SARDAR PATEL UNIVERSITY, MANDI

Himachal Pradesh

Established under H.P. Legislative Assembly Act 03 of 2022

Recognized under Section 2(f) - UGC Act 1956

Scheme & Syllabi of BSc/MSc Integrated (5 Yr) Physics

Session 2022 & 2023

Framed according to the National Education Policy (NEP 2020)

1. Introduction:

The NEP-2020 presents a unique opportunity to transform higher education in India from a teacher-centric approach to a student-centric one. It emphasizes Outcome Based Education wherein Graduate Attributes are the foundation for designing Programs, Courses, and Supplementary activities. This curriculum framework for B.Sc. (Honours) Physics focuses on providing students with a solid foundation in the subject while developing essential skills for further studies and research. The framework aims to equip students with cognitive abilities and practical skills necessary to excel in diverse professional careers in our evolving knowledge-based society. Additionally, the curriculum aims to maintain global competitiveness by promoting excellence in Physics knowledge and skills, scientific orientation, problem-solving abilities, and the cultivation of rational thinking and ethical values in students.

Graduate Attributes in Physics:

Graduates in Physics should demonstrate the following key attributes:

- Proficiency in disciplinary knowledge and skills.
- Effective communication skills.
- Strong critical thinking and problem-solving abilities.
- A curious and inquisitive approach to learning.
- Capability to work collaboratively in teams.
- Competence in project management.
- Proficiency in digital and ICT (Information and Communication Technology) usage.
- Ethical awareness and reasoning skills.
- Appreciation for both national and international perspectives.
- A commitment to lifelong learning and continuous improvement.

Flexibility in Program Design:

The degree programs offer students flexibility in customizing their studies based on their preferences and requirements. Students can choose from the following options:

- Single Major subject/discipline, Generic Electives, Ability Enhancement, Skill Development, and Vocational courses, including Extracurricular Activities.
- One Major subject/discipline and one Minor subject/discipline, along with Generic Electives, Ability Enhancement, Skill Development, and Vocational courses, including Extracurricular Activities.
- Two Major subjects/disciplines along with Generic Electives, Ability Enhancement, Skill Development, and Vocational courses, including Extracurricular Activities.
- One Major subject/discipline and one Vocational course along with Generic Electives, Ability Enhancement, Skill Development, and courses, including Extracurricular Activities.
- One Major Discipline and One Education Discipline along with Generic Electives, Ability Enhancement, and Skill Development Courses, including Extracurricular Activities.

2. Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

EXIT OPTIONS	Credits required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	56
Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	100 - 110
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-year Integrated Master's Degree Programme	144 - 158
Bachelor Degree with Honours in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme	188 - 206
Master's Degree in a Discipline at the Successful Completion of the Fifth Year (Ten Semesters) of the Five- year Integrated Master's Degree Programme	232- 250

3. Aims of Integrated (5Yr) program in Physics

The aims and objectives of our Integrated (5Yr) BSc/MSc programme are:

- Provide a conducive environment for students in educational institutions to reinforce their knowledge from the +2 level and cultivate a genuine interest in Physics. This includes developing a comprehensive understanding of physical concepts, principles, and theories.
- Encourage students to engage in hands-on learning by conducting experiments in laboratories that demonstrate the practical applications of the theoretical concepts learned in classrooms.
- Foster the ability to apply the acquired knowledge to tackle specific theoretical and experimental Physics problems effectively.
- Expose students to the vast scope of Physics as both a theoretical and experimental science, enabling them to address a wide range of natural phenomena, from the smallest subatomic scales (10^{-15} m) to the largest cosmic scales (10^{26} m) and from minute energy levels (10^{-10} eV) to extreme energy dimensions (10^{25} eV).
- Highlight the significance of Physics as a crucial branch of science, paving the way for pursuing interdisciplinary and multidisciplinary higher education and research.
- Emphasize the importance of Physics in sustaining existing industries and creating new ones, thereby generating job opportunities across various employment levels.
- The progressive curriculum of the program is structured to guide students from being novice problem solvers at the program's entry level to becoming expert problem solvers upon graduation, as outlined below:

➢ *By the end of the first year*: Students should have the ability to solve well-defined problems.

➢ *By the end of the second year*: Students should be capable of solving broadly defined problems.

➢ *By the end of the third year*: Students should possess the skills to tackle complex and ill-structured problems, which may require multidisciplinary approaches for solutions.

➢ *During the fourth year*: Students will gain practical problem-solving experience through internships or research experiences, preparing them for higher education, entrepreneurship, or employment in the workplace.

➢ *By the end of the fifth year*: Achieving Profound Mastery of the Subject with an Innate Research Temperament.

4. Curriculum Framework for Multidisciplinary Four- year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

Year	Objectives	Nature of Courses	Outcome	No. of courses
1st year – (1st & 2nd Semesters)	Understanding and Exploration	1) Discipline based Core Courses	Understanding of Disciplines	3+3
		2) Ability Enhancement Compulsory Courses	Gaining perspective of context/Generic skills	1+1
		3) Skill Enhancement/ Development Courses	Basic skills sets to pursue anyvocation	1+1
Exit option with Certification				
2nd year – (3rd & 4th Semesters)	Focus and Immersion	1) Discipline based Core Courses	Understanding of disciplines	2+2
		2) Open Elective		1+1
		3) Ability Enhancement	Gaining perspective of context	1+1
		4) Skill based/Vocational	Skill sets to pursue vocation	1+1
		5) Extra Curricular Activities	Development of various domains of mind & Personality	1+1
Exit Option with Diploma				
3rd year – (5th & 6th Semesters)	Real time Learning	1) Major Discipline Core and Elective Courses	In depth learning of major and minor disciplines, Skill sets for employability.	2+2 1+1
		2) Minor Discipline/ Generic or Vocational Electives/Field based Learning/ Research Project	Exposure to discipline beyond the chosen Subject Experiential learning/ Research.	1+1
Exit option with Bachelor Degree				
4th year – (7th & 8th Semesters)	Deeper Concentration	Major Discipline Core and Elective courses Research/ Project Work with Dissertation	Deeper and Advanced Learningof Major Discipline Foundationto pursue Doctoral Studies & Developing Research competencies	4+4
Bachelor Degree with Honours				
5th year –(9th & 10th semesters)	Master of the subject	Major Discipline Core and Elective courses/ Research/ Project Work with Dissertation	Deeper and Advanced Learning of the Major Discipline towards gaining proficiency	3+3/ 4+4
Master's Degree				

Course Structure (Major Discipline: Physics)

(Semester 1 – 10)

SEMESTER	Discipline Core Theory Course	Core Papers
1st	PHYBM 101	Mechanics
2nd	PHYBM 201	Electricity, Magnetism and EMT
3rd	PHYBM 301 PHYBM 302	1. Wave Motion and Optics 2. Elements of Modern Physics
4th	PHYBM 401 PHYBM 402	1. Thermal Physics & Electronics 2. Analog Systems & Applications
5th	PHYBM 501 PHYBM 502	1. Classical Mechanics and Quantum Mechanics- I 2. Elements of Atomic, Molecular Physics
6th	PHYBM 601 PHYBM 602	1. Elements of Nuclear Physics and Nuclear Instruments 2. Elements of Condensed Matter Physics
7th	PHYBM 701 PHYBM 702 PHYBM 703 PHYBM 704	1. Mathematical Methods of Physics – I 2. Classical Electrodynamics. 3. Experimental methods of Physics 4. Research Methodology
8th	PHYBM 801 PHYBM 802 PHYBM 803 PHYBM 804	1. Classical Mechanics and Quantum Mechanics-II 2. Statistical Mechanics 3. Astrophysics & Astronomy 4. Research Project* (Select Two DSE subjects from the Pool B-II shown below) *In lieu of the research Project, two additional elective papers/ Internship may be offered.
9th	PHYBM 901 PHYBM 902	1. Mathematical Methods of Physics – II (Select one DSE subject from the Pool B-III shown below) 2. Research Project
10th	PHYBM 1001 PHYBM 1002	1. Quantum Mechanics – III (Select one DSE subject from the Pool B-IV shown below) 2. Research Project

Note: Utilize Course Code PHYBM 101 TH for theory courses and PHYBM 101 PR for Lab Courses. In the code "101," 1 indicates the semester, and 01 represents the subject number within that specific semester. Note that this numbering system will be subject to change in subsequent semesters.

