diffraction using laser, slit by using Laser, Thevenin and Norton theorem, the maximum power transfer theorem, Bipolar Junction Transistor.
7	Course Description	This course is about explaining the concepts optic communication systems, diffraction using laser, slit by using Laser, Thevenin and Norton theorem, the maximum power transfer theorem, Bipolar Junction Transistor.
8	Outline Syllabus	
	Unit 1	**Practicals based on optic communication systems, diffraction using laser**
		Sub unit a, b and c detailed in Instructional Plan
	Unit 2	**Practical related to single slit, slit by using Laser**
		Sub unit a, b and c detailed in Instructional Plan

	Unit 3	**Practical related to laser light using measuring scale, Thevenin and Norton theorem**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 4	**Practical related to maximum power transfer theorem, Make transistor as a switch**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 5	**Practical related to Configurations of Bipolar Junction Transistor**		
		Sub unit a, b and c detailed in Instructional Plan		
	Mode of Examination	Practical/Viva		
	Weightage Distribution	CA 60%	MTE 0%	ETE 40%
	Text Book/s	**B.Sc.Practical Physics** By Harnam Singh & P S Hemne S. Chand Publishing.		
	Other References	Physics for Degree Students B.Sc.First Year By C L Arora & P S Hemne S. Chand Publishing		

PHB368 Physics Lab 8

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: VI**
1	Course Code	PHB368
2	Course Title	Physics Lab 8
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	• To make the students familiar with the concepts of amplifier and Operational amplifier parameters. • To understand the concept of S.C.R, zener diode, RC circuit. • To know the RL circuit, transistor Biasing, DC load line. • To understand the concepts of Single stage Common emitter and Double stage Common emitter transistors.
6	Course Outcomes	CO1: Discuss the basic concepts of frequency response of a common emitter amplifier and Potential divider biasing in common emitter transistor. CO2: To describe the Operational amplifier parameters- Common Mode Gain, Differential Mode Gain, and CMMR. CO3: To design a 6.2 volts d.c. power supply using zener diode and also the study the circuit of op-amp for getting full gain, V-I characteristics of S.C.R. CO4: Discuss the RC circuit, RL circuit, transistor Biasing. CO5: To analyse Draw the DC load line, Single stage Common emitter, Double stage Common emitter transistor. CO6: Able to explain about the concepts of Operational amplifier parameters, S.C.R, zener diode, RC circuit, RL circuit, transistor Biasing, DC load line, Single stage Common emitter and Double stage Common emitter transistors.
7	Course Description	This course is about explaining the concepts Operational amplifier parameters, S.C.R, zener diode, RC circuit, RL circuit, transistor Biasing, DC load line, Single stage Common emitter and Double stage Common emitter transistors.
8	Outline Syllabus	
	Unit 1	**Practicals based on common emitter amplifier**
		Sub unit a, b and c detailed in Instructional Plan

	Unit 2	**Practical related to Operational amplifier**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 3	**Practical related to zener diode and S.C.R.**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 4	**Practical related to RC circuit, RL circuit, transistor Biasing**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 5	**Practical related to DC load line, Single stage Common emitter, Double stage Common emitter transistor**		
		Sub unit a, b and c detailed in Instructional Plan		
	Mode of Examination	Practical/Viva		
	Weightage Distribution	CA 60%	MTE 0%	ETE 40%
	Text Book/s	**B.Sc.Practical Physics** By Harnam Singh & P S Hemne S. Chand Publishing.		
	Other References	Physics for Degree Students B.Sc.First Year By C L Arora & P S Hemne S. Chand Publishing		

PHB369 Physics Lab 9

School: SBSR		**Batch: 2018-21**
Program: B.Sc.		**Current Academic Year: 2020-21**
Branch: Physics		**Semester: VI**
1	Course Code	PHB369
2	Course Title	Physics Lab 9
3	Credits	2
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	To make the students familiar with using CRO and logic gates. To understand the concept of NAND gate and Boolean expression. To know the Half Adder and Full Adder, Half subtractor and Full subtractor. To build Flip-Flop, design an astable multivibrator and monostable multivibrator.
6	Course Outcomes	After completion the students will be able to CO1: Learn the basic concepts of measuring (a) Voltage, and (b) Time period of a periodic waveform using CRO and the concepts of logic gates. CO2: To describe the NAND gate Boolean expression. CO3: To explain the Half Adder and Full Adder, Half subtractor and Full subtractor. CO4: Discuss the Flip-Flop, astable multivibrator. CO5: To analyse a monostable multivibrator of given specifications using 555 Timer.. CO6: Able to explain about the concepts CRO and logic gates, NAND gate, Half Adder and Full Adder, Half subtractor and Full subtractor, Flip-Flop, multivibrator.
7	Course Description	This course is about explaining the concepts CRO and logic gates, NAND gate, Half Adder and Full Adder, Half subtractor and Full subtractor, Flip-Flop, multivibrator.
8	Outline Syllabus	
	Unit 1	**Practicals based on CRO and the concepts of logic gates**
		Sub unit a, b and c detailed in Instructional Plan
	Unit 2	**Practical related to NAND gate Boolean expression**
		Sub unit a, b and c detailed in Instructional Plan
	Unit 3	**Practical related to Half Adder and Full Adder, Half subtractor and Full subtractor**

