DEPARTMENT OF PHYSICS

Learning Outcomes Based Curriculum
Int. B.Sc. B.Ed. (PHYSICS MAJOR) PROGRAMME

Preamble:

Integrated B.Sc B.Ed in Physics is a four year dual degree program which is designed to train young, bright and enthusiastic students in Physics and Education at Tezpur University. The candidates who have completed Class XII (or equivalent) from a recognized secondery education board with at least 60% (CGPA), are eligible to apply for this program. On successful completion of this program, the students will be awarded Integrated Bachelor of Science and Bachelor of Education degree in Physics from Tezpur University. Award of the Integrated B.Sc. B.Ed. in Physics degree shall be in accordance with the academic regulations of the university on the requirements of the given program. An admission test is usually adopted as qualifying criteria for short-listing and selection for all the categories.

1. Introduction:

The Integrated B.Sc B.Ed in Physics program will have courses that cover undergraduate level fundamental and advanced topics in Physics. In addition to that, the students will also have courses on Education and teching methodology. It aims at training the students to be efficiently capable in working in academics, and other frontiers in science and technology. The course includes theoretical and experimental courses as well as teaching internship. This program also includes basics of Chemistry, Mathematics, Biology and Communicative English. At the completion of the course, the students will have qualifiying degree for a post graduate course in Physics and other relevant subjects . Total credits to be completed in this program is 180.

2. Qualification descriptors for the graduates:

Knowledge & Understanding

(i) In-depth comprehensive knowledge on the fundamentals of Physics.

(ii) Understanding on theoretical postulates and principles.

(iii) Understanding of experimental findings and measurements.

Skills & Techniques

(i) Teaching skills

(ii) Problem solving skills

(iii) Computational skills

Competence

(i) Team work

(ii) Moral and ethical awareness

(iii) Social competence

3. Graduates Attributes:

(i) In-depth knowledge and understanding of major concepts: Understanding on theoretical principles and experimental findings in different sub-areas in Physics as well as related interdisciplinary fields.

(ii) Critical thinking: The capability of using aritical thinking in the different fundamental areas of Physics.

(iii) Analytical ability: The capability for analyzing and brainstorming on issues and problems in the field of Physics.

(iv) Problem solving skills: The ability towards solving problems in the various basic areas of Physics.

(v) Application of modern tools: The ability of handling/using different modern tools and techniques relevant for the areas in physical sciences.

(vi) Communication skills: The capability to transfer complicated/technical information on Physics in a clear, easy and precise manner in oral discussions and in writing.

(vii) Mutual and multidisciplinary competence: The ability of team work as well as working in interdisciplinary topics.

(viii) Teaching skills: The ability of classroom teaching.

(ix) Life long learning: The ability of self-directed learning aimed at brushing up personal skills and knowledge.

(x) Digital literacy: The ability of using modern search engines and tools for gathering up to date information on Physics. Also the ability of doing numerical analysis and simulation using a computer.

(xi) Moral and ethical awareness: Ability of avoiding any unethical behaviour like plagiarism, falsification or misrepresentation or manipulation of data etc.

(xii) Social responsibility: The ability of being a responsible citizen.

4. Program Outcomes:

1. Graduate has acquired the knowledge with facts and figures related to various subjects in pure sciences such as Physics, Chemistry, Mathematics, Biosciences, etc.
2. Graduate has learnt the art of teaching and acquired the ability to deal with the students based on their individual differences in various classroom situations.
3. Graduate has been able to understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena.
4. Graduate has acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.
5. Graduate has been able to think creatively in explaining facts and figures or providing solutions to the problems.
6. Graduate has developed various communication skills such as reading, listening and speaking, which help in expressing ideas and views clearly and effectively.

5. Programme structure

Total Credits: 180

Structure of the curriculum

Course category		No of courses	Credits per course	Total Credits
I.	Core courses (Theory)	37	3	111
	Core courses (Theory)	3	4	12
	Core courses (Theory)	2	2	4
	Core courses (Practical)	4	3	12
	Core courses (Practical)	4	4	16
	Core courses (Internship)	1	16	16
II.	Elective courses (Dept.)	1	3	3
III.	Elective courses (Open)	2	3	6
	Total credits:			**180**

6. SEMESTER-WISE SCHEDULE

SEMESTER I

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 101: Physics-I (non-major)	2	1	0	3	3
	PD 103: General Physics-I	2	1	0	3	3
	CD 101: Chemistry-I	2	1	0	3	3
	MD 101: Mathematics-I	2	1	0	3	3
	PD 197: Physics Lab –I	0	0	3	6	3
	ED 106: Education: An Evolutionary Perspective	2	0	1	4	3
	ED 104: Communicative English	3	0	0	3	3
	ED 105: Basics in Computer Applications	2	0	1	4	3

SEMESTER II

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 102: Physics-II (non-major)	2	1	0	3	3
	PD 104: General Physics-II	2	1	0	3	3
	CD 102: Chemistry-II	2	1	0	3	3
	MD 102: Mathematics-II	2	1	0	3	3
	PD 198: Physics Lab-II	0	0	3	6	3
	CD 107: Chemistry Lab-I	0	0	3	6	3
	ES 103: Environmental Studies	4	0	0	4	4
	ED 107: Education and Development	2	0	1	3	3
	NS 106: National Service Scheme	0	0	2	4	2

SEMESTER III

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 201: Physics III (non-major)	2	1	0	3	3
	PD 203: Classical Mechanics	2	1	0	3	3
	PD 217: Mathematical Physics-I	2	1	0	3	3

	CD 201: Chemistry III	3	0	0	3	3
	MD 219: Mathematics III	2	1	0	3	3
	PD 297: Physics Lab-III	0	0	4	8	4
	ED 205: Environmental Education	2	0	1	4	3
	ED 202: Learner and Learning	2	0	1	4	3
Elective	Open Elective-I	2	0	1	3	3

SEMESTER IV

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core Elective	PD 205: Electromagnetism	2	1	0	3	3
	PD 214: Electronics	2	1	0	3	3
	PD 216:Thermodynamics and Statistical Physics	2	1	0	3	3
	PD 218: Modern Physics	2	1	0	3	3
	PD 298: Physics Lab-IV	0	0	4	8	4
	ED 203: Contemporary Issues in Education	2	0	1	4	3
	ED 204: Assessment and Evaluation	2	0	1	4	3

SEMESTER V

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 303: Physical and Geometrical Optics	2	1	0	3	3
	PD 202: Introductory QM	2	1	0	3	3
	PD 315: Mathematical Physics II	2	0	1	3	3
	PD 309: Analog Electronics and communications	2	1	0	3	3
	PD 204: Atomic and Nuclear Physics	2	0	1	3	3
	ED 301: Teaching Approaches and Strategies	2	0	1	4	3
	ED 302: Classroom Organization and Management	2	0	1	4	3
	PD 399: Physics Lab-V	0	0	3	6	3

SEMESTER VI

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 307: Basic Material Science	2	1	0	3	3

	PD 317: Basic Computation Techniques	2	1	0	3	3
	PD 311: Waves and Accoustics	2	1	0	3	3
	ED 308: Pedagogy A: Physical Science I	2	0	1	4	3
	ED 307: Pedagogy B: Mathematics I Or ED 309: Pedagogy B: Bio Science I	2	0	1	4	3
	ED 303: School Education in NE India	2	0	0	2	2
	PD 300: Physics Lab-VI	0	0	4	8	4
Elective	Elective I	2	1	0	3	3

List of elective papers:

1. PD 220: Renewable Energy
2. PD 221: Nanomaterial Fundamentals and application
3. PD 222: Earth Science

SEMESTER VII

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	ED 408: Pedagogy A: Physical Science II	2	0	1	4	3
	ED 407: Pedagogy B: Mathematics II or ED 409: Pedagogy B: Bio Science II	2	0	1	4	3
	ED 404: Initial School Experience/School Internship-I	0	0	4	8	4
	PD 308: Laser Physics	2	1	0	3	3
	PD 400: Physics Lab-VII	0	0	4	8	4
Elective	Open Elective-II	2	0	1	3	3

SEMESTER VIII

Course type	Course title	Lecture (L)	Tutorial (T)	Practical (P)	Contact Hour(CH)	Credits
Core	PD 314: Measurement Physics	2	1	0	3	3
	ED 405: School Internship-II	0	0	15	30	16

7. Mapping of course with program outcomes (POs)

Course Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
PD 101: Physics I	×		×			
PD 103: General Physics I	×		×			
PD 197: Physics Lab I				×		
PD 102: Physics II	×		×			
PD 104: General Physics II	×		×			
PD 198: Physics Lab II				×		
CD 101: Chemistry-I	×		×			
MD 101: Mathematics-I	×		×			
ED 106: Education: An Evolutionary Perspective		×				
ED 104: Communicative English						×
ED 105: Basics in Computer Applications					×	
CD 102: Chemistry-II	×		×			
MD 102: Mathematics-II	×		×			
CD 107: Chemistry Lab-I				×		
ES 103: Environmental Studies	×		×			
ED 107: Education and Development		×				
NS 106: National Service Scheme						×
PD 201: Physics III			×		×	
PD 203 : Classical Mechanics			×		×	
PD 217: Mathematical Physics I			×		×	
PD 297: Physics Lab III				×		
PD 205: Electromagnetism			×		×	
PD 214: Electronics			×		×	
PD 325: Thermodynamics and Statistical Physics			×		×	
PD 218 :Modern Physics			×		×	
PD 298: Physics Lab-IV				×		
CD 201: Chemistry III	×		×			
MD 219: Mathematics III	×		×			
ED 205: Environmental Education	×					

ED 202: Learner and Learning		×				
XXXX : Open Elective-I	×					×
ED 203: Contemporary Issues in Education		×				
ED 204: Assessment and Evaluation		×				
PD 303: Physical and Geometrical Optics			×		×	
PD 202: Introductory QM			×		×	
PD 315: Mathematical Physics II			×		×	
PD 309: Analog Electronics and communications			×		×	
PD 204: Atomic and Nuclear Physics			×		×	
PD 399: Physics Lab-V				×		
ED 301: Teaching Approaches and Strategies		×				×
ED 302: Classroom Organization and Management		×				×
PD 307: Basic Material Science			×		×	
PD 317: Basic Computation Techniques			×		×	
PD 311: Waves and Accoustics			×		×	
PD 300: Project cum Physics Lab-VI				×		
ED 308: Pedagogy A: Physical Science I		×			×	
ED 307: Pedagogy B: Mathematics I Or ED 309: Pedagogy B: Bio Science I		×			×	
ED 303: School Education in NE India		×				
XXX: Elective I	×					
PD 308: Laser Physics			×		×	
PD 399: Physics Lab-V				×		
PD 314: Measurement Physics			×		×	
ED 408: Pedagogy A: Physical Science II		×			×	
ED 407: Pedagogy B: Mathematics II or ED 409: Pedagogy B: Bio Science II		×			×	
ED 404: Initial School Experience/School Internship-I		×				×
ED 405: School Internship-II		×				×
XXXX: Open Elective-II						

8. Evaluation plan:

Students at Tezpur University shall be evaluated separately in each Course through a Continuous Comprehensive Evaluation (CCE) system. The CCE system shall involve both formative and summative assessments, where students shall be evaluated through a number of smaller components (Sessional Tests and Examinations) spanning over a Semester and finally the students shall be awarded with Grades at the end of the Semester by summing up the performances in all those Sessional Tests and Examinations.