Minor Subjects

Minor subjects will be introduced with their respective syllabuses starting from the 5th semester onwards.

Open Electives

Semester – 3rd		
3.	PHYBM 303	1. Optical Instruments 2. Elements of Astronomy and Astrophysics 3. Energy source 4. Climate science
Semester – 4th		
4.	PHYBM 403	1. Medical Physics 2. Nanotechnology 3. Electrical Instruments

Discipline Specific Electives (DSE)

(7th to 10th Semesters)

7th Sem Electives Pool B-I (Select any two)		**8th Sem Electives Pool B-II (Select any two)**	
A.	Condensed Matter Physics-1	A.	Atomic & Molecular Physics-1
B.	Nuclear and Particle Physics	B.	Materials Physics & Nano materials
C.	Theoretical and Computational Physics-I	C.	Lasers and non-linear optics
D.	Biophysics	D.	Plasma Physics
E.	Astronomy and Astrophysics	E.	Physics of Semiconductor devices
9th Sem Electives (Specialization papers)Pool B-III		**10th Sem Electives (Specialization papers)Pool B-IV**	
A.	Condensed Matter Physics-2	A.	Condensed Matter Physics-3
B.	Nuclear and Particle Physics-2	B.	Nuclear and Particle Physics-3
C.	Atomic & Molecular spectroscopy-1	C.	Atomic & Molecular spectroscopy-2
D.	Materials Physics & Nanophysics –1	D.	Materials Physics & Nanophysics -2
E.	Theoretical and Computational Physics-I	E.	Theoretical and Computational Physics-2
F.	Astronomy and Astrophysics-1	F.	Astronomy and Astrophysics-2

DETAILED SCHEME & SYLLABUS OF 1st SEMESTER

Semester	Course Type	Course Code	Title of Paper	Credits	Max. Marks	Total Marks	Total Credits
1st	Core Course-I	PHYBM 101 TH	Mechanics (Theory)	4 (TH+IA)	Theory = 50 IA = 30	100	28
		PHYBM 101 PR	Mechanics (Lab)	2	Lab. = 20		
	SEC-I	PHYBM 102 TH	Electrical Circuits and Network Skills (Theory)	4 (TH+IA)	Theory = 50 IA = 30	100	
		PHYBM 102 PR	Electrical Circuits and Network Skills (Lab)	2	Lab. = 20		
	Core Course-II	PHYBM 103 TH	Inorganic Chemistry (Theory)	4 (TH+IA)	Theory = 50 IA = 30	100	
		PHYBM 103 PR	Inorganic Chemistry (Lab)	2	Lab. = 20		
	Core Course-III	PHYBM 104	Differential Calculus	6 (TH+IA =5,TU=1)	Theory = 70 IA = 30	100	
	A.E.C. Course-I	PHYBM 105	Writing Skills	4 (TH+IA)	Theory = 70 IA = 30	100	

B. Sc.-M. Sc. Physics Five Year Integrated Course
1st Semester

MECHANICS

Name of the Course	**PHYSICS-DSC: MECHANICS** **(Credits: Theory-04) Theory: 60 Lectures**
Code	**PHYBM 101TH**
Semester Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

This foundational course is of paramount importance as it serves as an introduction to fundamental concepts and mechanics, initiating students into college-level problem-solving in physics. It sets the learning paradigm and establishes the fundamental principles that will form the basis for the entire study of physics.

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering syllabus from all the units),section B(Unit I), section C(Unit II),section D(Unit III) and section E(Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1 (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit - I	**Ordinary Differential Equations:** 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients. **Coordinate systems and motion of a particle:** Volume, velocity and acceleration in Cartesian and Spherical co-ordinate systems, Solid angle. **(6 Lectures)** **Space Time Symmetry and Conservation Laws:** Relationship of conservation laws and symmetries of space and time. **(4 Lectures)** **Frames of Reference:** Inertial frames of reference, Galilean transformation and Galilean invariance, Non-inertial frames, Coriolis force and its applications. **(5 Lectures)**
Unit - II	**Gravitation and Inverse Square Force Law:** Newton's Law of Gravitation, Various forces in nature (qualitative), Central and non-central forces, Inverse square force, Centre of mass, Equivalent one body problem, Reduced mass, angular momentum in central force field, Equation of motion under a force law, Equation of orbit and turning points, Relationship between eccentricity and energy, Kepler's laws. **(15 Lectures)**
Unit - III	**Rotational Motion and Kinematics of Elastic and Inelastic Collisions :** Angular velocity, angular momentum, Torque, Conservation of angular momentum, Elastic and inelastic collisions, coefficient of restitution, Elastic collisions in laboratory and C. M. systems, Velocities, angle and energies in elastic collisions in C. M. and lab. Systems, Classical Scattering: Cross- section for elastic scattering, Rutherford scattering (with derivation). **(15 Lectures)**
Unit - IV	**Special Theory of Relativity:** Concept of stationary universal frame of reference and search for ether, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, Observer in relativity, Relativity of simultaneity. **(8 Lectures)** **Effects of Relativity:** Length contraction, Time dilation, Relativistic addition of velocities, Relativistic Doppler effect, Variation of mass with velocity and mass energy equivalence, Increase of mass in an inelastic collision, Relativistic momentum and energies, Transformation of momentum, energy, Minkowsky space. **(7 Lectures)**

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
- Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Mechanics, D.S. Mathur, S. Chand and Company Ltd.
- An Introduction to Mechanics, Kleppner, Tata Macgraw Hill.

LAB COURSE

Mechanics (Lab)

Course Code: PHYBM 101 PR

Credits – 02

List of Experiments to be performed in Lab I:

1. To determine the value of acceleration due to gravity 'g' at a place with Keter's Pendulum.
2. To plot a graph between distance of the knife-edges from the centre of gravity and time period of Bar pendulum. From the graph find
   (a) the acceleration due to gravity.
   (b) the radius of gyration and the moment of inertia of bar about an axis passing through the centre of gravity.
3. To find the moment of inertia of an irregular body about an axis through its centre of gravity with a Torsion pendulum.
4. To find the moment of inertia of Fly Wheel.
5. To find the angular acceleration and torque of a fly wheel and hence find the moment of inertia of fly wheel.
6. To determine the height of an accessible object using Sextant.
7. To determine the modulus of rigidity of copper by Maxwell's needle.
8. To study the law of conservation of linear momentum and law of conservation of kinetic energy using one dimensional collision apparatus of two hanging sphere.
9. To verify law of conservation of linear momentum and law of conservation of kinetic energy in case of elastic collision.
10. To find the Young's modulus of the material of a rectangular bar by bending.
11. To determine the diameter of a capillary tube using travelling microscope.
12. To study the motion of a spring. Calculate spring constant and value of 'g'.