		Sub unit a, b and c detailed in Instructional Plan		
	Unit 4	**Practical related to Flip-Flop, astable multivibrator**		
		Sub unit a, b and c detailed in Instructional Plan		
	Unit 5	**Practical related to monostable multivibrator**		
		Sub unit a, b and c detailed in Instructional Plan		
	Mode of Examination	Practical/Viva		
	Weightage Distribution	CA 60%	MTE 0%	ETE 40%
	Text Book/s	**B.Sc.Practical Physics** By Harnam Singh & P S Hemne S. Chand Publishing.		
	Other References	Physics for Degree Students B.Sc.First Year By C L Arora & P S Hemne S. Chand Publishing		

Dissertation: Physics Department

PHB371 Dissertation 1

School: SBSR		**Batch:2018-21**
Program: B. Sc		**Current Academic Year: 2020-21**
Branch:Physics		**Semester V**
1	Course Code	PHB371
2	Course Title	Dissertation 1
3	Credits	3
4	Contact Hours (L-T-P)	0-0-3
	Course Status	Compulsory
5	Course Objective	• Deep knowledge of a specific area of specialization. • Develop research skills especially in project writing and oral presentation. • Develop time management skills. • Develop skill to summarize the published work by literature survey • Inculcate Team spirit
6	Course Outcomes	**CO 1:** The course gives an introduction to the concept of research within the subject, as regards approaching a question, collecting and analyzing background material and presenting research questions and conclusions. **CO 2:** investigation of a physics-based or physics-related problem **CO 3:** planning, management and operation of an investigation to test a hypothesis **CO 4:** development of information retrieval skills **CO 5:** carrying out a health and safety assessment **CO 6:** Establishment of co-operative working practices with colleagues.
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and then approved by the Head of Department.
8	Outline syllabus	
	Unit 1	**Introduction**
	Unit 2	**Hypothesis**
	Unit 3	**Case study/Lab work**
	Unit 4	**Report**
	Unit 5	**Presentation**

	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	5 Recent International Journal Articles of repute.		
	Other References	-		

INSTRUCTIONAL PLAN

Academic Year: 2020-21 (Odd Semester)

School: SBSR	**Subject: Physics**
Program: B.Sc	**Subject Code: PHB371**
Branch: Physics	**Instructor:**

Scheme			**Scheme of Examination**		
L	P	T	Internal Assessment	Mid Term Examination	End Term Examination
0	0	3	60%	-	40%

Course outline

Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and then approved by the Head of Department.

Course Evaluation	
Attendance	None
Any other	CA judged on the presentation, report and work done with supervisor.
References	
Text book	-
Other References	5 Recent International Journal Articles.
Softwares	NA

List of tasks introduced and deliverables:

Since this is related to projects, studios, dissertations, etc, the detailed units should comprise of weekly schedule of tasks introduced and devliverable details of the assigned task.

Week	**Unit**	**Deliverables**	**Days & Date of Lecture/Submission**	
Week 1-4	**1a-1c**	Introduction: investigation of a physics-based or physics-related problem		
Week 5-6	**2a-2c**	Select 5 Recent International Journal Articles		
Week 7-11	**3a-3c**	Complete the case study from the selected articles		
Week-12-13	**4a-4c**	Preparation of the report.		
Week 14-15	**5a-5c**	Preparation of the presentation.		

PHB372 Dissertation 2

School: SBSR		**Batch :2018-21**		
Program: B. Sc		**Current Academic Year: 2020-21**		
Branch: Physics		**Semester VI**		
1	Course Code	PHB372		
2	Course Title	Dissertation 2		
3	Credits	3		
4	Contact Hours (L-T-P)	0-0-3		
	Course Status	Compulsory		
5	Course Objective	**1.** Deep knowledge of a specific area of specialization. **2.** Develop communication skills especially in project writing and oral presentation. **3.** Develop skill to summarize the published work by literature survey **4.** Develop some time management skills.		
6	Course Outcomes	**CO 1:** The course gives an introduction to the concept of research within the subject, as regards approaching a question, collecting and analysing background material and presenting research questions and conclusions. **CO 2:** Cultivate a deeper interest in physics and acquire a taste for research. **CO 3:** engage in activities that support their professional goals. **CO 4:** learn effective project organizational skills.		
7	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and then approved by the Head of Department.		
8	Outline syllabus			
	Unit 1	**Introduction**		
	Unit 2	**Hypothesis**		
	Unit 3	**Case study/Lab work**		
	Unit 4	**Report**		
	Unit 5	**Presentation**		
	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	MTE	ETE
		60%	0%	40%
	Text book/s*	5 Recent International Journal Articles of repute.		