8.1 Evaluation of Theory Courses:

There shall be minimum two Sessional Tests and two Examinations for each Theory Course as detailed in Table 8.1 including their nomenclature, type, maximum marks, duration, and period.

Table 8.1: Evaluation system for Theory Courses

Sessional Test/ Examination		**Course credit≤2**		**Course credit≤3**		**Semester period**	**Calendar period**	
Nomenclature	**Type**	**Marks**	**Duration**	**Marks**	**Duration**		**Spring**	**Autumn**
Sessional Test-I	Written	20	30 min	25	45 min	Within 5th week	Within 3rd week of Feb.	Within 1st week of Sept.
Mid-Semester Examination	Written	30	90 min	40	2 hours	Within 10th week	Within 3rd week of Mar.	Within 1st week of Oct.
Sessional Test-II	Written/ Quiz/ Assignment/ Seminar/ Field visit etc.	20	xx*	25	xx*	Within 14th week	Within 3rd week of Apr.	Within 1st week of Nov.
End-Semester Examination	Written	50	2 hours	60	3 hours	Within 18th week	Within 3rd week of May.	Within 1st week of Dec.

* Duration shall be decided by the Course Instructor(s) based upon the type adopted for evaluation.

Course coverage in a Theory Course shall preferably be as follows:

(a) Sessional Test-I : From the beginning up to the Sessional Test-I.
(b) Mid-Semester Examination: From the beginning up to the Mid-Semester Examination.
(c) Sessional Test-II: From the Mid-Semester Examination up to the Sessional Test-II.
(d) End-Semester Examination: Questions for not more than 20% of the total marks may be asked from the portion of the syllabus covered prior to the Mid-Semester Examination. The rest of the marks shall be devoted to the syllabus covered after the Mid-Semester Examination.

8.2 Evaluation of Practical Courses

There shall be two Examinations for a Practical Course if having L-T-P structure of 0-0-z (i.e., having Practical component only), otherwise only one Examination if having L-T-P structure of x-0-z or x-y-z (i.e., having Lecture and/or Tutorial components also) as detailed in Table 8.2.

Table 8.2: Evaluation system for Practical Courses

Examination		**L-T-P structure-wise Marks**		**Semester period**
Nomenclature	**Type**	**L-T-P: 0-0-z**	**L-T-P: x-y-z**	
Mid-Semester (Practical) Examination	Viva, Report	30	---	Before Mid-Semester Examination as stated in Table 4.1

End-Semester (Practical) Examination	Practical examination, Viva, Report	70	50	Before End-Semester Examination as stated in Table 4.1

End-Semester (Practical) Examination shall cover the entire Practical component of a Course starting from the beginning.
If desirable, a Course Instructor may add more evaluation components in both Mid-Semester (Practical) and End-Semester (Practical) Examinations.

8.3 Evaluation of Project Courses

There shall be two Examinations for a Project Course if not having any other Lecture/ Tutorial/Practical based Course to study along with the Project Course in the concerned Semester, otherwise only one Examination as detailed in Table 8.3.

Table 8.3: Evaluation system for Project Courses

Examination		**Course(s) to be studied in the concerned Semester**		**Semester period**
Nomenclature	**Type**	**Project Course only**	**Project Course along with other Courses**	
Mid-Semester (Project) Examination	Presentation, Viva, Progress Report	25	--	Before Mid-Semester Examination as stated in Table 4.1
End-Semester (Project) Examination	Presentation, Viva, Dissertation	75	100	Before End-Semester Examination as stated in Table 4.1

8.4 Letter Grade and Grade Point

Table 8.4: Letter Grades and Grade Points

Letter Grade	Grade Point	Description
O	10	Outstanding
A+	9	Excellent
A	8	Very good
B+	7	Good
B	6	Above average
C	5	Average
P	4	Pass
F	0	Fail

Table 8.5: Additional Letter Grades

Letter Grade	Type of Course	Status	Reason	Grade Point
W	Theory/ Practical Course	Withdrawn	Course is withdrawn due to any reason	0
X	Project Course	Continued/ Incomplete	Course is spanned over the next Semester or the project work remains incomplete	-
I	Any	Incomplete	Appearing in the End-Semester Examination of the	-

			Course remains pending	

For more detail please visit:

http://www.tezu.ernet.in/academic/2020/February/Academic_Regulation.pdf

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9. DETAILED SYLLABUS

Semester-I

PD 101: PHYSICS-I **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to understand the basics of vectors and matrices, introductory mechanics and properties of matter.
CO2: The students will learn the detail of the coordinate systems: plane polarized, cylindrical and spherical; along with various vector and scalar properties.
CO3: The students will be able to extensively use vectors and matrices in solving various problems in an intended learning outcome.
CO4: The students are also expected to understand the basic mechanics in both inertial and non-inertial frames, motion under a central force and the mechanics of a system of particles.

Course Content:

Coordinates, Vectors and Matrices:
Coordinate systems, plane polar, cylindrical and spherical polar; line element, surface element and volume element; gradient, divergent and curl.
Line, surface and volume integrals.

Properties of matrices; complex conjugate matrix, transpose matrix, hermitian matrix, unit matrix, diagonal matrix, adjoint of a matrix, self-adjoint matrix, cofactor matrix, symmetric matrix, anti-symmetric matrix, unitary matrix, orthogonal matrix, trace of a matrix, inverse matrix, eigenvalue, diagonalization of matrices.

Mechanics:
Work-energy theorem, conservative forces and potential energy; energy diagram; non-conservative forces; motion in non-inertial frames; uniformly rotating frame; centrifugal and Coriolis forces.

Motion under a central force.

System of particles; centre of mass, equation of motion of the centre of mass; laboratory and centre of mass frame of references; elastic and inelastic collisions; linear and angular momentum and their conservation laws; fixed axis rotation; moment of inertia; theorem of parallel and perpendicular axes; compound pendulum, Kater's and bar pendulum.

Properties of Matter:
Elasticity; elastic constants; Hooke's law; torsional oscillation; bending of a beam; cantilever; surface tension; viscosity; kinematics of moving fluids.

Text Books:
1. Potter M. C., Goldberg J., *Mathematical methods*, 2nd edition (Phi Learning Pvt. Ltd., 2008).
2. Kleppner, D. and Kolenkow, R., *Introduction to Mechanics*, (McGraw-Hill, 1973).

Suggested Readings:
1. Harper C., *Introduction to Mathematical Physics*, 1st edition *(*Phi Learning Pvt. Ltd., 2008).
2. Chow, T. L., *Mathematical Methods for Physicists: A concise introduction*, 1st edition (Cambridge Univ. Press, 2000).
3. Takwale R., Puranik P., *Introduction to Classical Mechanics*, (McGraw Hill, 2017).
4. Young, H. D. and Freedman, R. A., *University Physics*, 12th edition (Pearson, 2009).
5. Spiegel M., *Vector Analysis: Schaum's Outlines Series*, 2nd edition (McGraw Hill, 2017).
6. Mathur, D. S., *Mechanics*, (S. Chand & Co. Ltd., 2000).

PD 197: Physics Lab –I **(L0-T0-P3-CH6-CR3)**

Course Outcomes:

CO1: The students will be able to use the different components and equipment in physics practical.
CO2: The students will also able to work effectively and safely in the laboratory environment independently and as well as in teams.

Course Contents:

1. Laboratory related components:
    a. Laboratory safety measures; handling of chemical; electrical and electronics items and instruments; handling of laser and laser related instruments and experiments; handling of radioactive samples and related instruments; general safety measures etc.
2. Familiarization with equipment and components:
    a. Familiarization of different Electrical and Electronics components and hence identification & determination of values of unknown components
    b. Familiarization of different optical and hence show different optical behavior & pattern by using different optical components and optical sources (white light, laser, sodium light etc.)
    c. Familiarization of Microsoft excel, Origin and other software for data analysis
    d. Soldering and de-soldering of components in a circuit board.