Note: A minimum of EIGHT experiments to be carried out.

Reference Books for Laboratory Experiments:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B. Saraf	Vikas Publications	2013
2	A laboratory manual of Physics for undergraduate classes, 1st Edition,	D P Khandelwal	Vikas Publications.	1985
3	B.Sc. Practical Physics (Revised Edition)	C. L Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B. Saha	New Central Book Agency Pvt Ltd.	2002

ELECTRICAL CIRCUITS AND NETWORK SKILLS

Name of the Course	**PHYSICS-SEC1: ELECTRICAL CIRCUITS AND NETWORK SKILLS** **(Credits: Theory-04)** **Theory: 60 Lectures**
Code	**PHYBM 102 TH**
Semester Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks,*
2. *The candidate will be required to attempt five questions in all. The duration of the examination will be 3 hours.*

Syllabus:

Basic Electricity Principles: Voltage, Current, Resistance, and Power, Ohm's law, Series, parallel, and series-parallel combinations, AC Electricity and DC Electricity, Familiarization with multi-meter, voltmeter and ammeter. **(3 Lectures)**

Understanding Electrical Circuits: Main electric circuit elements and their combination, Rules to analyze DC sourced electrical circuits, Current and voltage drop across the DC circuit elements, Single-phase and three-phase alternating current sources, Rules to analyze AC sourced electrical circuits, Real, imaginary and complex power components of AC source, Power factor, Saving energy and money. **(4 Lectures)**

Electrical Drawing and Symbols: Drawing symbols, Blueprints, Reading Schematics, Ladder diagrams, Electrical Schematics, Power circuits, Control circuits, Reading of circuit schematics, Tracking the connections of elements and identify current flow and voltage drop. **(4 Lectures)**

Generators and Transformers: DC Power sources, AC/DC generators, Inductance, capacitance, and impedance, Operation of transformers. **(3 Lectures)**

Electric Motors: Single-phase, three-phase & DC motors, Basic design, Interfacing DC or AC sources to control heaters & motors, Speed & power of ac motor. **(4 Lectures)**

Solid-State Devices: Resistors, inductors and capacitors, Diode and rectifiers, Components in Series or in shunt, Response of inductors and capacitors with DC or AC sources. **(3 Lectures)**
Electrical Protection: Relays, Fuses and disconnect switches, Circuit breakers, Overload devices, Ground-fault protection, Grounding and isolating, Phase reversal, Surge protection, Interfacing DC or AC sources to control elements (relay protection device). **(4 Lectures)**

Electrical Wiring: Different types of conductors and cables, Basics of wiring-Star and delta connection, Voltage drop and losses across cables and conductors, Instruments to measure current, voltage, power in DC and AC circuits, Insulation, Solid and stranded cable, Conduit, Cable trays, Splices: wire nuts, crimps, terminal blocks, split bolts, and solder, Preparation of extension board. **(5 Lectures)**

Reference Books:

- A text book in Electrical Technology – B. L. Theraja – S. Chand & Co.
- A text book of Electrical Technology – A. K. Theraja
- Performance and design of AC machines – M. G. Say ELBS Edn.

LAB COURSE

Electrical Circuits and Network Skills (Lab)

Course Code: PHYBM 102 PR

Credits – 02

List of Experiments to be performed in Lab II:

1. To study Ammeter and Voltmeter.
2. To check continuity of a wire with the help of a Digital Multimeter.
3. To measure voltage of different batteries with the help of a Digital Multimeter.
4. To test LED's by using Digital Multimeter.
5. To find the resistance of carbon resistor by using Digital Multimeter and comparison with colour coding.
6. To find the resistance of parallel combination of resistors by using Digital Multimeter.
7. To find the resistance of series combination of resistors by using Digital Multimeter.
8. To test p-n diode using Digital Multimeter.
9. To measure current and voltage in a circuit with Digital Multimeter.
10. To check n-p-n and p-n-p transistor using parallel combination of resistors.
11. Practice of Soldering.
12. To measure current and voltage in a circuit with Digital Multimeter.
13. To study CRO.

Note: **A minimum of EIGHT experiments to be carried out.**

INORGANIC CHEMISTRY

Name of the Course	**INORGANIC CHEMISTRY** **(Credits: Theory-04) Theory: 60 Lectures**
Code	**PHYBM 103 TH**
Semester Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections A, B, C, D and E. Section A will be compulsory. Examiner will set nine questions in all, selecting two questions from section B, C, D and E of* ***10*** *marks each and may contain more than one part. Section A will be of* ***10*** *marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of* ***one*** *mark each covering the entire paper.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

Syllabus:

Unit - I	**Atomic Structure:** Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra, Need of a new approach to Atomic structure, Schrodinger wave equation and meaning of various terms in it, Significance of ψ and ψ^2, Radial and angular nodes and their significance, Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals, Significance of quantum numbers, Shapes of s, p and d atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms, Stability of half-filled and completely filled orbitals, concept of exchange energy, Relative energies of atomic orbitals, Anomalous electronic configurations, Slater rules and applications. **(14 lectures)**
Unit - II	**Chemical Bonding and Molecular Structure:** ***Ionic Bonding***: General characteristics of ionic bonding, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds, Statement of Born-Landé

	equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character, ***Covalent bonding- VB Approach***: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, Concept of resonance and resonating structures in various inorganic and organic compounds, MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules up to Ne (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches. **(16 Lectures)**
Unit - III	**Hydrogen:** Unique position of Hydrogen in the periodic table, isotopes, ortho and para hydrogen, Industrial production, Hydrides and their chemistry, Heavy water, Hydrogen bonding, Hydrates. **S-Block Elements:** Periodicity of elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity(Pauling Scale), General characteristics of s-block elements like density, melting points, flame colouration and reducing character, solvation and complexation tendencies and solutions of metals in liquid ammonia. **(8 Hours)**
Unit - IV	**P- Block Elements:** Comparative studies including diagonal relationship of group 13 and 14 elements, Borohydrides, Hydrides, oxide and oxy-acids and halides of boron, borax, Borazine, allotropic forms of carbon, fullerenes, carbides of calcium and silicon, Hydrides, oxides, oxoacids and halides of nitrogen, Allotropic forms of phosphorous, Hydrides, halides, oxides and oxyacids of phosphorous, Basic properties of halogens and inter halogen compounds, pseudohalogens and poly halides. **Noble Gases:** Occurrence of noble gases, History of discovery of noble gases and isolation of noble gases form air, Preparation properties and structure of important compounds of noble gases-flourides, oxides, oxyflorides of xenon (valence bond structure only), Krypton difloride and clatherate compounds of noble gases. **(12 Hours)**

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley& Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry:

Principles of Structure andReactivity, Pearson Education India, 2006.