	Other References	-

INSTRUCTIONAL PLAN

Academic Year: **2020-21** (Even Semester)

School: SBSR	**Subject: Physics**
Program: B. Sc	**Subject Code: PHB 372**
Branch: Physics	**Instructor:**

Scheme			**Scheme of Examination**		
L	P	T	Internal Assessment	Mid Term Examination	End Term Examination
0	0	3	60%	-	40%

Course outline

Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and then approved by the Head of Department.

Course Evaluation	
Attendance	None
Any other	CA judged on the presentation, report and work done with supervisor.
References	
Text book	-
Other References	5 Recent International Journal Articles.
Softwares	NA

List of tasks introduced and deliverables:

Since this is related to projects, studios, dissertations, etc, the detailed units should comprise of weekly schedule of tasks introduced and deliverable details of the assigned task.

Week	**Unit**	**Deliverables**	**Days & Date of Lecture/Submission**	
Week 1-4	**1a-1c**	Introduction: investigation of a physics-based or physics-related problem		
Week 5-6	**2a-2c**	Select 5 Recent International Journal Articles		
Week 7-11	**3a-3c**	Complete the case study from the selected articles		
Week-12-13	**4a-4c**	Preparation of the report.		
Week 14-15	**5a-5c**	Preparation of the presentation.		

Annexure

Papers from other departments

MSM101 Foundation Course in Mathematics

School: SBSR		**Batch :**
Program: B.Sc. (H)		**Current Academic Year:**
Branch: Maths, Physics, Chemistry		**Semester: I**
1	Course Code	MSM101
2	Course Title	FOUNDATION COUSE IN MATHEMATICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	• To familiarise the students with basic concepts of matrices, determinants and solving the system of linear equations. • To understand the basic concept of sets theory, co-ordinate geometry, complex number and vector algebra.
6	Course Outcomes	CO1: Explain the concept of matrices and solve systems of linear equations and determinants. (K2,K3, K4) CO2: Explain the concept of complex numbers and calculate the nth roots of complex numbers and illustrate the solutions of simple Polynomial equations. (K2, K3, K4) CO3: Memorize the basic of Cartesian coordinate system and use algebraic techniques to explain intercepts and explore equations of lines on the number plane. (K1, K3, K4) CO4: Describe and differentiate the symmetries from graphs of conic sections. (K1, K2) CO5: Describe and use the concepts of set theory, relation and functions. (K1,K2,K3) CO6: Explain the basic concepts of vector algebra and use to find area of parallelogram and quadrilateral, Vector triple product .(K2,K 3,K4)
7	Course Description	This course is an introduction to the fundamental of Mathematics. The primary objective of the course is to develop the basic understanding of linear algebra, complex number, co-ordinate geometry, sets theory and vector algebra.
8	**Outline syllabus**	**Foundation course in Mathematics**
	Unit 1	**Matrices**
	A	Evaluation of determinants, Properties of determinants,
	B	Matrices: types of matrices, addition, subtraction and multiplication of matrices, symmetric and skew symmetric matrix. Inverse of matrix.
	C	Rank of a matrix, Consistency of system of equations, Characteristic equation, Cayley -Hamilton theorem.
	Unit 2	**Complex Numbers**
	A	Representation of complex number in Argand plane, Modulus and argument of complex number

	B	Algebraic operations, De- Moivre's theorem		
	C	Nth root of complex number, Euler's formula		
	Unit 3	**Co-ordinate geometry**		
	A	Cartesian coordinate system, Distance between two points Equations of line in various forms		
	B	Equation of circle in various forms, Equation of tangent and normal to the circle.		
	C	Equation of ellipse, parabola and hyperbola		
	Unit 4	**Sets Theory**		
	A	Definition of set, types of sets, Union and intersection of sets, Venn diagram, De-Morgan's law.		
	B	Relation and functions.		
	C	Composite function and inverse function.		
	Unit 5	**Vector Algebra**		
	A	Addition and subtraction of vectors and their geometric application.		
	B	Scalar and vector product, their physical application, Projection of vector on another vector, area of triangle.		
	C	Area of parallelogram and quadrilateral, Vector triple product.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons Inc. 2. Jain, M.K., and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publications		
	Other References	1. Thomas, B.G., and Finny R.L., "Calculus and Analytical geometry", Pearson Education Asia, Adison Wisley. 2. Simmons, G.F., "Differential Equations with applications with applications", Tata McGraw-Hill.		