3. Use of equipment:
    a. Multimeter and its uses
    b. Function generator and its uses
    c. CRO and its use to measure the wavelength, frequency, amplitude etc. of a given electrical signal.
4. Study the variation of time period with distance between center of gravity and center of suspension for a bar pendulum and,
    a. determine
        a) radius of gyration of the bar about its axis through its center of gravity and perpendicular to its length and,

b) value of g

5. Determine the moment of a given magnet and horizontal component of Earth's magnetic field using magnetometers
6. Determine g through Kater's Pendulum
7. Find the refractive index of a given prism with the help of a spectrometer.
8. To determine the surface tension of the given liquid (water/CC14) by capillary tube method.
9. To measure the focal length of a given lens using (a) Bessel's method and (b)Magnification method.
10. To study elastic and inelastic collisions using suspended spherical balls of different materials.
11. Determination of Young's modulus of the given wire by torsional oscillation (Searl's method)

PD 103: General Physics I **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students are expected to get introductory ideas of Mechanics, Properties of Matter and Mathematical Physics.
CO2: The students will get an overview of the work, energy and force; systems of particles; rigid body dynamics and basic properties of matter.
CO3: The students are expected to learn about various coordinate systems; Line, surface and volume integrals with physical examples; properties of matrices and differential equations.

Course Content:

Introductory Mechanics and Properties of Matter:

Work, Energy and Force: Work-energy theorem, conservative forces and potential energy, energy diagram, non-conservative forces, motion in non-inertial frames, uniformly rotating frame, centrifugal and introductory concept of Coriolis forces.

System of particles: Centre of mass, equation of motion of the centre of mass, laboratory and centre of mass frame of references, Elastic and inelastic collisions, linear and angular momentum and their conservation laws.

Rigid body dynamics: Fixed axis rotation, moment of inertia, theorem of parallel and perpendicular axes, calculation of moment of inertia for bodies of different shapes, compound pendulum, Kater's and bar pendulum, calculation of the acceleration due to gravity.

Properties of matter: Elasticity, elastic constants, Hooke's law, torsional oscillation, bending of a beam, cantilever, surface tension, viscosity, kinematics of moving fluids.

Introductory Mathematical Physics:

Coordinate systems: plane polar, cylindrical, spherical polar, line element, surface element and volume element in different coordinate systems, gradient, divergent and curl.

Integrals: Line, surface and volume integrals with physical examples.

Properties of matrices: complex conjugate matrix, transpose matrix, hermitian matrix, unit matrix, diagonal matrix, adjoint of a matrix, self-adjoint matrix, cofactor matrix, symmetric matrix, anti-symmetric matrix, unitary matrix, orthogonal matrix, trace of a matrix, inverse matrix, eigenvalue and diagonalization of matrices.

Differential equations: Ordinary differential equations and their solutions.

Text Books:

1. Kleppner, D. and Kolenkow, R., Introduction to Mechanics, (McGraw-Hill Book Co., Inc, 1973)
2. Potter M. C., Goldberg J., *Mathematical methods*, 2nd edition (Phi Learning Pvt. Ltd-New Delhi, 2008)

Suggested Readings:

1. Takwale R., Puranik P., *Introduction to Classical Mechanics*, (McGraw Hill Education 2017)
2. Young, H. D. and Freedman, R. A., University Physics, 12th edition (Pearson, 2009)

3. Harper C., *Introduction to Mathematical Physics*, 1st edition *(*Phi Learning Pvt. Ltd-New Delhi, 2008)
4. Chow, T. L., *Mathematical Methods for Physicists: A concise introduction*, 1st edition (Cambridge Univ. Press, 2000)
5. Mathur, D. S., Mechanics, (S Chand & Co Ltd, 2000).
6. Spiegel M., *Vector Analysis: Schaum's Outlines Series*, 2nd edition (McGraw Hill Education, 2017)

CD 101: Chemistry-I (L3-T0-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be able to understand atomic theory and its evolution.
CO2: The students will be able to understand periodic propertied of elements
CO3: The students will be able to understand basic of organic molecules, structure, bonding and organic reaction mechanisms.
CO4: The students will be able to understand synthesis of hydrocarbons.
CO5: The students will be able to understand basics of Chemical thermodynamics and thermodynamic laws.
CO6: The students will be able to understand fundamentals of solutions and colligative properties.

Course Content:

Structure of atom, Hund's rule, Aufbau principle, Pauli's exclusion principle.

Periodic Properties: Periodicity of the elements, shielding, effective nuclear charge, Slater's rule, the size of the atoms, atomic, covalent and van der Waals radii, ionization energy, electron affinity, electronegativity.
Basics of organic chemistry-1: Bonding, structure and physical properties of organic compounds: Valence bond theory: Concept of hybridization oforganic compounds and shapes of molecules; MO theory: Acyclicπorbital system and cyclic πorbital systems;
Physical properties: Melting point, boiling point, solubility, dipole moment.

Basics of organic chemistry-2: Electronic and steric effects: Inductive effect, resonance, hyperconjugation, steric effect, steric inhibition of resonance.
Basics of organic chemistry-3: Thermodynamics and kinetics of organic reactions:

Free energy and equilibrium, enthalpy and entropy factor, intermolecular & intramolecular reactions, rate constant and free energy of activation, free energy profiles for one step and multi-step reactions, catalyzed reactions, kinetic control and thermodynamic control, kinetic isotopic effect, principle of microscopic reversibility, Hammondpostulate.
Alkanes: Synthesis by: Decarboxylation, reduction of alkyl halides and tosylates, Kolbe electrolysis, Wurtz reaction, Corey–House synthesis; Reactions of alkanes: Halogenation, nitration, sulphonation, oxidation and cracking of alkanes.
Alkenesand alkynes: Synthesis, Dehydration of alcohols, pyrolysis of esters, Cope reaction, Elimination of alkyl halides, germinal-and vicinal dihalides, Hofmann elimination; Reactions: Addition of X2(X = halogen), H-X, HO-X, interhalogens, water, Oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, catalytic reduction, dihydroxylation, epoxidation, polymerization, alkylation of alkynes, oxidation of alkynes to 1,2-diketones, allylic and benzylic halogenation of alkenes mediated by radicals.
First Law of Thermodynamics: Thermodynamics terms, state and path functions, concept of heat and work, internal energy, enthalpy, first law of thermodynamics; w, q, U and H for expansion and compression of ideal gases, heat capacities, physical change, standard enthalpies of physical and chemical changes, Hess's law, Kirchhoff's law.
Second Law of Thermodynamics: Spontaneous processes, Carnot cycle, entropy, criteria of spontaneity, statements of the second law of thermodynamics, entropy changes, Clausius inequality, Gibbs energy, Helmholtz energy, Third law of thermodynamics.
Solutions: Ideal and non-ideal solutions, Colligative properties.

Text Books:

1. Lee, J. D., *Concise Inorganic Chemistry*, 5th Edn., Chapman & Hall, 2002.
2. Atkins, P. and Paula, J., de. *Atkins' Physical Chemistry*, 10thEdn., Oxford University Press, 2014.
3. Clayden, J., Greeves, N., Warren, S., Wothers, P. *Organic Chemistry*, 2nd Edn., Oxford University Press, 2012.
4. Finar, I. L., *Organic Chemistry,*Volume 1, 6th Edn., Pearson Education, 2002.

Reference Books:

1. Levine, I. N., *Physical Chemistry*, 6th Edn., McGraw Higher Edn., 2008.
2. Carey, F. A., Sundberg, R. J., *Advanced Organic Chemistry, Part A: Structure and Mechanisms*,5th Edn., Springer, New York, 2007.
3. March, J., Smith, M. B., *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, 6th Edn., Wiley, 2007.

MD 101: Mathematics I **(L2-T1-P0-CH3-CR3)**

Course Outcomes :

CO1: The students will be able to describe the fundamental properties of the real numbers that lays the foundation of the formal development of mathematical ability.
CO2: The students will be able to demonstrate an understanding of the theory of convergence of sequences and series, continuity, differentiation.
CO3: The students will be able to develop skills in constructing mathematical arguments.
CO4: The students will be able to understand utilize the concepts in solving the problems in their respective fields of study.

Course Content:

Inequalities involving arithmetic, geometric, and harmonic means, Cauchy-Schwarz inequality.

Sequences: Cauchy sequence, Cauchy's General principle of convergence, Subsequences, Convergence and divergence of monotonic sequences, Sandwich theorem. Infinite series: statements of basic properties of infinite series (without proofs), Convergence, Absolute and conditional convergences. Tests for convergence: Comparison test, Ratio test, Raabe's test, Leibnitz's test.

Functions of one variable: Limit, Continuity, Differentiability, Rolle's Theorem, Mean value theorems and applications, Taylor's theorem.

Critical points, convexity, curvature of plane curves, Asymptotes. Curve tracing: tracing of catenary, cissoids, asteroid, cycloid, folium of Descartes, cardioid, lemniscate.

Functions of two or more variables: Limit, Continuity, Partial derivatives, Euler's theorem on homogeneous functions, Differentiability, Chain rule, Directional derivatives, Gradient vectors and Tangent planes, Taylor's theorem (statement only), Criteria for Maxima/Minima/Saddle points, Lagrange's method of multipliers.

Text Books:

1. Thomas and Finney, *Calculus and Analytic Geometry*, (Pearson Education, Eleventh (Indian) Edition)

2. Bartle, R. G. and Sherbert, D. R., *Introduction to Real Analysis*, (John Wiley and Sons, Third (Indian) Edition)

Reference Books:

1. Apostol, T. M., *Calculus, Vol I & II*, (John Wiley and Sons, Second (Indian) Edition).

2. Mapa, S.K., *Higher Algebra*, (Asoke Prakashan, Kolkata)

ED 106: Education: An Evolutionary Perspective (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The students will be able to analyse the premises, contexts that are unique to education and appreciate the nature, the purpose of education, and their practical ramifications in the school context.

CO2: The students will be able to analyse the philosophical reflections and educational thoughts of great Educational thinkers

CO3: The students will be able to understand the nature of knowledge in Education and its contribution to status of education as a discipline and interdisciplinary in nature

CO4: The students will be able to inquire into the roles of teacher, school and the community in the changing perspectives of pedagogy

CO5: The students will be able to explain the historical development of education as a system, its evolving structures and examine the concerns, issues related to education system.

Course Contents:

Unit -1: Concept of Education

Meaning of Education: Ancient to Present, Concepts in Education and their changing connotations: school, curriculum, teacher, learner, teaching, learning, instruction, freedom, autonomy and control in relation to the child and teacher;

Education as an organized, institutionalized, formal and state sponsored activity.