LAB COURSE

INORGANIC CHEMISTRY LAB

Course Code: PHYBM 103 PR

Credits – 2

Differential Calculus

Name of the Course	**Differential Calculus Credits = 6 (L-5,T-1,P-0)**
Course Code	**PHYBM 104**
Continuous Comprehensive Assessment: Based on Mid-terms Tests, Class tests, Assignments, Quiz, Seminar and Attendance	**Max. Marks:30**
Tutorials: Solving Problems and exercises	15 hours
Semester Based Examination	**Max. Marks: 70** Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions for Paper Setters and Candidates:

*1. The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.*

2. Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Unit - I	Limit and Continuity (epsilon and delta definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem. **(19 Hours)**
Unit - II	Indeterminate forms, Rolle's theorem, Lagrange's & Cauchy Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(1+x), $(1+x)^m$. **(19 Hours)**
Unit - III	Concavity, Convexity & Points of Inflexion, Curvature, Radius of curvature, centre of curvature, Asymptotes, Singular points, Double point, Polar coordinates, Relation between Cartesian and polar coordinates. **(19 Hours)**
Unit - IV	Functions of several variables (upto three variables): Limit and Continuity of these functions Partial differentiation, Euler's theorem on homogeneous functions, Maxima and Minima with Lagrange Multipliers Method (two variables), Jacobian (upto three variables). **(18 Hours)**

Books Recommended:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

Writing Skills

Name of the Course	A.E.C.Course: Writing Skills (English) (Credits: Theory-04) Theory: 60 Lectures
Code	**PHYBM 105**
Semester Based Examination	**70 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA**: Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

Instructions for Paper Setters and Candidates:

1. The question paper will consist of eight questions in all. All questions will be compulsory. However choices are to be provided in each question. Each question will carry marks as per pattern of testing given below.

For End Term Examination: 70 Marks **(Three Hours)**

1. Notice	6 Marks
2. Letter Writing	10 Marks
3. Resume Writing	10 Marks
4. Diary Writing	6 Marks
5. Paragraph Writing (80-100 words)	6 Marks
6. Report Writing	10 Marks
7. Summary or Note Making	10 Marks
8. Feature Article or Interview (200 words)	12 Marks

2. The candidate will be required to attempt eight questions in all. The duration of the examination will be 3 hours.

Syllabus of English [PHYBM 105]

Writing Skills

i. Diary Writing
ii. Paragraph Writing
iii. Summary/Note-making
iv. Formal and Informal Letter Writing

v. CV/Resume Writing
vi. Report Writing
vii. Interview/Feature Article
viii. Notice Writing

Classroom Activity:

Speaking Skills, Listening Skills, Mock Interview, Speech Making and Project Work

Suggested projects:

Sports writing, poetry about women/men, poetry in translation, translating a poem, telling a story, fantasy writing, chat shows, the menace of dowry, a success story, creative writing, theatre groups, interviewing a celebrity, writing a newspaper article on a current topic, today's youth icons, leadership and politics, examination system and benefits of reform, the epics, communalism, gender discrimination, social activism.

Recommended Reading:

1. *English Communication Skills: AECC under CBCS, HPU.* Meenakshi F. Paul and Madhumita
Chakraborty. Macmillan, 2017.

Suggested Readings:

1. *Fluency in English,* Part I. Macmillan, 2005.
2. *Fluency* in English. Part II. OUP, 2006. Unit 1-15.
3. *El Dorado: A Textbook of Communication Skills*.Orient Blackswan, 2014. Units 1-5.
4. *Interchange.* Workbook III, Fourth Edition.Cambridge University Press, 2015. Units 1-8.
5. *New Headway.* Intermediate Student's Book. 3rd Edition, Oxford University Press, 2012. Units 1-6.
6. *Write to be Read*: *Reading, Reflecting & Writing.* First South Asian edition, Cambridge University Press, 2014. Units 1-4.
7. *Business English*. Pearson, 2008. Units 4-6.

DETAILED SCHEME & SYLLABUS OF 2nd SEMESTER

Semester	Course Type	Course Code	Title of Paper	Credits	Max. Marks	Total Marks	Total Credits
2nd	Core Course-IV	PHYBM 201 TH	Electricity, Magnetism and EMT (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	28
		PHYBM 201 PR	Electricity, Magnetism and EMT (Lab.)	2	Lab. = 20		
	SEC-2	PHYBM 202 TH	Physics Workshop Skill (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	
		PHYBM 202 PR	Physics Workshop Skill (Lab.)	2	Lab. = 20		
	Core Course-V	PHYBM 203 TH	Organic Chemistry (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	
		PHYBM 203 PR	Organic Chemistry (Lab.)	2	Lab. = 20		
	Core Course-VI	PHYBM 204	Differential Equations	6 (TH + IA=5,TU=1)	Theory = 70 IA = 30	100	
	A.E.C. Course-II	PHYBM 205	Environment Science	4 (TH)	Theory = 100	100	

B. Sc.-M. Sc. Physics Five Year Integrated Course
2nd Semester

ELECTRICITY, MAGNETISM and EMT

Name of the Course	**ELECTRICITY, MAGNETISM AND EMT** **(Credits: Theory-04)Theory: 60 Lectures**
Code	**PHYBM 201 TH**
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory = **05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), section B (Unit I), section C (Unit II), section D (Unit III) and section E (Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.

Unit - I	**Vector Analysis**: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem, Stokes's theorem, Green's theorem. **(5 Lectures)** **Electrostatics**: Significance of electrostatic force, Electrostatic Field, electric flux,

	Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor, electrostatic potential, electrostatic potential energy. Electric potential due toa dipole and quadrupole, long uniformly changed wire, charged disc. Electric potential energy. Electric field as a gradient of a scalar potential. Calculation of electric field due to a pointcharge and a dipole from potential. Method of Electrical Images. Poisson and Laplace equations. **(7 Lectures)** **Electric Current and Fields of Moving charges**: Current and current density. Continuity equation; $\nabla.\mathbf{J} + \partial\rho/\partial t = 0$. Microscopic form of Ohm's law ($\mathbf{J} \alpha \mathbf{E}$) and conductivity. Failure of Ohms law and its explanation. Invariance of charge. **(3 Lectures)**
Unit - II	**Magnetism:** Ampere circuital law and its applications. Hall Effect, Expression for Hall constant and its significance. Divergence and curl of magnetic field **B**. Vector potential: Definition of vector potential **A** and derivation. **(5 Lectures)** **Field of Moving Charges:** E in different frames of reference. Field of a point charge moving with constant velocity. Field of charge that starts or stops (qualitative). Interaction between movingcharge and force between parallel currents. **(4 Lectures)** **Surface current density**: Definition. and its use in calculation of change in magnetic field at acurrent sheet. Transformation equations of E and B from one frame of reference to another.Dielectrics, parallel plate capacitor with a dielectric, dielectric constant, polarization and polarization vector, displacement vector **D**, molecular interpretation of Claussius - Mossotti equation, boundary conditions satisfied by **E** and **D** at the interface between two homogenous dielectrics, illustration through a simple example. **(6 Lectures)**

Unit - III	**Electrostatic Fields in Dielectrics:** Polarization of matter. Atomic and molecular dipoles,induced. Dipole moment and atomic polarizability. Electric susceptibility and polarization vector Capacity of a capacitor filled with Dielectrics. Dielectrics and Gauss's law Displacement vector-Establishment of relation $\nabla . D = \rho_{free}$. Energy stored in a dielectric medium. **(7 Lectures)** **Magnetic Fields in Matter**: Behavior of various substances in magnetic fields. Definition of M and H and their relation to free and bound currents. Magnetic permeability and susceptibility andtheir interrelation. Orbital motion of electrons and diamagnetism. Electron spin and paramagnetic. Ferromagnetism. Domain theory of ferromagnetism, magnetization curve, hysterics loss, ferrites. **(8 Lectures)**
Unit - IV	**Maxwell`s equations and Electromagnetic wave propagation:** Displacement current, Maxwell's equations and its physical interpretation, EM waves and wave equation in a medium having finite permeability and permittivity but with conductivity $\sigma = 0$. Poynting vector, Poynting theorem, Impedance of a dielectric to EM waves, EM waves in conducting mediumand skin depth. EM waves velocity in a conductor and anomalous dispersion. Reflection and Transmission of EM waves at a boundary of two dielectric media for normal and oblique incidence of reflection of EM waves from the surface of a conductor at normal incidence. **(15 Lectures)**

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Introduction to Electrodynamics, D.J. Griffth, 3rd Edition, Prentice Hall of India.
- Electricity and Magnetism, Brij Lal and Subramanium, S. Chand & Co. Ltd.