MSM105 Calculus I

School: SBSR		**Batch :**
Program: B.Sc. (H)		**Current Academic Year:**
Branch: Mathematics, Physics		**Semester: I**
1	Course Code	MSM105
2	Course Title	Calculus-I
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	To make students familiar with the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of first order ordinary differential equation has been also introduced.
6	Course Outcomes	Students will be able to CO1: Memorize the basic of differentiation & Successive differentiation and solve with Leibnitz's theorem. (K1, K3) CO2: Explain and solve the Taylor's theorem, Maclaurin's theorem of one variable & two variables, Maxima minima for one & two variables, Lagrange's multipliers method and point of inflexion for various functions. (K1, K2, K3) CO3: Describe the Partial differentiation, Homogeneous functions and drive Euler's theorem with applications and apply the concept of Jacobian and its applications. (K1, K2, K3,) CO4: Memorize the basics of Integration with by parts method, partial fraction, Definite integration & its properties and evaluate the Beta and Gamma functions. (K1, K3, K6) CO5: Evaluation of double integrals, Change of order of integration, change of variables, Area bounded by the curves, evaluation of triple integrals and its applications. (K1, K6) CO6: Formulate and evaluate first order differential equation. (K2, K5, K6)

7	Course Description	This course is an introduce the concepts of successive differentiation along with the concepts of partial differentiation, basic integration & multiple integration. A brief of formulation and evaluation of first order differential equation.
8	Outline syllabus : **Calculus 1**	
	Unit 1	**DIFFERENTIATION**
	A	Concepts of limit, continuity and differentiability, differentiation of standard functions, product and quotient rule for differentiation, chain rule
	B	Successive differentiation and its applications, Leibnitz's theorem
	C	Taylor's theorem, Maclaurin's theorem, Maxima-minima, Points of inflexion
	Unit 2	**PARTIAL DIFFERENTIATION**
	A	Partial differentiation, homogeneous functions, Euler's theorem
	B	Jacobian of explicit and implicit functions and its applications, Taylor's expansion in two variables
	C	Maxima-minima in two variables, Lagrange's multipliers method
	Unit 3	**INTEGRATION**
	A	Integration of standard functions, integration by parts, by substitution
	B	Partial fractions, Definite integrals and its properties
	C	Beta and Gamma functions.
	Unit 4	**MULTIPLE INTEGRATION**
	A	Evaluation of double integrals
	B	Change of order of integration, change of variables
	C	Area bounded by the curves, evaluation of triple integrals and its applications
	Unit 5	**ORDINARY DIFFERENTIAL EQUATIONS**
	A	Formation of an ODE , Order and degree of an ODE
	B	First order differential equation and methods of solution including variable separable, homogeneous

	C	Exact differential equations, Equation reducible to exact differential equation		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	• Kreyzig, E., "Advanced Engineering Mathematics", John Willey & Sons.		
	Other References	• Jain, M.K. and Iyenger, S.R.K., "Advanced Engineering Mathematics", Narosa Publications. • Thomas, B.G., and Finny R.L., "Calculus and Analytical Geometry", Pearson education Asia, Adison Wesley. • Simmons G.F., "Differential Equations with applications", Tata McGraw Hill.		

BCH101 PHYSICAL CHEMISTRY-I

School: SBSR		**Batch :**
Program: B. Sc		**Current Academic Year:**
Branch: Chemistry		**Semester: 01**
1	Course Code	BCH101
2	Course Title	**PHYSICAL CHEMISTRY-I (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. To provide the understanding of physical states of matter and how they are related to daily life application 2. To define how the initially primitive models of real gases in physical chemistry are elaborated to take into account more detailed observations. 3. To understand the laws of solid state chemistry and the arrangement of ions/atoms/molecules in a crystal lattice 4. To list different properties of liquids involving surface tension and viscosity coefficients. 5. To extend the concept of solutions from Raoult's Law to industrial application processes. 6. To provide the introduction and application of solid, liquid and gaseous states.
6	Course Outcomes	CO1: The structural features of solid-state material by having the knowledge of packing arrangements. CO2: Different properties of liquids and their application in daily life. CO3: The separation processes of steam distillation and solvent extraction. CO4: Ideal and Non ideal gas behaviour and their properties. CO5: The basics of thermodynamics to the lab-scale heat exchange processes. CO6: Fundamental properties, thermodynamical properties and application of all states of mater
7	Course Description	Course emphasizing on the various solid state structures and its correlation to atomic coordinated, distinguishing properties of liquid state, physical properties of molecule's in solutions and gaseous state, thermochemistry aspects of chemical process.
8	Outline syllabus	
	Unit 1	**Solid State**
	A	Crystalline and amorphous solids, crystal lattices and unit cell, Crystal systems, types, close packing,
	B	Packing fraction, crystal density, Ionic Radii, radius ratio. X–Ray diffraction: Bragg's law,