Shifts in process of Education: knowledge giving, didactic and constructivist interpretations, modes of Education: distance and face-to-face (tutorial, small group, large group) and oral/aural to digital; individualized and group based.

Unit–2: Aims of Education

Aims of education: Changing aims of Education in the context of globalization, Educational aims as derived from the Constitution of India

Ideas of educational thinkers -Vivekananda, Gandhi, Tagore, Aurobindo, Dewey, Krishnamurthy and Paulo Friere.

Unit-3: Evolving Knowledge Base in Education

Nature of knowledge in education: concepts, statements, educational viewpoints, Metaphors and theories; Emerging Knowledge base in education, Differences between information, knowledge, belief, and opinion, Interfaces with cognate disciplines such as physical, natural and social sciences.

Unit-4: Learning Environment: The Changing Scenario

Changing roles of Teacher, learner's participation, knowledge emphasis, learning resources. Shift in learning environments as well as pedagogy: Knowledge: focused to teacher, learner and learning environment.

Unit-5: Systems and structures in school education

Education as a system and structure: meaning and nature , Evolution of educational network over the past two centuries - 1800s to 21st century, Role of state-central government: need for a national system of education, Predominant concerns of the education system– coordination, quality assurance and Feasibility, Systemic reforms in education: meaning and need.

Demands from the secondary education system upon achieving universal elementary education .

School Based Activities:

Students will visit the schools and observe the learning environment in relation to teacher's role, learner's participation, knowledge emphasis and learning resources.

Term paper/ seminar and discussions on some of the units

Text Books:

1. Gara Latchanna2014.*Foundation of Education*. New Delhi: Neel Kamal Publications Pvt.Ltd.
2. Aggarwal, J C2008. *Great Philosophers and Thinkers on Education*, New Delhi: Shipra. Publications
3. Taneja V. R. *Socio-Philosophical Approach to Education* (Atlantic Publishers and Distributors, New Delhi, 2005).

Reference Books:

1. Dewey, John. *My Pedagogic Creed'*, in D.J. Flinders and S.J. Thorton(eds.) The Curriculum Studies Reader (Routledge: New York, 1997)
2. Dewey, John *Experience and Education* (Touchstone, New York,1997)
3. Kumar Krishna. *Learning From Conflict* (Orient Longman, New Delhi,1996)
4. Margaret, K.T. *The open Classroom* (Orient Longman: New Delhi, 1999)
5. Ozmon, Howard A and Craver,Samuel M *Philosophical Foundations of Education* (Prentice Hall, New York, 2007)
6. Prema, Clarke. *Teaching & Learning: The Culture of pedagogy* (Sage Publication, NewDelhi, 2001)

ED 104: Communicative English (L3-T0-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be able to speak English with reasonable correctness of pronunciation and write English with reasonable clarity in different language contexts.
CO2: The students will be able to communicate in English on specific occasions such as office and business work.

CO3: The students will be able to enhance their ability for effective use of vocabulary and grammar in various language tasks such as taking and making notes, and writing letters, reports and essays.
CO4: The students will be able to make oral presentations in English as part of their need to enhance their professional skills.

Course Content:

A. *Oral Communicative Activities:*

Information transfer activities: Pair and group works involving transfer of information: describing pictures, interpreting diagrams, gleaning information from different types of written materials including articles etc. and talking aboutthem; taking part in formal seminar presentation and group discussion.

B. ***Reading:***

Reading and comprehension: global and local comprehension, drawing interferences.Materials: Stories and essays (preferably a collection of comparatively short essays on scientific, interestingly written topics, biographical/autobiographical writings, short stories-adventure and scientific fiction and shorter poems).
Reading silently in class followed by short comprehension questions, brief writing exercises, summaries in brief, personal responses (not typical question-answer type)-both oral and written. Reading material from Internet and talking and writing about them; reading scientific reports, literary writings, articles collected from newspapers and magazines, Internetetc and writing notes etc. on them.

C. *Writing:*

Preparing reports, project proposals. Writing applications of various types and for various purposes, curriculum vitae/resume, letters to the editors, letters to various agencies. Writing short notes on article/reports that had been read, notes on lectures (talks-radio/TV/audio, video cassettes), opinions on

discussions/letters heard, notice both formal and informal/friendly, notes to inform others etc., interpreting pictures, advertisements, visuals (video, TV etc.) and writing briefly about them.

D. *Vocabulary and grammar:*
Discussion on the following before and/or after the activities mentioned in A, B and C above. Structure of simple sentences; Agreement of verb and subject; use of adverbials; Tenses, Use of passive in scientific discourse, various types of questions, direct and indirect narration, Articles, Prepositions, English modal verbs, Errors in the use of individual words.

Text Books:

1. Sharma, S. and B. Mishra. (2009). *Communication Skills for Engineers and Scientists.*PHI, New Delhi.
2. Wood, F. T. (2010). *A Remedial English Grammar for Foreign Students.* Macmillan, Delhi.

Reference Books:

1. Greenbaum, Sidney. (2005).*Oxford English Grammar*. Oxford University Press, New Delhi.
2. Kenneth, Anderson, Tony Lynch, and Joan Mac Lean. (2008). *Study Speaking.*CUP, New Delhi.
3. Lynch, Tony. (2008). *Study Listening*. CUP, New Delhi.
4. Thomson and Martinet. (2008). *A Practical English Grammar.*Oxford ELBS, Delhi.

ED 105: Basics in Computer Applications (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The student will be able to describe a computer system and its working.
CO2: The student will be able to open the windows operating system and use word processing package
CO3: The student will be able to appreciate the use of the word processing package in education
CO4: The student will be able to acquire the skills of trouble shooting whenever there are problems in the working of computer.

Course Content:

Unit -1: Computer Hardware and Organization
Motherboard, Processor, RAM, Cache, Interface Cards, I/O Ports. Parts of a PC.CPU, Control Unit, ALU, Instruction Set, Registers. Generation of Computers, Classification of Computers.

Unit–2: Types of Memory
Memory organization, fixed & variable word length memory, Static and dynamic memory, RAM, ROM, cache memory, flash memory, Secondary Memory – HD, CD, DVD, Tape, and Pen-drive.

Unit-3: Software and Programming and Problem Solving Aspect
OS, Utilities & Service programs, Communication s/w, DBMS, Multimedia s/w, Application s/w , Some common algorithms along with their flowcharts.

Unit-4: Concepts of Computer Network
Introduction, Network Classification by scale and connection methods, Network architecture and topology, Intranet, Extranet, Internet, TCP/IP, Basic h/w, Components of Network.

Unit-5: Data Base and Web Page
Introduction to Database and some concepts of DBMS, Simple concepts of Web Page designing using HTML.

Lab Classes:

Working knowledge of Windows, MS-Word, MS-Excel, MS-PowerPoint, Simple web page designing using basic HTML tags.

Text Books:

1. P. K. Sinha and P. Sinha, "*Foundations of Computing*" BPB Publications.

Reference Books:

1. R. G. Dromey, "*How to Solve it by Computer*", Prentice Hall of India,
2. A. S. Godbole& A. Kahate, "*Web Technologies*", TATA McGraw Hill,
3. E. Navathe, "*Fundamentals of Database Systems*", Pearson Education.

Semester-II

PD 102: PHYSICS-II (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will have a good idea on relativity, electricity, magnetism and electronics.

CO2: The student will be able to study the advanced courses like General relativity, Electrodynamics, Digital electronics etc.

Course Content:

Special Theory of Relativity:

Frames of reference, relative velocity and accelerations, Concept of ether, Michelson-Morley experiment, elements of special theory of relativity, the postulates, Galilean and Lorentz transformations, equivalence of mass and energy, time dilation, length contraction, simultaneity, Doppler effect, twin paradox.

Electromagnetism:

Coulomb's law (electric), electric field due to a system of charges, Gauss's law in differential and integral forms, electric dipole, its electric field and potential, capacitance of parallel plates.

Coulomb's law (magnetic), Biot-Savart law, force on a current and on moving charges in a B-field.

Electronics:

Kirchhoff's law, network theorem, nodal analysis, mesh analysis, maximum power transfer theorem, series circuits, parallel circuits (DC analysis only), semiconductors, p-type, n-type semiconductors, p-n junction, diode, triode.

Text Books:

1. Beiser A., *Concepts of Modern Physics*, 6th edition (Tata McGraw Hill, 2008).
2. Rakshit, P. C. and Chattopadhaya, D., *Electricity and Magnetism*, (New Central Book Agency, 2012).
3. Robbins, A. H. & Miller, W. C., *Circuit Analysis* (Delmar Cengage Learning, 2003).

Reference Books:

1. Resnick, R., *Introduction to Special Relativity*, 1st edition (Wiley, 2007).
2. Griffith, D. J., *Introduction to Electrodynamics*, 3rd edition (Prentice Hall of India, 1999).
3. Edminister, J. A., *Electrical Circuits- Schaum's Outline series*, 2nd edition (McGraw Hill,1983).

PD 198: Physics Lab -II **(L0-T0-P3-CH6-CR3)**

Course Outcomes:

CO1: The students will have a good foundation in the fundamentals related to the experiments included in this course and their advanced applications.

Course Content:

(a) Design LCR series and parallel circuits and to measure resonant frequencies.
(b) To prove Thevenin's and Norton's theorem.
(c) Determine the force between two current carrying conductors.
(d) Study the I-V characteristics of a Diode.
(e) Study of Lissajous Figure of two different waves using CRO and find out the unknown frequency of an electrical signal.
(f) To determine the thickness of thin film using interferometric method.
(g) Determine the mechanical/ Electrical equivalent of heat by Joule's Calorimeter.
(h) Determine the coefficient of linear expansion of the given metal sample by optical lever method.
(i) Determine of the co-efficient of viscosity of water by Poiseulle's method.
(j) Determine the wavelength of the given source of light using Fresnels' Biprism.
(k) Measurement of frequency of an unknown tuning fork using a sonometer.
(l) To determine the coefficient of self-inductance of a coil by Rayleigh's D.C. Bridge method.