- Electricity and Magnetism, A S Mahajan and A A Rangwala, Tata McGraw Hill Company.

ELECTRICITY, MAGNETISM AND EMT LAB

Name of the Course	PHYSICS-DSC 1B LAB: ELECTRICITY, MAGNETISM AND EMT (Credits: -02)
Code	PHYBM 201PR
Yearly Based Examination	20 marks (3 Hrs)
Distribution of Marks: Experiment = **8 Marks**, Written/ Skills= **4 Marks** Viva Voce = **4 Marks**, Practical Record Book= **4 Marks.**	

PHYSICS LAB- DSC 1B LAB: ELECTRICITY, MAGNETISM AND EMT

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:

(i) Measurement of charge and current sensitivity
(ii) Measurement of CDR
(iii) Determine a high resistance by Leakage Method
(iv) To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) QualityFactor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem
11. To determine unknown capacitance by flashing and quenching method
12. To find frequency of ac supply using an electrical viberator.
13. To study the induced emf as a function of the velocity of the magnet (simple method).

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia PublishingHouse.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt.Ltd.

• Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
• B.Sc. Practical Physics C.L. Arora, S. Chand and company Ltd.

PHYSICS WORKSHOP SKILL

Name of the Course	**PHYSICS WORKSHOP SKILL** **(Credits: Theory-04)** **Theory: 30 Lectures**
Code	**PHYBM 202 TH**
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment(CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory:** Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory = **05 marks. CCA Skill**: Project File or Dissertation Record + Seminar = **5 + 5 marks.**	

Instructions for Paper Setters and Candidates:

1. *Examiner will set seven questions in all covering the entire syllabus each of 10 marks.*
2. *The candidate will be required to attempt five questions in all .*
3. *The duration of the examination will be 3 hours.*

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode

Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **(4 Lectures)**

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metalsheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of differentdiameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnelusing metal sheet.

(10 Lectures)

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making

regulated power supply. Timer circuit, Electronic switch using transistor and relay.

(10 Lectures)

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motoraxel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys workingprinciple of power generation systems. Demonstration of pulley experiment.

(6 Lectures)

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

PHYSICS WORKSHOP SKILL LAB

Name of the Course	**PHYSICS WORKSHOP SKILL LAB** **(Credits: -02)**
Course Code	**PHYBM 202 PR**
Maintain Project file or Dissertation to check Analytic Skill/Problem solving in skill exam.	
Yearly Based Skill Examination	**20 marks (3 Hrs)**
Distribution of Marks: Hands on Skill Test = **15 Marks**, Viva Voce = **5 Marks**.	

1. To determine volume of a given cylindrical object using vernier calliper.
2. To determine thickness of torsional pendulum.
3. To determine the thickness of glass plate using spherometer.
4. To measure amplitude of time varuing signals.
5. To measure frequency of time varying signals.
6. To determine the moment of inertia of a sphere.
7. To determine the least count of sextant.

8. To determine height of a pole using Sextant.

ORGANIC CHEMISTRY

Name of the Course	**ORGANIC CHEMISTRY** **(Credits: Theory-04)**
Code	**PHYBM 203 TH**
Semester Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

Instructions for Paper Setters and Candidates:

*1. The question paper will consist of five sections A, B, C, D and E. Section A will be compulsory. Examiner will set nine questions in all, selecting two questions from section B, C, D and E of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each sectionincluding the compulsory question. The duration of the examination will be 3 hours.

Unit - I	**Fundamentals of Organic Chemistry:** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

	Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer projections. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(18 Hours)**
Unit - II	**Aliphatic Hydrocarbons:** **Alkanes:** (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti- Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes:** (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. **Reactions:** Formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$. **(12 Hours)**
Unit - III	**Aromatic hydrocarbons:** Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4carbons on benzene).

	Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. **Preparation**: from alkenes and alcohols. **Reactions:** hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation, Williamson's ether synthesis. Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. **Reactions (Chlorobenzene)**: Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **(15 Hours)**
Unit - IV	**Alcohols, Phenols and Ethers (Up to 5 Carbons):** **Alcohols:** Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. **Reactions:** With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. **Phenols:** (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer - Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI. **Aldehydes and ketones (aliphatic and aromatic):** (Formaldehye, acetaldehyde, acetone and benzaldehyde) **Preparation:** From acid chlorides and from nitriles. **Reactions:** Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. **(15 Hours)**

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India

Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
5. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

LAB COURSE

ORGANIC CHEMISTRY LAB

Course Code: PHYBM 203 PR

Credits – 2

Max Marks: 20 **TIME ALLOWED: 03 HOURS**

1) Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2) Separation of mixtures by Chromatography: Measure of R_f value of a mixture of two organic compounds.
3) Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional group (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative and melting point determinaton.

Reference Books:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical OrganicChemistry, Prentice-Hall, 5th edition, 1996.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Differential Equations

Name of the Course	**Differential Equations** **(Credits: Theory-06 L-5, T-1, P-0)** **Theory: 60 Lectures**
Code	**PHYBM 204**
Yearly Based Examination	**70 marks (3 Hrs)**
Continuous ComprehensiveAssessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

Instructions for Paper Setters and Candidates:

1. The question paper will consist of two Sections A & B of 70 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus.. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

2. Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Unit - I	First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations.
Unit - II	Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters.
Unit - III	The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations(PDE), Linear partial differential equation of first order, Lagrange's method.
Unit - IV	Charpit's method for solving PDE, Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended :

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.

Environment Science

Name of the Course	Environment Science (A.E.C. Course-II) (Credits: Theory-04)
Code	PHYBM 205
Semester Based Examination	100 marks (3 Hrs)

Instructions for Paper Setters and Candidates:

The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions of two marks each that will cover entire course will compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit - I	Introduction to environmental studies & Ecosystems: Multidisciplinary nature of environmental studies: Scope and importance; what is an ecosystem? :Structure and function of ecosystem, Energy flow in an ecosystem, food chains, food webs and ecological succession, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems; Levels of biological diversity: genetic, species and ecosystem diversity, Biogeographic zones of India, Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation, Endangered and endemic species of India, Threats to biodiversity, Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions, Conservation of biodiversity, In-situ and Ex-situ conservation of biodiversity, Concept of sustainability and sustainable development. **(15 Lectures)**
Unit - II	Natural Resources & its management and conservation: Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and overexploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. **(15 Lectures)**
Unit - III	Environmental Pollution & Management: Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Solid waste management: Control measures of urban and industrial waste- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD); Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. **(15 Lectures)**

Unit - IV	Environment & Social Issues: Human population growth: Impacts on environment, human health and welfare; Re-settlement and rehabilitation of project affected persons; ease studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; Environmental communication and public awareness, case studies. ***Dangers and III Effects of Drug Consumption*** Introduction- Definition of addiction, addict and Mode of action of drugs on body organs. Types of Drugs - Sedatives and tranquillizers, opiate narcotics, stimulants, Hallucinogens, Examples and their harmful effects. Reasons for drug addiction- Curiosity, peer pressure, frustration and depression, family history, prolonged use of drugs for pain relief. Ill effects of drug addiction - on the health of the victim, family and society. Rehabilitation of Drug Addicts- Role of family, friends, society and rehabilitation centres. **(15 Lectures)**

Suggested Readings:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt,
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India 's Himalaya dams. Science, 339: 36-37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. Singh, J. S., Singh, S. P. & Gupta, S. R. 2014. Ecology, Environment Science and Conservation. S. Chand Publishing New Delhi.