	C	Structures of NaCl, KCl and CsCl (qualitative treatment only). Point Defects. Glass and liquid crystals.		
	Unit 2	**Liquid State**		
	A	Qualitative treatment of the structure of the liquid state, Radial distribution function		
	B	Physical properties of liquids: vapour pressure, surface tension, coefficient of viscosity and their determination.		
	C	Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases.		
	Unit 3	**Solution**		
	A	Deviations from Raoult's law – non-ideal solutions. Colligative properties: vapour pressure-composition and temperature composition curves of ideal and non-ideal solution, azeotropes, distillation of solutions.		
	B	Partial miscibility of liquids: critical solution temperature, effect of impurity on partial miscibility of liquids.		
	C	Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.		
	Unit 4	**Gaseous State**		
	A	Kinetic theory of gases, derivation of Ideal gas equation, Maxwell distribution of molecular velocities and molecular energies, principle of equipartition of energy,		
	B	Deviation of gases from ideal behaviour, compressibility factor (Z) and expansitivity factor, van der Waal's equation of state and its application to explain deviation of gases.		
	C	Critical constant of gas in terms of van der Waal's constant: derivation of P_c, T_c and V_c, principle of corresponding states.		
	Unit 5	**Thermodynamics and Thermochemistry**		
	A	Recapitulation of Laws of Thermodynamics, Entropy changes in reversible and irreversible processes, Entropy changes for an ideal gas in isothermal, isobaric and isochoric processes,		
	B	Physical significance of entropy, Helmholtz free energy (A) and Gibbs free Energy (G), variation of Free Energy with pressure and temperature, Maxwell relations, Gibbs-Helmholtz equ.		
	C	Relation between Enthalpy of reaction at constant volume and pressure, Enthalpy of formation, Kirchhoff equation, Hess's Law and application, measuring the enthalpy of combustion.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. P.W. Atkins and Julio de Paula, "Physical Chemistry", 8th Ed., W. H. Freeman Publication, 2006.		

		2. G.M. Barrow, "Physical Chemistry" Tata McGraw-Hill Education, 2008. 3. Puri, Sharma and Pathania, "Principles of Physical Chemistry" Vishal Publishing Co. 4. Bahl Arun, Bahl B.S. and J.D Tuli, "Essentials of Physical Chemistry", S.Chand & Co. 5. KL Kapoor , "Textbook of Physical Chemistry" Volume 1 and 2, Macmillan Publishers

BCH102 Organic Chemistry-1 BCH102

School: SBSR		**Batch :**
Program: B. Sc		**Current Academic Year:**
Branch: Chemistry		**Semester: 02**
1	Course Code	BCH102
2	Course Title	**Organic Chemistry-1 (C)**
3	Credits	4.0
4	Contact Hours (L-T-P)	(3 1 0)
	Course Status	Compulsory
5	Course Objective	1. To introduce students to many of the key concepts of organic chemistry through a survey of the basic reactions types. 2. To promote understanding of basic facts and concepts and to inculcate interest in Organic chemistry. 3. To elaborate various electronic factors, an understanding of nucleophiles, electrophiles, electronegativity, and resonance, reaction intermediates and their effect on the course of organic reactions. 4. To discuss the theories of organic acids/bases, the concept of Formal charges and Curley Arrow rule. 5. To explain, classify and apply fundamental organic reactions such as SN2, SN1, E2, E1, alkene addition, electrophilic aromatic substitution, 1,2/1,4-additions to organic molecules. 6. To elaborate logical and detailed mechanisms for various fundamental reactions which involves nomenclature, physical properties, synthesis, reactions, of alkanes, alkenes, dienes, and alkynes. 7. To demonstrate the basics of Stereochemistry, Classify molecules as chiral or achiral, identify chiral carbons as (R) or (S), identify relationships between pairs of molecules as enantiomers, diastereomers, or equivalent, and identify when a solution is racemic versus optically active. 8. To provide knowledge of basics of organic chemistry, alkanes and cycloalkanes, alkenes and dienes, alkynes and stereochemistry.
6	Course Outcomes	Students will be able to: CO1: explain many concepts like electronic displacement, bond fission, Reaction intermediates, curly arrow rule, nucleophilicity etc. CO2: understand the synthesis, reactions of alkanes, cycloalkanes and their mechanism CO3: explain the synthesis, reactions of alkenes and dienes CO4: summarize the physical and chemical properties of alkynes CO5: explain and apply the concept of stereoisomerism and conformation