PD 104: General Physics II **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The student will gain a good idea on electromagnetism, relativity and electronics.

Course Content:

Electrostatics:

Coulomb's law and Gauss's law with applications: Coulomb's law (electric), electric field due to a system of charges, Gauss's law in differential and integral forms with applications, electric dipole, its electric field and potential, capacitance of parallel plate.

Magnetostatics:

Coulomb's law and Biot-Savart law with applications: Coulomb's law (magnetic), the Biot-Savart law, current carrying conductors in a magnetic field.

Special Theory of Relativity:

Basic developments and concepts: Frames of reference, relative velocity and accelerations, concept of ether, Michelson Morley experiment and its result, elements of special theory of relativity, the postulates, Galilean and Lorentz transformations, time dilation, length contraction, Doppler effect, twin paradox.

Mass-energy equivalence: Equivalence of mass and energy, concept of the electronvolt unit and relevant examples with fundamental particles.

Electronics:

Circuit analysis: Network theorem, nodal analysis, mesh analysis, maximum power transfer theorem, series circuits, parallel circuits (DC analysis only).

Semiconductors: p-type and n-type, p-n junction, diode, triode, LED, solar cell.

Text Books:

1) Griffith, D. J., *Introduction to Electrodynamics*, 3rd edition, (Prentice-Hall of India, 1999)
2) Purcell E.M., Electricity and Magnetism, 3rd edition , Cambridge University Press; 3 edition
3) Beiser A., *Concepts of Modern Physics*, 6th Edition (Tata McGraw-Hill 2008)
4) Robbins, A. H. & Miller, W. C., *Circuit Analysis*, (Delmar Cengage Learning., 2003).

Reference Books:

1) Rakshit, P. C. and Chattopadhaya, D., *Electricity and Magnetism*, (New Central Book Agency, 2012).
2) Resnick, R., *Introduction to Special Relativity*, 1st edition (Wiley 2007).
3) Edminister, J.A., *Electrical Circuits- Schaum's Outline series*, 2nd edition (McGraw Hill, 1983).

CD 102: Chemistry –II (L3-T0-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be able to understand the structure and bonding of homo nuclear diatomic molecules
CO2: The students will be able to understand polarizability of ions
CO3: The students will be able to understand stereochemistry of organic molecules–conformation and configuration, asymmetric molecules and nomenclature.
CO4: The students will be able understand to aromatic compound and aromaticity.
CO5: The students will be able understand to organic Intermediates, their generation and reactivity.
CO6: The students will be able understand to properties of gases and liquids.
CO7: The students will be able understand to kinetics of simple reactions.
CO8: The students will be able understand to fundamentals of electrochemistry.

Course Content:

Structure and Bonding: Valence Bond and LCAO-MO theory, bonding in homonuclear diatomic molecules (e.g.: H2, N2, O2, F2), covalent and ionic bonding, bond order, resonance, formal charge, VSEPR model, Polarizability of cations and anions, Fazan's rules.
Basics organic chemistry-4: Nucleophiles, electrophiles, keto-enol tautomerism, acidity and basicity of organic compounds, Frost diagram, Hückel's rules for aromaticity, antiaromaticity, homoaromaticity.
Stereochemistry-1:Representation of organic molecules in Fischer, saw horse, Newman, and flying-wedge, projection formulae and their interconversion, symmetry elements, molecular chirality, optical activity, optical purity, meso compounds, racemic mixture, resolution, enantiomers, diastereomers, epimers, anomers, atropisomers, basic concepts of stereochemical nomenclatures: *threo*/*erythro*, *syn*/*anti*, *R*/*S*, *cis*/*trans*and *E*/*Z*).
Reactive intermediates:Carbocation, carbanion, carbene, nitrene, free radical and benzyne: Generation, stability and reactions.
Properties of gases and liquids: Equations of state, kinetic model of gases, collision theory, real gases, Maxwell distribution of molecular speeds, qualitative description of the structure of liquids, surface tension and viscosity.
Electrochemistry: Conduction in electrolyte solutions, ionic mobility, Kohlrausch law, Ostwald's dilution law, transport number, Debye-Huckel Limiting Law, electrochemical cells, EMF, Nernst equation.
Rate of reactions: Rate equations of zero, first, second, pseudo 1storder reactions, determination of order of a reaction, activation energy, activated complex theory, collision theory.

Text Books:

1. Atkins, P., Paula, J. de. *Atkins' Physical Chemistry*, 10th Edn., Oxford University Press, 2014.
2. Overton, T., Armstrong, F., Rourke, J., Weller, M. *Inorganic Chemistry*, 6th Edn., Oxford University Press, 2015.

3. Clayden, J., Greeves, N., Warren, S., Wothers, P. *Organic Chemistry*, 2nd Edn., Oxford University Press, 2012.
4. Sengupta, S. *Basic Stereochemistry of Organic Molecules*, 1st Edn., Oxford University Press, 2014.

Reference Books:

1. Laidler, K. J., Meiser, J. H., Sanctuary, B. C., *Physical Chemistry,* 4th Edn.,Brooks Cole, 2002.
2. Carey, F. A., Sundberg, R. J. *Advanced Organic Chemistry, Part B: Reactions and Synthesis*, 5th Edn., Springer, New York, 2007.
3. March, J., Smith, M. B. *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure*, 6th Edn., Wiley, 2007.
4. Eliel, E. L., Wilen, S. H., Doyle, M. P. *Basic Organic Stereochemistry*, 1st Edn., Wiley-Interscience, 2001.

CD 107: Chemistry Laboratory-I (L0-T0-P3-CH6-CR3)

Course Outcomes:

CO1: The students will be able to do analysis of inorganic mixures
CO2: The students will be able to do estimation of compunds
CO3: The students will be able to do measurement of some physical properties.

Course Content:

1) Qualitative Analysis of Inorganic Mixtures (excluding interfering radicals)
2) Preparation of Mohrs salt
3) Estimation of Glucose
4) Nitration of organic compounds
5) Reduction of functional groups
6) Preparation of buffer solution and measurement of pH.
7) Viscosity measurement of solution
8) Conductometric acid-base titration
9) Measurement surface tension of liquid by stalagmometer
10) Verification of Beer-Lamberts law
11) Titration of a mixture of AcOH, HCl and CuSO4by conductometric method and CuSO4 by conductometric method

Text Books:

1. Furniss, B. S., Ford, A. J. H., Smith, P. W. H., Tatchell, A. R. Vogel's *Textbook of Practical Organic Chemistry,* 5thEdn.,Wiley, 1989.
2. Jadav, J. B. *Advanced Practical Physical Chemistry*, Krishna Prakashan, 2015.

Reference Books:

1. Mendham, J., Danney, R. C., Barnes, J. D., Thomas, M., Vogel's *Textbook of Quantitative Chemical Analysis*, 6thEdn., Prentice Hall, 2009.
2. Gurdeep, R., *Advanced Practical Inorganic Chemistry,* Krishna Prakashan, 2013.

MD 102: Mathematics II (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will learn the basic methods and tools of solving ordinary differential equations.

CO2: The students will learn about vectors as well as surface and volume integrations.

CO3: The students will develop an aptitude in finding applications of the methods.

Course Content:

Ordinary differential equations(ODE): Basic definitions: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines, formulation of ODE, Linear and non-linear differential equations.

Variables separable equation, homogeneous and non-homogeneous equation, exact equations and integrating factors, linear and Bernoulli's equation, equations reducible to first order Clairaut's equation.

Second order Differential Equations: Linear equations with constant coefficients. Standard methods for solution of homogeneous and non-homogeneous linear differential equations, linear differential equations with variable coefficients and Method of Variation of Parameter.

Line integral, Double integral, triple integral, Jacobian, Surface integral and their applications. Space co-ordinates, lines and planes, Polar coordinates, Cylinders, Quadric surfaces, Volume, Area, length, volume and surface area of solids of revolution.

Vector Calculus, vector point function, continuity and differentiation of vector point function, partial derivative of vectors, Curl, Grade, Divergence; Green, Gauss and Stokes Theorem.

Text Books:

1. Boyce, William E. and Dprima, Richard, C. *Elementary Differential Equations*, (John Wiley, Indian Edition, 2000).

2. Spiegel, M. R., *Vector Analysis*, *Schaum's outline series*, *(*Publishing House India).

3. Thomas *and* Finney, *Calculus and Analytic Geometry*, (Pearson Education, Eleventh (Indian) Edition).

Reference Books:

1. Jain, R. K. and Iyengar, S. R. K., *Advanced Engineering Mathematics*, Third Edition, (Narosa publishing house, India).

2. Ramana, B. V., *Higher Engineering Mathematics*, (McGraw Hill, India).

ES 103: Environmental Studies **(L4-T0-P0-CH4-CR4)**

Course Outcomes:

CO1: The students will be able to recognize the need for learning environmental studies and develop foundational knowledge on the topic.
CO2: The students will be able to appreciate the environment around us, spread awareness on environment degradation, promote environment protection and sustainable mitigation strategies.
CO3: The students will be able to develop critical thinking and analytical ability to resolve interdisciplinary issues related to the environment around us.

Course Content:

Introduction to environmental studies, Multidisciplinary nature of environmental studies, Scope and importance; Concept of sustainability and sustainable development.

Ecosystems:
What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
a) Forest ecosystem

b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Natural Resources: Renewable and Non-renewable Resources, 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 over-exploitation 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.

Biodiversity and Conservation: 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.
Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.
Unit 5: Environmental Pollution: Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.

Unit 6: Environmental Policies & Practices; 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.

Unit 7: Human Communities and the Environment; Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case 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 (e.g., CNG vehicles in Delhi).