DETAILED SCHEME & SYLLABUS OF 3rd SEMESTER

Semester	Course Type	Course Code	Title of Paper	Credits	Max. Marks	Total Marks	Total Credits
3rd	Core Course-VII	PHYBM 301 TH	Wave Motion and Optics (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	30
		PHYBM 301 PR	Wave Motion and Optics (Lab.)	2	Lab. = 20		
	Core Course-VIII	PHYBM 302 TH	Elements of Modern Physics (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	
		PHYBM 302 PR	Elements of Modern Physics (Lab)	2	Lab. = 20		
	Open Elective -I	PHYBM 303	1. Optical Instruments 2. Elements of Astronomy and Astrophysics 3. Energy source 4. Climate science	4 (3 TH + 1 TUT)	Theory = 70 IA = 30	100	
	SEC-III	PHYBM 304	Computational Physics Skills	3 (TH + IA+ Seminar)	End Term = 70 IA = 30	100	
	A.E.C. Course-III	PHYBM 305	Soft Skills	3	Internal = 100	100	
	Value Added	PHYBM 306	Community Connect Based Course	8	MT=100, IA= 100, ET = 200	400	

B. Sc.-M. Sc. Physics Five Year Integrated Course
3rd Semester

Wave Motion and Optics

Name of the Course	**Wave Motion and Optics** **(Credits: Theory-04)Theory: 60 Lectures**
Code	**PHYBM 301 TH**
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory = **05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), section B (Unit I), section C (Unit II), section D (Unit III) and section E (Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in theblanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question fromeach sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit - I	**Waves:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation (derivation), Wave Equation – Differential form (derivation). Particle and Wave Velocities - Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). Brief account of Ripple and Gravity Waves. **Superposition of Harmonic Waves :** Linearity and superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular harmonic oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. **(15 Lectures)**

Unit - II	**Standing Waves :** Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gases (derivation). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. **Acoustics:** Absorption coefficient, Reverberation time - Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. **(15 Lectures)**
Unit - III	**Nature of light :** Corpuscular theory- laws of reflections and refraction; The Wave model, Group velocity & wave velocity - relation between them, Maxwell's electromagnetic waves. **Interference of light by division of wave front:** Coherent source-Interference of light waves by division of wave-front, Young's double slit interference- theory and experiment, Fresnel Biprism- theory and experiment (determination of wavelength). **Interference of light by division of amplitude:** Interference at thin films – reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Reflection). Determination of Refractive index of a liquid, Michelson Interferometer-Determination of wavelength of light **(15 Lectures)**
Unit - IV	**Fraunhofer diffraction:** Introduction- Fraunhofer diffraction- Theory of single slit diffraction, Two slit diffraction pattern, Theory of diffraction Grating, Normal and oblique incidence – experimental determination of wavelength, Resolving power – Rayleigh criterion, Expression for resolving power of grating and telescope **Fresnel Diffraction-** Concept of Fresnel half period zones, Comparison of Zone plate with lens, Theory of diffraction at a straight edge, Qualitative discussion on diffraction by a circular aperture and diffraction by an opaque disc **Polarisation:** Production of polarized light, Malus' law, Phenomenon of double refraction in crystals, Quarter wave plate and half wave plate, Optical activity, Laurent's half shade polarimeter **(15 Lectures)**

Text Books:

1 The Physics of Waves and Oscillations, N K Bajaj Tata McGraw-Hill Publishing Company Ltd., Second Edition, 1984.

2 Waves and Oscillations, N Subramanyam and Brij Lal, Vikas Publishing House Pvt. Ltd., Second Revised Edition, 2010.

3 A Text Book of Sound, D R Khanna and R S Bedi Atma Ram & Sons, Third Edition, 1952

4 Oscillations and Waves, Satya Prakash Pragathi Prakashan, Meerut, Second Edition, 2003

5 A Text Book of Optics, Brij Lal, M N Avadhanulu & N Subrahmanyam S. Chand Publishing, 2012

References Books

1 Optics, Ajoy Ghatak McGraw Hill Education (India) Pvt Ltd, 2017

LAB COURSE

Wave Motion and Optics (Lab)

Course Code: PHYBM 301 PR

Credits – 02

List of Experiments to be performed in Lab:

1. Velocity of sound through a wire using Sonometer.
2. Frequency of AC using Sonometer.
3. Study of Lissajous' Figures
4. To verify the laws of transverse vibration using Melde's apparatus.
5. Helmholtz resonator using tuning fork.
6. Helmholtz resonator using electrical signal generator.
7. Study of Lissajous figures using CRO
8. To determine refractive index of the material of a prism using sodium source.
9. To determine refractive index of a liquid by parallax method.
10. To determine the dispersive power and Cauchy constants of the material of a prism using Hg source.
11. To determine wavelength of sodium light using Fresnel Biprism.
12. Determination of radius of curvature of a lens using Newton's rings.
13. To determine the thickness of a paper using air-wedge.
14. Study of Fraunhofer diffraction at single slit
15. Study of Diffraction at a straight edge.
16. To determine wavelength of spectral lines of Hg source using plane diffraction grating.
17. To determine dispersive power and resolving power of a plane diffraction grating.
18. To verify Brewster's law.
19. To determine specific rotation of a solution using Polarimeter.

Note: A minimum of EIGHT experiments to be carried out.

Elements of Modern Physics

Name of the Course	**Elements of Modern Physics (Theory)** **(Credits: Theory-04)Theory: 60 Lectures**
Code	**PHYBM 302 TH**
Yearly Based Examination	**50 marks (3 Hrs)**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA Theory**: Midterm Exam = **10 marks,** Class Test/Seminar/Assignments/Quiz = **05 marks,** Attendance Theory = **05 marks. CCA Lab**: Lab Seminar + Lab Attendance = **5+5 marks.**	

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), section B (Unit I), section C (Unit II), section D (Unit III) and section E (Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 09 marks. Question Number 1. (Section A), will consist of seven sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in theblanks and/or short answer type questions.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question fromeach sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours.*

Unit - I	Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. **(15 Lectures)**
Unit - II	Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle. Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension. **(15 Lectures)**

Unit - III	One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. **(15 Lectures)**
Unit - IV	Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission. Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions. **(15 Lectures)**

Suggested Reading:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics:Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics,Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning
6. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

LAB COURSE

Elements of Modern Physics (Lab)

Course Code: PHYBM 302 PR

Credits – 02

List of Experiments to be performed in Lab:

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor & compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum

energy of photo-electrons versus frequency of light.
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.
11. Determination of Eg in Si and Ge.
12. Determination of Planck's constant using photocell.
13. Dependence of scattering angle on kinetic energy and impact parameter in Rutherford scattering (mechanical analogue).
14. Verification of Rutherford- Soddy nuclear decay formula - mechanical analogue.
15. To find half-life period of a given radio-active substance using GM counter/ Charterctisitcs of GM Counter.

Note: A minimum of EIGHT experiments to be carried out.