		CO6: apply the basic concept of organic chemistry in synthesis & reactions of hydrocarbons and analyze the stereochemistry of hydrocarbons
7	Course Description	Course emphasizing basic organic chemistry which encompasses various types of electronic displacement, reaction intermediates. Further this course enables the students to generalize the structure properties relationship of Alkanes, alkenes, alkynes and cycloalkane. It also gives in-depth idea to prepare various above compounds by different methods. It also covers the basic information about stereoisomerism.
8	Outline syllabus	
	Unit 1	**Basics of Organic Chemistry**
	A	Electronic Displacements- Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Homolytic and Heterolytic fission with suitable examples,
	B	Reaction Intermediates types, shape and relative stability of carbocations, carbanions, free radicals and carbenes Dipole moment; Organic acids and bases; their relative strength..
	C	Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity. Introduction to types of organic reactions and their mechanism: Addition, Elimination, Substitution and rearrangement reactions.
	Unit 2	**Alkanes and Cycloalkanes**
	A	Alkanes- Methods of synthesis (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids & their salts)
	B	Chemical reactions: Nitration, Halogenation, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.
	C	Cycloalkanes- Nomenclature, synthesis, relative stability-Baeyer Strain Theory, physical properties & Chemical properties.
	Unit 3	**Alkenes and Dienes**
	A	Methods of synthesis, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination,
	B	Relative stabilities of alkenes Chemical reactions – hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration, oxidation, oxymercuration-reduction.
	C	Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization. Dienes, Relative stability of dienes, Conjugated dienes, 1,2 and 1,4 additions.
	Unit 4	**Alkynes**
	A	Methods of synthesis, chemical reactions, acidity of terminal alkynes,

	B	Mechanism of electrophilic and nucleophilic addition reactions		
	C	Hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.		
	Unit 5	**Stereochemistry**		
	A	Concept of isomerism and its types, Projection: Newman projection and Sawhorse formulae, Fischer and flying wedge formulae and their interconversion, Difference between conformation and configuration.		
	B	Conformational isomerism in ethane, n-butane and unsubstituted cyclohexane (axial and equatorial bonds), Optical isomerism –Molecular chirality, enantiomers, stereogenic center, optical activity, chiral and achiral molecules with one & two stereogenic centers		
	C	Disasteromers, meso compounds, Absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism – cis/trans, E/Z system of nomenclature, geometric isomerism in alicyclic compounds.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Organic Chemistry by Solomon & Fryhle. 2. Advanced Organic Chemistry by Bahl and Bahl. 3. Organic Chemistry by Morrison and Boyd. 4. Stereochemistry of carbon compounds; E. L. Eliel. 5. Stereo Chemistry: Conformation and Mechanism; D. Nasipuri. 6. Stereochemistry: conformation and Mechanism; P. S. Kalsi. 7. Conformational analysis; Eliel, Allinger, Angyal and Morrison.		

BCH201 Inorganic Chemistry-I

School: SBSR		**Batch :**
Program: B.Sc		**Current Academic Year:**
Branch:Chem (H)		**Semester:3rd**
1	Course Code	BCH201
2	Course Title	Inorganic Chemistry-I
3	Credits	4
4	Contact Hours (L-T-P)	3-1-2
	Course Status	Compulsory /Elective/Open Elective
5	Course Objective	1. To provide the basics of structure of atoms and the basics of theories involve there in. 2. To introduce the concept of ionic bonding of solids and the different factors that affect ionic bonding. 3. To illustrate the importance of covalent bonding and its usefulness in predicting fundamental properties of the molecules. 4. To explain to the student about shapes of a covalent molecule 5. To provide an introduction to the basic concepts in Molecular Orbital Theory and apply them to understand and compare the stability and reactivity of the molecules. 6. To introduce other types of non-covalent interaction that could be present in a molecule.
6	Course Outcomes	The student will be able to CO1 :understand the various theories to describe atomic structure CO2 :know about ionic bonding, significance and factors affecting the strength of ionic bonding CO3: explain the basis of covalent bonding in molecules CO4 : explain the basics of M.O Theory CO5: explain about band theory of solids and non-covalent interactions present in them CO6 :gain insight about various ionic, covalent and non-covalent interactions that are present in the molecule and their structural studies
7	Course Description	This course describes the basic theories involved in atomic structure and chemical bonding. This course satisfies the requirement of B.Sc chemistry honors' programme.
8	Outline syllabus	
	Unit 1	**Atomic Structure**