Unit 8: Field work; Visit to an area to document environmental assets: river/forest/flora/fauna, etc. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Text Books:

1. E. Bharucha, *Textbook of Environmental Studies*,Orient Black Swan, 2015.

Reference Books:

1. R. Carson, *Silent Spring*, Houghton Mifflin Harcourt, 2002.
2. M., Gadgil, & R. Guha, *This Fissured Land: An Ecological History of India*, Univ. of California Press, 1993.
3. B. Gleeson and N. Low, *Global Ethics and Environment*, London, Routledge, 1999.
4. P. H. Gleick, *Water in Crisis. Pacific Institute for Studies in Dev.*, Environment & Security. Stockholm Env. Institute, Oxford Univ. Press, 1993.

5. Martha J. Groom, Gary K. Meffe, and Carl Ronald Carroll, *Principles of Conservation Biology*,*Sunderland*, Sinauer Associates, 2006.
6. Grumbine, R. Edward and M.K. Pandit, *Threats from India's Himalaya dams*, Science, 339:36-37, 2013.
7. P. McCully, *Rivers no more: the environmental effects of dams*, Zed Books, 1996.
8. McNeill and R. John, *Something New Under the Sun: An Environmental History of the Twentieth Century*, W. W. Norton & Company, 2000.
9. E.P. Odum, H.T. Odum and J. Andrews, *Fundamentals of Ecology*, Philadelphia: Saunders, 1971.
10. I.L. Pepper, C.P. Gerba and M.L. Brusseau, *Environmental and Pollution Science*, Academic Press, 2011.
11. M.N. Rao and A.K. Datta, *Waste Water Treatment*, Oxford and IBH Publishing Co. Pvt. Ltd.,1987.
12. P.H. Raven, D.M. Hassenzahl and L.R. Berg, *Environment*, 8thedition, John Wiley & Sons, 2012.

A. Rosencranz, S. Divan, and M.L. Noble, *Environmental law and policy in India*, Oxford, 1992.

13. R. Sengupta, *Ecology and economics: An approach to sustainable development*, OUP, 2003.
14. J.S. Singh, S.P. Singh, and S.R. Gupta, *Ecology, Environmental Science and Conservation*, S. Chand Publishing, New Delhi, 2014.
15. N.S., Sodhi, L. Gibson, and P.H. Raven, *Conservation Biology: Voices from the Tropics*, John Wiley & Sons, 2013.
16. V. Thapar, *Land of the Tiger: A Natural History of the Indian Subcontinent*, India Book House, 1998.
17. C. E. Warren, *Biology and Water Pollution Control*, WB Saunders, 1971.
18. E. O. Wilson, *The Creation: An appeal to save life on earth*, New York: Norton, 2006.
19. World Commission on *Environment and Development*, *Our Common Future*, Oxford University Press, 1987.

ED 107: Education and Development (L2-T0-P1-CH3-CR3)

Course Outcomes:

CO1: The student will be able to explain the relationship between Education and individual, National development.
CO2: The student will be able to examine the influences of political and policy decisions on Education and its aims, content and procedures.
CO3: The student will be able to analyze the role of education in ensuring sustainable development.
CO4: The student will be able to understand the financial supplication for education.

Course Contents:

Unit-1: Education for Development
National Development–Meaning, Scope and Different Viewpoints, Education as a development indicator and related Indicators of national development, Education Commission 1964-66, NPE-1986, POA-1992. Education and development of life skills: preparation of individuals for the 21st century, Role of education in ensuring sustainable development.

Unit-2: Education and Socio-cultural Context
Education as an instrument of social change- influence of education on society, family and their practices, Socio-cultural influences on the aims and organization of education, Impingement of cultural history on education.

Unit-3: Education and Economic Development
Education for economic development- its meaning and nature, Education as an investment, Education as development of human resource: Education for Employability, Consumer driven educational programmes, Planning Commission, World Bank.

Unit-4: Education and Globalization
Liberalization, Privatization, Internationalization and Globalization of Education.

Unit -5: Emerging interface between political policies and Education

The National and State educational policies, Implementations of educational policies, State and centrally sponsored schemes of education.

Relationship between constitutional provisions and educational policies, Right to Education.

School Based Activities:

Students will visit one government primary and one government secondary school to interact with teachers, students and community members to reflect on implementation of any one state/Centrally sponsored schemes/ programmes like RMSA, RTE Act 2009, Mid-Day meal, Kasturba Gandhi BalikaVidyalaya (KGBV) etc.

Interact with school Heads to collect information about the progress of the schools as well as the scholarships and other inspirational motives received from various resources

Students will visit a local community and interact with different community members and get information to develop understanding about the significance of education in economic, socio-cultural and globalized contexts.

Text Books:

1. Chandra, S.K. *Education and Development* (Discovery Publishing House, Delhi, 2010).
2. Jayapalan, N. *History of Education in India* (Atlantic Publishers, New Delhi, 2008).
3. *School Education in India – Present Status and Future Needs* (NCERT, New Delhi, 1986).

Reference Books:

1. Ministry of HRD, *Department of Education Learning without Burden, Report of the National Advisory Committee.* Education Act. October, 2004.
2. UNDPA. *Human Development Reports* (New Delhi. Oxford, Oxford University Press) *Education for All: The Quality Imperative. EFA Global Monitoring Report* (UNESCO Paris, 2004).
3. *World Bank. Reaching the Child: An Integrated Approach to Child Development* (Oxford University Press, Delhi, 2004).

NS 106: National Service Scheme (L0-T0-P2-CH4-CR2)

Course Outcomes:

CO1: The students will be able to understand the community and identify the needs, problems of the community and involve them in problem-solving.

CO2: The students will be able to utilize their knowledge in finding practical solutions to individual and community problems.

CO3: The students will be able to develop competence required for group-living and sharing of responsibilities as well as gain skills in mobilizing community participation.

CO4: The students will be able to acquire leadership qualities, democratic attitudes and develop capacity to meet emergencies, natural disasters and practice national integration and social harmony.

Contents and Activities: Students will organize and actively participate in various activities given below:

National Service Scheme:

National Youth Festival, National Integration Camp, Blood Donation Camp, Plantation, Immunisation Camp, Shramdaan, Swaccha Bharat Abhiyaan, Disaster Management, Community Development Programme, Right to Education Awareness Camp,Personality Development

National Cadet Corps:

Annual Training Camp, National Integration Camp, Army Attachment Camp, Blood Donation Camp, Shramdaan, Swaccha Bharat Abhiyaan, Disaster Management, Community Development Programme, Right to Education Awareness Camp, Drill Practice, Weapon Training, Map Reading, Personality Development.

Semester-III

PD 201: Physics-III **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1 : The student will have a good overview on quantum mechanics.

Course Content:

Particle properties of waves: Wave particle duality, Photoelectric effect, Black body radiation, Plank radiation law, Rayleigh-Jeans law, Stefan's law.

Atomic physics: Rutherford model, Bohr model, hydrogen atom (quantum numbers and spectral series; qualitative), X-ray, Moseley's law, Basics of Lasers. Basics particle physics: elementary forces and particles.

Limitations of classical physics: Qualitative discussions of the problem of the stability of the nuclear atom. The photo-electric effect. Franck-Hertz experiment and the existence of energy levels. Experimental evidence for wave-particle duality, X-ray diffraction and Bragg law. Compton scattering. Electron and neutron diffraction. Einstein and de Broglie's relations ($E = h\gamma$, $p = h/\lambda$).

Schrodinger equation: The concept of the wave function as a probability amplitude and its probabilistic interpretation. Plane wave solutions of the one-dimensional time-dependent Schrodinger equation for a particle in free space and elementary derivation of the phase and group velocities (quantitative discussion of wave packets is not required).

Uncertainty relation: The position-momentum uncertainty relation and simple consequences. Solutions of the one-dimensional Schrodinger's equation for an infinite square well potential; qualitative treatment of the finite well (derivation not required). Linear harmonic oscillator.

Text Books:

1. Beiser, A., *Concepts of Modern Physics* (McGraw-Hill, 2002).
2. Krane, K. S., *Modern Physics* (Wiley).

Reference Books:

1. Beiser, A., Perspectives *of Modern Physics* (McGraw-Hill Inc.,US).
2. Thornton, S. T. and Rex, A., Modern Physics for Scientists and Engineers (Cengage Learning; 4 edition).
3. Gautreau, R. Schaum's Outline of Modern Physics, (McGraw-Hill; 2 edition).

4. Young, H.D. and Freedman, R.A., *University Physics*, 12th edition, (Pearson, 2009).

PD 203: Classical Mechanics **(L2-T1-P0-CH3-CR3)**

Course Outcome:

CO1: The students will understand concepts of generalized coordinates and constrained motion.
CO2: The students will be able to apply Newtonian as well as Lagrangian and Hamiltonian mechanics to describe motion of physical systems, including systems involving central potential.
Course Content:

Mechanics of a particle: Conservation theorems for a particle, motion of a particle under damping forces, motion of a particle under central force, motion of a body in a resisting medium, Kepler's laws of planetary motion, moving co-ordinate systems, Galilean transformation, Coriolis force, Foucault's pendulum.

Mechanics of a System of Particles: Centre of mass and its motion, conservation theorems for a system of particles, collision problems, constraints, generalised co-ordinates, configuration space, principle of virtual work, D'Alembert's principle.

Lagrangian Formulation: Lagrange's equation, the rules of forming Lagrange's equation, Lagrange's equations for non-conservative forces, spherical and cylindrical co-ordinates, Hamilton's principle and Lagrange's equation, application of Lagrange's equation, motion of charged particle in an electromagnetic field, superiority of Lagrange’s approach over Newtonian approach.

Hamiltonian Formulation: Phase space, Hamiltonian function and Hamiltonian equation, Application of Hamiltonian equation, Harmonic oscillator, compound pendulum, cyclic co-ordinates, Liouville's theorem, Routh's procedure.

Text Books:

1. Goldstein, H., *Classical Mechanics*, (Narosa, 2001).
2. Kleppner, D. and Kolenkow, R., Introduction to Mechanics, (McGraw-Hill Book Co., Inc, 1973)

Suggested Readings:

1. Rana N. C., and Joag, P. S., *Classical Mechanics*, (Tata McGraw-Hill, 1991).
2. Takwale, R. G. and Puranik, P. S., *Introduction to Classical Mechanics*, (Tata McGraw-Hill, 1978).
3. Panat, P. V., *Classical Mechanics*, (Narosa Publishing House).
4. Upadhyaya, J. C., *Classical Mechanics*, (Himalayan Publishing House).