Suggested Reading:

1. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal
2. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

OPEN ELECTIVE COURSE

Course Code – PHYBM 303

(4 credits)

Instructions for Paper Setters and Candidates:

1. The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), section B (Unit I), section C (Unit II), section D (Unit III) and section E (Unit IV). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and IV respectively. Each question from section B, C, D and E will carry 12.5 marks. Question Number 1. (Section A), will consist of ten sub-questions each of 2 marks of types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and seven sub-questions from section A (Compulsory question number 1). The duration of the examination will be 3 hours

1. Optical Instruments

Unit - I	**Basics of Optics:** Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (No derivations; concepts to be discussed qualitatively). **(15 Lectures)**
Unit - II	**Camera and microscopes:** Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of (i) Simple microscopes (ii) Compound microscope (iii) Electron microscopes (iv) Binocular microscopes *Self study:* Experimental determination of magnifying power of a microscope. **(15 Lectures)**
Unit - III	**Telescopes:** Construction, working and utilities of (i) Astronomical telescopes (ii) Terrestrial telescopes (iii) Reflecting telescopes **(13 Lectures)**

Unit - IV	**Spectrometer:** Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer – Construction, working and utilities, measurement of refractive index. **(13 Lectures)**
	Activity for tutorial classes 01 lectures/week 1. Find position and size of the image in a magnifying glass and magnification 2. Observe rain bows and understand optics. Create a rainbow. 3. Find out what makes a camera to be of good quality. 4. Observe the dispersion of light through prism. 5. Make a simple telescope using magnifying glass and lenses. 6. Learn principle of refraction using prisms. 7. Check bending of light in different substances and find out what matters here. 8. Learn about different telescopes used to see galaxies and their ranges.

Reference Books:

1. Galen Duree. Optics for Dummies. Wiley. 2011.
2. Blaker J W. Optics: An Introduction for Students of Engineering. Pearson, 2015.
3. Hecht E. Optics. Pearson. 5th Edition, 2019.
4. Khurana A K. Theory And Practice Of Optics & Refraction. Elsevier India. 2016.

2. Elements of Astronomy & Astrophysics

Unit - I	**Ancient Astronomy:** Greek Observations, Sumerian Observations, Mayan Observations, Arabic Observations , Chinese Observations **Indian Astronomy:** Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara, Astronomy in Indian Scriptures, Precession of the Equinox, Celebrations of Equinox **Medieval & Modern Astronomy:** Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other, Modern Astronomy **(10 Lectures)**
Unit - II	**Optical Tools for Astronomy:** Pin Hole, Binoculars, Telescopes & Imaging (1 hour) Mathematical Methods of Observations: Angular Measurement, Trigonometric functions, Stellar Parallax **Observational Terminologies:** Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc. **(10 Lectures)**

Unit - III	**Observations of the Solar System** **The Sun:** Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots **The Moon:** Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names **Inner Planets:** Mercury & Venus - Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits. **Outer Planets:** Mars, Jupiter & Saturn - Observational History. Observational Windows, Appearance, Frequency of Oppositions, Conjunctions, Moons Eclipses. Galilean Moons, Saturn's Rings. **(13 Lectures)**
Unit - IV	**Major Astronomy Observations** **March to June:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. **June to September:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. **September to December:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. **December to March:** Prominent Stars and Constellations Visible during this period, Methods of Spotting. **(13 Lectures)**
	Activity for tutorial classes 01 lectures/week 1. Measuring Seasons using Sun's Position. 2. Measuring Distance using Parallax 3. Estimation of the Stellar Diameter using Pin Hole 4. Measuring Height of an Object Using Clinometer. 5. Star spotting using constellation maps 6. Constellation spotting using Skymaps 7. Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere. 8. Estimation of the Size of the Solar System in using Light Years. 9. Identification of Lunar Phases across a year. 10. Measuring Constellation of the Sun using Night Sky maps or Planispheres.

Reference Books:

1 The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelro

3. Energy Sources

Unit - I	**Introduction:** Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resouroes. **Conventional energy sources:** Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology. **(13 Lectures)**
Unit - II	**Renewable energy sources:** Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **Solar energy:** Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(13 Lectures)**
Unit - III	**Wind and Tidal Energy harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy. **(10 Lectures)**
Unit - IV	**Geothermal and hydro energy** Geothermal Resources, Geothermal Technologies. Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Carbon captured technologies, cell, batteries, power consumption. **(10 Lectures)**
	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India

	7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

4. Climate Science

Unit - I	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds. **(13 Lectures)**
Unit - II	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. **(10 Lectures)**
Unit - III	**Modelling of the atmosphere:** General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models.

	R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CS[illegible] Centre for Mathematical Modeling and Computer Simulation, and many more. **(10 Lectures)**
Unit - IV	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. *Causes for global warming:* Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering. **(13 Lectures)**
	Activity for tutorial classes 01 lectures/week 1. What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place. 4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).

Reference Books:

1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010.
2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.

COMPUTATIONAL PHYSICS SKILLS

Name of the Course	**PIIYSICS-SEC III: Computational Physics Skills (Credits: 03)** **45 Lectures**
Code	**PHYBM 304**
Semester Based Examination	**70 marks**
Continuous Comprehensive Assessment (CCA)	**30 marks**
CCA: Based on Midterm Exam, Class Test/Seminar/Assignments/Quiz and Attendance: **CCA report:** Midterm Exam = **15 marks,** Class Test/Seminar/Assignments/Quiz = **10 marks,** Attendance Theory = **05 marks.**	

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. • Highlights the use of computational methods to solve physical problems • Use of computer language as a tool in solving physics problems (applications) • Course will consist of hands on training on the Problem solving on Computers.

Note:

The students in the class will be divided in to groups. There will be regular teaching of the theoretical aspects along with the Practical training of the students in various skill Development Subjects. Students shall submit a report of nearly 20 pages about the work done (giving details, highlighting innovation and future prospectus) by the end-semester.

Projects/Jobs will be allocated to the students and will be evaluated by a Committee during (i) the midterm interaction with weightage 30 %, (ii) end-semester evaltion based on the presentation and project report, and innovation will be given extra credits.

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal. **(6 Lectures)**

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and

Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. **(8 Lectures)**

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1 **(10 Lectures)**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.

Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors. **(9 Lectures)**

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices.
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.

7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization. **(12 Lectures)**

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
5. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
6. Computational Physics: An Introduction, R. C. Verma et al. New Age International Publishers, New Delhi(1999)
7. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning 8. Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n . , 2 0 0 7 , Wiley India Edition.

SOFT SKILLS

Name of the Course	**PHYSICS-AEC III: Soft Skills (Credits: 03)**
Code	**PHYBM 305**

After the successful completion of the course, students will learn:

- the dynamics of effective and professional communication skills and put them into daily use
- to write a Professional resume using creative methods of online platforms
- the dynamics of interview skills and GD preparations and presentations in public platforms and present the best of themselves as job seekers
- to understand, analyze and express their personality styles and personal effectiveness in various environments
- to learn and update themselves with the required knowledge in Numerical ability and Test of Reasoning for competitive examinations

Module 1: Effective Communication & Professional communication

Effective communication: Definition of communication, Process of Communication, Barriers

of Communication, Non-verbal Communication. JOHARI Window as a tool of effective communication.

Professional Communication: The Art of Listening, The passage, Kinesthetic, Production of Speech, Speech writing , Organization of Speech, Modes of delivery, Conversation Techniques, Good manners and Etiquettes, Different kinds of Etiquettes, Politeness markers.