	A	Bohr's theory, its limitations and atomic spectrum of hydrogen atom.		
	B	Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom.		
	C	Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations,		
	Unit 2	**Chemical Bonding-I**		
	A	Ionic bond and factors affecting ionic bond; lattice energy and its calculation by Born-Haber cycle.Madelung constant,		
	B	solvation energy, factors affecting solvation energy and solubility of ionic solids.		
	C	Polarizing power and polarizability; Ionic Potential, Fajan's rules.		
	Unit 3	**Chemical Bonding-II**		
	A	Covalent bonding: Concept of Hybridization, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3).		
	B	Bent's Rule, Resonance in Inorganic molecules and ions, VSEPR theory, Shortcomings of VSEPR theory,		
	C	Prediction of structures and variation of bond angles on the basis of VSEPR theory, prediction of hybridization and shapes of simple inorganic molecules and ions such as NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O by valence shell electron pair repulsion (VSEPR) theory.		
	Unit 4	**Chemical Bonding-III**		
	A	Valence bond theory - A mathematical approach and its limitations, directional characteristics of covalent bond. Molecular orbital theory (LCAO method)		
	B	Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules,		
	C	Molecular orbital energy level diagrams (He_2, B_2, C_2, Be_2, N_2, O_2, F_2, NO, CO, HF, CN^-), Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules.		
	Unit 5	**Chemical Bonding-IV**		
	A	Polar covalent bonds, Dipole moment.		
	B	Hydrogen bonding and its effect on the physical and chemical properties of compounds of the main group elements. van der Waal's forces (dipole-dipole interactions, ion-dipole interactions, ion-induced dipole interactions)		
	C	Metallic bonding: Band theory and its illustration.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%

	Text book/s*	**References** 1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
	Other References	1. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970 2. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014. 3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962. 5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

BCH151 Syllabus of Chemistry Lab I

School: SBSR		**Batch:**	
Program: BSc. (H)		**Current Academic Year:**	
Branch: Chemistry		**Semester: 1**	
1	Course number	**BCH151**	
2	Course Title	**Chemistry Lab I**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	To learn methods for quantitative estimation of different chemical species by various volumetric methods and to understand calorimetric formula, heat capacity of calorimeter, water equivalent of calorimeter and enthalpy.	
6	Course Outcomes	1. Able to prepare primary standard and secondary standard solutions. 2. Understand the importance of pH and pH meter. 3. Explain the cause of change in thermal energy of a system during any physical or chemical change. 4. Correlate the change in thermal energy with the heat lost or gained by the system. 5. Distinguish between heat capacity and water equivalent of calorimeter. 6. Able to understand the colligative properties. 7. Able to understand the concept Kinematic viscosity.	
7	Outline syllabus:		
7.01	CHB 151.01	Task 1	To prepare a standard solution of sodium carbonate (Na_2CO_3) and use it to standardise a given solution of HCl.
7.02	CHB 151.02	Task 2	To determine the strength of given HCl solution by titrating it against 0.1 N Na_2CO_3 solution pH metrically.
7.03	CHB 151.03	Task 3	To determine the heat capacity of the calorimeter.
7.04	CHB 151.04	Task 4	To determine the enthalpy of neutralization of NaOH and HCl.
7.05	CHB 151.05	Task 5	To determine the enthalpy of hydration of anhydrous copper sulphate.
7.06	CHB 151.06	Task 6	Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
7.07	CHB 151.07	Task 7	Study the variation of viscosity of sucrose solution with the concentration of solute using Ostwald viscometer.
7.08	CHB 151.08	Task 8	To demonstrate the colligative property of elevation in boiling point.

7.09	CHYB151.09	Task 9	To demonstrate the colligative property of depression in freezing point.
7.10	CHB 151.10	Task 10	To demonstrate the phenomenon of osmosis using semi permeable membrane.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	**References**		
9.1	Text book	O.P. Pandey, D.N. Bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	1. Eastman. E.D. and Rollefson, G.K. *Physical Chemistry* 1947 ed. McGraw-Hill p307. 2. Pauling, Linus: *General Chemistry* 1970 ed. Dover Publications pp459-460. 3. Moore, Walter J. *Physical Chemistry* 1962 ed. Prentice Hall p132.	