PD 217: Mathematical Physics-I **(L2-T0-P1-CH4-CR3)**

Course Outcomes:

CO1: The students will be able to understand basic theory of vectors analysis, curvilinear coordinate systems, differential equations, matrices, Fourier series and probability theory.
CO2: The students should be able to apply methods of vector differentiation and integrals as well as separation of variables to solve differential equations, Expansion of Fourier and Taylor series, various integrals to special functions, solve differential equations using matrix methods.
CO3: The students will learn the use basic probability theory to analysed experimental data.

Course Content:

Scalar and vector fields, differentiations, divergence and curl; integrations, Greens, Gauss’s and Stokes theorems and their applications, transformations of coordinate systems and vector components, metric

coefficients, curvilinear coordinates, expressions for grad., div., and curl, Helmholtz equation in three-dimensions and separable variables in various coordinate systems, matrices and determinants.

Beta, gamma and error functions, relationship between the beta and gamma functions, reduction of some classes of integrals to gamma functions, Sterling's formula; derivation of values of gamma functions.

Fourier series: Evaluation of coefficients, graphical representations, even and odd functions, properties of Fourier series, Fourier integrals.

Elements of probability: Mathematical probability, compound probability, total probability, sample space, random variables, expectation value, averages, mean, standard deviation, binomial distribution, normal distribution; variance, covariance and correlation; theory of errors, central limit.

Random Process: Random variables to random process, statistical averages, stationary processes.

Text Books:

1. Harper, C., *Introduction to Mathematical Physics, (*Prentice Hall, 2009).
2. Arfken, G. B., and Weber, H. J., *Mathematical Methods for Physicists*, (Elsevier Ltd, Oxford, 2005).

Suggested Readings:

4. Morganeau, H. and Purphy, C. M., *The Mathematics of Physics and Chemistry*, (Young Press, 2009).
5. Spiegel, M. R., *Vector Analysis*, Schaum's outline series, (Tata McGraw-Hill 1979).

PD 297: Physics Lab-III **(L0-T0-P4-CH8-CR4)**

Course Outcomes:

CO1: The students will be able to learn practically the interference and diffraction, thermocouple, Wheatstone bridge principles and Op-Amp.
CO2: The students will get motivated to develop small experiments related to these techniques and develop their physical understanding.

Course Content:

1. To observe the rotation of the plane of polarization of monochromatic light by a given solution and to determine the specific rotation of sugar solution using a Polarimeter.
2. Determine the wavelength (λ) of the given monochromatic light by using Lloyd's mirror.
3. To measure thermo e.m.f. of a thermocouple as a function of temperature and find inversion temperature.
4. To measure the radius of curvature of a given concave mirror and to measure the refractive index of a liquid by this method.
5. To measure the inductance of a given inductor using Anderson bridge.
6. To measure the capacitance of a capacitor by de-Sauty method and to find permittivity of air.
7. To study Op-Amp. characteristics:
    a. To get data for different input bias current,

    b. To measure and null the output offset voltage.

8. Determine the efficiency of the given solar cell for different intensity and different frequency of light sources.
9. Measure the elasticity of the given sample by Newton's ring method.

CD 201: Chemistry –III **(L3-T0-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to understand concepts of acids and bases, and their strength.
CO2: The students will be able to understand fundamentals of coordination chemistry.
CO3: The students will be able to understand aromatic compounds and aromaticity.
CO4: The students will be able to understand synthesis and properties of hydrocarbons.
CO5: The students will be able to understand weak electrolyte and ionic equilibrium.

Course Content:

Acid -Base concept: Arrhenius concept, Brønsted-Lowry acids and bases, Lewis acids and bases, Hard Soft acids -bases and HSAB principle, Acid and base strength, levelling effect.

Coordination chemistry: Werner's theory, classification of ligands, coordination number, nomenclature of coordination compounds, isomerism.

Aromaticity and Hückel Rule, Orientation of substituents, Directive influence of substituents, opration, kinetically and thermodynamically controlled reactions.

Alkynes: Preparation, properties and reactions.

Alkyl halides: Preparation, properties and reactions.

Ionic equilibrium: Arrhenius theory of electrolytic dissociation, Ostwald dilution law, Dissociation constant of week acids and bases, Ionization of water, pKwand pH, Salt effect, pH expressions for various neutralization reaction, Henderson-Hasselbalch equation, solubility product, common ion effect, Buffer solutions, theory of acid base indicators, acid base titration curves (pH variation).

Text Books:

1. Huheey, J. E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. *Inorganic Chemistry*: Principles of *Structure and Reactivity*, 4th Edn., Pearson Education, 2006.
2. Barrow, G. M. *Physical Chemistry*, 5th Edn., McGraw Hill, 2007.
3. Finar, I. L. *Organic Chemistry*, Volume 1, 6th Edn., Pearson Education, 2002.
4. Ghosh, S. K., *Advanced General Organic Chemistry*, 3rd Edn., New Central Book Agency (P) Ltd., 2008.

Reference Books:

1. Smith, M. B., March, J. *March's Advanced Organic Chemistry, Reaction Mechanism and Structure* 6th Edn., Wiley, 2007.
2. Clayden, J., Greeves, N., Warren, S., Wothers, P. *Organic Chemistry*, 2nd Edn., Oxford University Press, 2012.

MD 219: Mathematics III **(L1-T1- P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be aquinted with various definitions related to statistics, probability, distributions and introdeced to scope and study area of statistics.

Course Content:

Definitions of Statistics, population, sample, data and characteristics of data. Measures of central tendency, dispersion. Histogram, frequency curve and boxplot.

Skewness and its measures. Normal and student's-t curves. Kurtosis and its measures. Effects of change of origin and scale. Definition of Probability and some properties of the probability function.

Random variable, Probability distribution and distribution function. Discrete and continuous distribution. Some important discrete and continuous distributions.

Random sampling and sampling fluctuation, Simple random sampling, variance of sample mean under SRS WOR, Estimation of population size (capture-release- capture method), Correlation and simple linear regression. Rank correlation.

Text Books:

1. Medhi, J., *Statistical Methods: An introductory Text*, (New Age International (P) Ltd, 2000).

2. Gupta, S.C. and Kapoor, V. K., *Fundamentals of Mathematical Statistics*, (S. Chand & Co., 2007).

3. Cochran, W.G., *Sampling Techniques*, third edition (John Wiley & Sons, 1977).

Reference Books:

1. Feller, W., *An Introduction to Probability Theory and Its Applications*, Vol. I, (Wiley, 2005).

2. Uspensky, J.V., *Introduction to Mathematical Probability*, (McGraw Hill, 2005).

ED 205: Environmental Education (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The student will be able to describe the concept, importance, scopes and aims of environmental education.
CO2: The student will be able to explain the environmental pollution, possible hazards and its courses and remedies.
CO3: The student will be able to develop a sense of responsibility towards conservation of environment, biodiversity and sustainable development.
CO4: The student will be able to develop reasonable understanding about the role of school and education in fostering the idea of learning to live in harmony with nature and the need to conserve the environment for sustainable development.

Course Contents:

Unit- 1: Introduction to Environmental Education
Meaning of environment, concept, importance, aims and scope of Environmental Education, Differences between Environmental Education and Environmental Science. Multidisciplinary nature of Environmental Education.

Unit -2: Environmental Pollution
Nature, causes, effects of air, water, soil, marine, noise, thermal pollution, Measures for checking pollution, Greenhouse effect and Ozone layer depletion and its effects.

Unit -3: Bio-diversity and related issues
Meaning of Bio-diversity, Bio Diversity of Assam, Wild life protection Act, Conservation of Bio Diversity, Need for conservation of genetic diversity for maintaining ecological balance, Biosphere Reserve, National Park, Wild life Sanctuary, learning to live in harmony with nature.

Unit -4: Environmental Awareness through Education
Different programmes of Environmental Education for secondary school students, Environmental education for developing healthy attitude towards environmental protection.

Unit- 5: Role of Teachers and Students

Environment Education tool for sustainable development, Social and educational issues of environmental conservation, Role of teachers and students in Environmental conservation.

Practicum
Students will visit the nearby environmental sites or local polluted areas to observe and study from environmental awareness view point and submit the report.
Visit to national park and sanctuary for study of Bio Diversity and to submit their respective presentations.

Text Books:
1. Krishnamacharyulu, V. and G.S.Reddy. (2004).*Environmental Education: For B.Ed. Students of Indian Universities.* Neelkamal Publications, New Delhi.
2. Vijayan.S. (2008). *Principles of Environmental Education*. Sarup & Sons, New Delhi.
3. Kumar Aravind, (2003).*Environmental challenges of 21st century*. PH Publishing Corporation. New Delhi

Reference Books:
1. Robert B. Stevensyn. (2013).*International handbook of search on Environmental Education*. Rutledge publication.
2. Suresh Pauchari.(2012).*Environmental Education*. Pearson publication
3. Robert B.Stevenson (2012). *International handbook of research on environmental education*, Routledge.
4. Edgar Gonzalez-Gaudiano and Michael A. Peters. (2008). *Environmental education*. Sense publishers, Europe.
5. Palmer.J& Philips. N.(1990). *The handbook of Environmental Education*. Routledge. Newyork.

ED 202: Learner and Learning (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The student will be able to describe the basic concepts of nature of learner and develop an understanding about the influence of a psycho-social cultural context in shaping human development.
CO2: The student will be able to acquainted with the nature, extent and causes of individual differences among learners and caters for the educational needs to various types of children.
CO3: The student will be able to critically analyse the different theoretical perspectives on learning and get conversant with psychological principles and techniques to facilitate learning.
CO4: The student will be able to identify the various factors of learning and discuss the role of the teacher and school in addressing various factors influencing learning.
CO5: The student will be able to comprehend teaching as a process of communication and be aware of paradigm shift in teaching learning.