Module II. Resume Writing & Interview Skills

Resume Writing: Meaning and Purpose. Resume Formats. Types of s Resume. Functional and Mixed Resume, Steps in preparation of Resume, Model resumes for an IT professional Chronological, Types of interviews, Creative resumes using online platforms

Interview Skills: Common interview questions, Dos and Don'ts for an interview, Attitude, Emotions, Measurement, Body Language, Facial expressions, Different types of interviews, Telephonic interviews, Behavioral interviews and Mock interviews (Centralized).

Module III: Group Discussion & Team Building

Group Discussion: Group Discussion Basics, GD as the first criterion for selecting software testers, Essentials of GD, Factors that matter in GD, GD parameters for evaluation, Points for GD Topics, GD Topics for Practice, Tips for GD participation. Video shooting of GD presentation & Evaluation (Centralized)

Team Building: Characteristics of a team, Guidelines for effective team membership, Pedagogy of team building, Team building skills. Team Vs Group – synergy, Types of synergy, Synergy relates to leadership ,Stages of Team Formation, Broken Square-Exercise, Leadership, Leadership styles, Conflict styles, Conflict management strategies & Exercises

Module IV: Personal Effectiveness

Personal Effectiveness: Self Discovery: Personality, Characteristics of personality, kinds of self, Personality inventory table, measuring personality, intelligence and Exercises

Self Esteem: Types -High & Low self esteem, Ways of proving self esteem, Hypersensitive to criticism, activities. Goal setting: Goal setting process, Decision making process & Exercises.

Stress Management: Identifying stress, Symptoms of stress, Responding to Stress, Sources of stress, Coping with stress and Managing stress.

Module V: Numerical Ability

Average, Percentage, Profit and Loss, Problems of ages, Simple Interest, Compound Interest, Area, Volume and Surface Area, Illustration, Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Illustrations, Boats and Streams, Calendars and Clocks.

Module VI: Test of Reasoning

Verbal Reasoning: Number series, letter series, coding and decoding, logical sequence of words, Assertion and Reasoning, Data Sufficiency, Analogy, Kinds of relationships.

Non-Verbal Reasoning: Completion of Series, Classification, analogical, Pattern comparison, Deduction of figures out of series, Mirror Reflection Pattern, Hidden figures, Rotation pattern, Pattern completion and comparison, Sense of direction, Blood relations.

Reference books:

- Melchias G, Balaiah John, John Love Joy (Eds), 2018. Winners in the Making: A primer on soft skills. SJC, Trichy.
- Aggarwal, R.S. Quantitative Aptitude, S.Chand & Sons.
- Aggarwal, R.S. (2010). A Modern Approach to Verbal and Non Verbal Reasoning. S.Chand & C0,Revised Edition.
- Covey, Stephen. (2004). 7 Habits of Highly effective people, Free Press.
- Egan, Gerard. (1994). The Skilled Helper (5th Ed). Pacific Grove, Brooks/Cole.
- Khera ,Shiv (2003). You Can Win. Macmillan Books , Revised Edition.

COMMUNITY CONNECT BASED COURSE

Name of the Course	**Community Connect Based Course (Credits: 08)**
Code	**PHYBM 306**

Under Unnat Bharat Abhiyan, to actively engage students, one 8 credit elective open course has been proposed for B.Sc. student to be taken in 3rd Semester. This course shall encourage young minds to explore the creative ideas to contribute for sustainable development of rural India. Under this course the students have to take individual projects or a collaborative group under the supervision of faculty member/s from department.

The projects should be around physics discipline such as mentioned below:

1. Awareness on efficient energy usage.
2. Awareness on energy harvesting techniques such as electricity using solar/wind/water energy.
3. Energy storage devices and their usage for common public.
4. Awareness on E-Waste and its management.
5. Innovative projects which ease day to day life of people.
6. Making audio-visual demonstrations for awareness on various areas.
7. Practicing innovative methods of teaching physics concepts to school students.
8. Awareness on technologies such as remote sensing, weather forecast etc. and their usage for common public.

The duration of the project will be for one semester (3rd Semester), during which student have to work on any of the identified problem. The project should be directly concerned with community.

Identifying the problem

Students can identify a problem based upon following:

1. Day to day observations of community around their living place.

2. One of the government schemes for welfare of community.
3. Some creative idea/device/model which may be useful for community.

Literature Review

Once the problem is identified, student should do a systematic literature review in first month and should submit the report of the same to the faculty supervisor. Under literature review, student should explore the available view points, options and schemes related to the stated problem. At the end of the literature review various aspects of the choice of the project and plan of execution of the project should be clearly defined.

Scope for implementation

The student should explore possibilities of implementation of available options in reference to the problem identified on the basis of community chosen. The amendments can be suggested for optima impact of the schemes/model.

Coordination with local representatives

The students with the help of community connect cell and faculty supervisor shall arrange for public interactions where he/she can educate people on the project, its importance in their life and benefits that can be extracted from the solutions proposed.

Final report

At the end of the semester, student shall submit a consolidated report of the project to the department. The report can include a short movie of the whole project including statement, importance and benefits of the project.

Financial implications

As the project is associated with community welfare and may involve financial liabilities such as visiting the field areas, preparing some experimental demonstration etc. To avail financial support from department, student has to submit a proposal to the department, which will be screened by a departmental committee. Based upon recommendations of the screening committee full financial assistance may be provided to the student for pursuing the project.

Evaluation

The overall course will be for 400 marks (8 credits) divided as follows.

Midterm exam (100M)

The midterm exam will be for 100 marks. In midterm exam student has to present progress of his work before departmental committee. In presentation the student should clearly state:

- Objectives of the project
- Community survey and identification of target community
- Plan of action with methodology of study
- Timeline for execution of the project

End term Exam (200M)

The final exam shall be of 200 marks in which student have to submit overall report and presentation before committee of examiners (including external examiner). Out of total 200 marks for end term marks, final report shall be of 100 marks, presentation for 50 marks and

assessment of overall impact of the project for 50 marks.

Internal Assessment (100M)

The internal assessment shall be for 100 marks and shall be accessed by concerned supervising faculty. The marks can be split into following categories:

- Attendance (in terms of number of hours spent in community): 25 Marks
- Number of presentations made before supervisor: 25 Marks
- Analysis of outcome: 25 Marks
- Community feedback: 25 Marks

Attendance

- Student have to maintain minimum attendance of 75%.

DETAILED SCHEME & SYLLABUS OF 4th SEMESTER

Semester	Course Type	Course Code	Title of Paper	Credits	Max. Marks	Total Marks	Total Credits
4th	Core Course-IX	PHYBM 401 TH	Thermal Physics & Electronics (Theory)	4 (TH + IA)	Theory = 50 IA = 30	100	24
		PHYBM 401 PR	Thermal Physics & Electronics (Lab)	2	Lab. = 20		
	Core Course-X	PHYBM 402	Analog Systems & Applications	4 (TH + IA)	Theory = 70 IA = 30	100	
	Open Elective-II	PHYBM 403	1. Medical Physics 2. Nanotechnology 3. Electrical Instruments	4 (TH + TUT)	Theory = 70 IA = 30	100	
	SEC-IV	PHYBM 404 TH	Basic Instrumentation Skills (Theory)	2(TH + IA + Seminar)	Theory = 50 IA = 30	100	
		PHYBM 404 PR	Basic Instrumentation Skills (Lab)	2	Lab = 20		
		PHYBM 405 TH	Computer Programming	2 (TH + IA)	Theory = 50 IA = 30	100	
		PHYBM 405 PR	Computer Programming Laboratory	2	Lab = 20		
	Value added	PHYBM 406	Yoga and Meditation	2	Internal =100	100	