1	Course number	**BCH152**	
2	Course Title	**Chemistry Lab**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	• To learn methods for, purification and qualitative analysis of organic compounds • To execute independently purification techniques to organic compounds like filtration, recrystallization, sublimation and distillation. • To perform the qualitative test on unknown organic compounds i.e preliminary tests, tests for extra elements. • To understand the basic concept of quantitative analysis for organic compounds • To understand the concept of organic acid and perform the acid base titration to calculate their solubility in solvents at room temperature.	
6	Course Outcomes	Students are able to • Understand the methods of separation and purification • Understand the Qualitative analysis of organic compounds • Prepare solutions of different strength and standardize them • Execute the volumetric analysis experiments for organic compounds	
7	Outline syllabus:		
7.01	**BCH-152**.01	Task 1	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using: Water solvent (Phthalic acid, Benzoic acid), Determination of the melting points of above compounds and report the yields of pure compounds.
7.02	**BCH-152**.02	Task 2	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization using Alcohol (naphthalene), Determination of the melting points of above compounds and report the yields of pure compounds.
7.03	**BCH-152**.03	Task 3	To check the solubility of organic compounds and Filtration/Purification of organic compounds by recrystallization Alcohol-Water (Aspirin from tablet), Determination of the melting points of above compounds and report the yields of pure compounds.

7.04	**BCH-152**.04	Task 4	To perform the purification of crude naphthalene by sublimation method and calculate the percentage yield and M.P..
7.05	**BCH-152**.05	Task 5	Purification of organic compounds(Water + acetone) by simple distillation.
7.06	**BCH-152**.06	Task 6	Elimination reaction of 2-pentanol
7.07	**BCH-152**.07	Task 7	Cycloaddition reaction of Cyclopentadiene and maleic anhydride
7.08	**BCH-152**.08	Task 8	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.09	**BCH-152**.09	Task 9	To To Analyze the presence of extra elements (N, S, halogens) other than C, H, &O in the given organic compound.
7.10	**BCH-152**.10	Task 10	To determine the solubility of given organic acid(oxalic acid
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quizzes	None	
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks	
8.15	Presentations	None	
8.16	Any other	None	
8.2	MTE	None	
8.3	End-term examination: None		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	

BCH251 Chemistry Lab

	Course number	**BCH251**	
2	Course Title	**Chemistry Lab**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Objective	1. To learn the methods for calibration of laboratory glass wares used in experiments. 2. To understand the method of solutions of different normality and Molarity. 3. To understand the process of standardization of a given solution. 4. To understand the concept of redox titration and the reactions involved 5. To perform the qualitative analysis of inorganic compounds. 6. To identify cations and anions in a given mixture. 7. To execute independently the determination of flash point of a given oil. 8. To determine the calorific value of any given material by bomb calorimeter.	
6	Course Outcomes	Students will be able to 1. Calibrate the burette and pipette used to get the results with zero error. 2. Prepare the solutions of any given normality and strength. 3. Understand the estimation of mixture of salts. 4. Standardise NaOH with oxalic acid. 5. Understand the reactions involved in redox titrations. 6. Measure the calorific value of any given fuel. 7. Understand the process of determination of flash point and fire point.	
7	**Outline syllabus:**		
7.01	**CHB-251**.01	Task 1	To calibrate the lab apparatus and preparation of solutions of different Molarity/Normality of titrants.
7.02	**CHB-251**.02	Task 2	To standardization of NaOH with standard Oxalic acid
7.03	**BCH-251**.03	Task 3	To estimate the carbonate and hydroxide present together in mixture.
7.04	**BCH-251**.04	Task 4	To estimate of Fe(II) and oxalic acid using standardized KMnO4 solution.
7.05	**BCH-251**.05	Task 5-8	**Semi-micro qualitative analysis using H2S of mixtures** - not more than two ionic species (one anion and one cation and

			excluding insoluble salts) out of the following: Cations : NH4+, Pb2+, Ag+, Bi3+, Cu2+, Cd2+, Sn2+, Fe3+, Al3+, Co2+, Cr3+, Ni2+, Mn2+, Zn2+,Ba2+, Sr2+, Ca2+, K+ Anions : CO32– , S2–, SO2–, S2O32–, NO3–, CH3COO–, Cl–, Br–, I–, NO3– ,SO42-, PO43-, BO33-,C2O42-, F- (Spot tests should be carried out wherever feasible**)**
7.06	**BCH-251**.06	Task 9	To detect flash point and fire point of a lubricant.
7.07	**BCH-251**.07	Task 10	To determine the calorific value of a fuel using Bomb Calorimeter.
8	**Course Evaluation**		
8.1	Course work: 100% marks		
8.2	Attendance	None	
8.3	Homework	Yes	
8.4	Quizzes	Yes	
8.5	Labs	Evaluation of work done on each lab turn in the lab, notebook and feedback from oral quiz about the work done that day, punctuality, interaction. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 60 marks	
8.6	Presentations	None	
8.7	Any other	None	
8.8	MTE	None	
8.9	End-term examination: Yes, 40 marks		
9	References		
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.	
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.	