Course Contents:

Unit- 1: Nature of the Learner: Child and Adolescent
Learner as a developing individual; a psycho-social entity; stages of development.
Developmental characteristics of a child and an adolescent: Physical, Cognitive, social, Emotional, moral and language; their interrelationships.
Factors influencing development such as heredity, nutrition, child-rearing practices, siblings and peers.

Unit -2: Understanding Differences between Learners
Differences between individual learners: Multiple Intelligence, Learning Style, Self-Concept, Self-Esteem, Attitude, Aptitude, Skills and Competencies, Interest, Values, Locus of Control and Personality.
Understanding -differently - abled learners, slow learners, gifted and exceptional learners, Methods of assessing individual differences: tests, observation, rating scales, self-reports, Catering to individual differences: grouping, individualizing instruction, guidance and counseling, bridge courses, enrichment activities and clubs.

Unit -3: Understanding Learning

Nature of learning: learning as a process and learning as an outcome, Types of learning: factual, associations, conceptual, procedural, generalizations, principles and rules, attitudes, values and skills.

A critical analysis of the relevance and applicability of various learning theories for different kinds of learning situations.

Pedagogic principles for organizing learning: behavioristic, cognitivist, and humanistic.

Unit -4: Factors Influencing Learning

Biological and hereditary factors influencing learning, Factors related to the subject matter content and learning material, Factors related to the method of learning, Factors influencing remembering and forgetting, Conceptual organization and Reorganization, scaffolding.

Attention, motivation and readiness as factors influencing scholastic learning, Role of the teacher and school in addressing various factors influencing learning.

Unit -5: Learning Communication and Experience

Concept, components and types of communication, Classroom communication –an analysis of its facilitative and Inhibitive nature.

Role of media in communication process, teaching as interpersonal communication, Reflection on the factors of communication affecting learning and learner, The issue of media influences on learning – role of parents and teachers Paradigms for organizing learning: teacher centric, subject centric and learner centric.

School Based Activities

Students will visit school and interact with class teacher for the following tasks:

Critical analysis of classroom instruction in the light of the understandings developed in Units 2 & 3

Any one experiment on learning – division of attention, memory, transfers of learning.

Analysis of common behavioral problems observed in classroom, suggesting the ways to address them.

Administration of group intelligence test and reporting the result.

Analysis of classroom problems of high and low achievers and the strategies to address these problems.

Text Books:

1. Aggarwal, J.C. (2009). *Psychology of Learning & Development*, Shipra Publication, Delhi
2. Mangal, S.K. (2007).*Essentials of Educational Psychology*, Prentice Hall of India, New Delhi
3. Chauhan, S. S.(2005) Advance Educational Psychology, Vikas Publishing House, New Delhi.

Reference Books:

1. Anita, Woolfolk. (2013). *Educational Psychology*: Active Learning Edition
2. Woolfolk, A.E. (2009) *Educational Psychology* (11th Edition, My Education Lab Series,(Prentice Hall, New York.
3. Matheson, David. (2004). *An Introduction to the study of education* (2nd edition). David Fulton Publish.
4. Dandipani, S.(2000). *A Textbook of Advanced Educational Psychology*. New Delhi:

Semester-IV

PD 205: Electromagnetism **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will develop strong creativity, analytical capability and innovativeness.

CO2: The students will be able to realize and enjoy the philosophical mysteries of electromagnetism via exercises of mathematical physics, vector operation, electricity and magnetism.

CO3: The students will be able to understand the physical universe from a new perspective of electromagnetic origin eventually after the applicability of the considered models skilfully.

Course Content:

Electrostatics in vacuum: Coulomb's law, Electric field due to a system of charges, Field lines, flux and Gauss's law, Gauss's law in differential form, the electric dipole and its electric field and potential, the couple and force on, and the energy of, a dipole in an external electric field, Gauss's law in integral form, field and potential due to surface and volume distributions of charge, force on a conductor, the capacitance of parallel plate, cylindrical and spherical capacitors, electrostatics in the presence of dielectric media, Modification to Gauss's law, polarisation, the electric displacement, relative permittivity, capacitance and energy in the presence of dielectric media.

Magnetic effects in the absence of magnetic media: the B-field, steady currents: the B-field set up by a current, the Biot-Savart law, the force on a current carrying conductor and on moving charges in a B-field, the magnetic dipole and its B-field, the force and couple on, and the energy of, a dipole in an external B-field, energy stored in a B-field.

Gauss's law in integral form, simple cases of the motion of charged particles in electric and magnetic fields.

Text Books:

1. Griffith, D. J., *Introduction to Electrodynamics*, 3rd edition, (Prentice-Hall of India, 1999).
2. Purcell, E. M., *Electricity and Magnetism*, Berkely Physics Course, Vol. 2 (McGraw-Hill, 1965).

Suggested Readings :

1. Matveev, A.N., *Electricity and Magnetism*, (Mir Publishers, 1986).

PD 214: Electronics **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The student will acquire the knowledge with facts and figures related to this field for better understanding in higher versions of electronic devices.

Course Content:

Series and Parallel Resonant circuits (Detailed AC analysis)
Introduction to Three Phase Circuits. Two port n/w, Z-parameter, Y-parameter, Transmission.
Semiconductors: p and n Type Semiconductors. Energy Level Diagram, Mobility and conductivity, transport phenomenon due to donor and acceptor impurities, Fermi level, Hall Effect, conductivity measurement Conductivity and Mobility.
Diodes: Barrier Formation in pn Junction Diode (Simple Idea). Current Flow Mechanism in Forward and Reverse Biased Diode (Recombination, Drift and Saturation of Drift Velocity). Derivation of Mathematical Equations for Barrier Potential, Barrier Width and Current for Step Junction. pn junction and its characteristics. Static and Dynamic Resistance. Diode Equivalent Circuit. Ideal Diode. Load Line Analysis of Diodes and Q-point.
Two-terminal Devices and their Applications: (1) Rectifier Diode. Half-wave Rectifiers.
Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification.
Efficiency. Qualitative idea of C, L and π - Filters. (2) Wave shaping circuits (3) Zener Diode and Voltage Regulation. (4) Photo Diode, (5) Varactor Diode.

Bipolar Junction Transistors, n-p-n and p-n-p transistors. Characteristics of CB, CE and CC Configurations. Current gains α, β and γ and Relations between them. Load Line Analysis of transistors. DC Load line and

Q-point. Physical Mechanism of Current Flow. Active, Cutoff, and saturation Regions. Transistor in Active Region and Equivalent Circuit.

Fundamental of Digital Circuits, Combinational Circuits.

Text Books:

1. Robbins, A. H. & Miller, W.C., *Circuit Analysis*, (Delmar Cengage Learning., 2003).
2. Hayt, W. H. & Kemmerly, J. E., *Engineering Circuit Analysis*, (McGraw Hill, New York, 1993).

Suggested Readings:

1. Millman, J., Halkias, C.C. and Jit, S., *Electronic Devices and Circuits*, (McGraw Hill Education,India, 2016).
2. Kumar, A., *Fundamentals of Digital Electronics* (PHI Learning Pvt. Ltd., 2003).
3. Toro,V. Del, *Electrical Engineering Fundamentals*, (Prentice Hall, 1994).
4. Edminister, J.A., *Electrical Circuits- Schaum's Outline series*, 2nd edition (McGraw Hill,1983).
5. Smith, R.J. and Dorf, R.C., *Circuits, Devices and Systems*, (John Wiley & Sons, 1992).
6. Morris, J. *Analog Electronics*, (Arnold Publishers, 1991).
7. Mottershead, A. *Electronic Circuits and Devices*, (Prentice Hall, 1997).
8. Streetman, B.G. & Banerjee, S., *Solid State Electronic Devices*, (Pearson Prentice Hall, 2006).
9. Bhargava, N. N., Kulshreshtha D.C. & Gupta S.C., *Basic Electronics & Linear Circuits*, (Tata McGraw Hill, 2006).
10. Boylestad, R. & Nashelsky, L. *Electronic Devices and Circuit Theory*, 8th edition, (Pearson Education, India, 2004).
11. Malvino A. P., *Electronic Principals*, (Glencoe, 1993).

PD 216: Thermodynamics and Statistical Physics (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be able to explain fundamental concepts relevant to thermodynamics and thermo dynamical systems, work, power and heat in thermodynamic systems, explain thermo dynamical laws in Isolated, Closed and Open systems and the concept of Entropy.

CO2: The students will be able to explain phase transitions and derive thermo dynamical laws form microscopic description in ideal fluid systems.

Course Content:

Macroscopic description of the state, extensive and intensive variables, temperature, thermodynamic variables (pressure, temperature, etc.), thermal equilibrium, equation of state.

Thermal conductivity, zeroth law of thermodynamics**,** temperature scales; work, heat and internal energy, the Gibbs-Duhem relation.

Thermodynamic processes: reversible, irreversible, quasi-static, adiabatic, isothermal.

First law of thermodynamics**,** specific heat capacity, enthalpy, kinetic theory of gases and Maxwell-Boltzmann statistics; calculation of pressure, kinetic interpretation of temperature, mean free path, Maxwell's distribution, equi-partition of energy; heat engines.

The second law of thermodynamics, Carnot cycle and Kelvin temperature scale, Clausius' theorem, entropy and its physical interpretation, entropy change for simple processes.

Free energies: Helmholtz free energy, Gibbs free energy, Legendre transformations, conditions of equilibrium, Maxwell's relations, phases and phase transitions, equilibrium between two-phases, general equilibrium conditions, the Clausius-Clapeyron equation, phase transformation of substances, Van der Walls gas and the liquid gas transition, thermodynamics of magnetic systems, The third law of thermodynamics.

Microscopic versus macroscopic points of view, kinetic theory of gases, concept of ensembles, micro-canonical, canonical, grand-canonical ensembles, partition function, postulates of classical statistical mechanics, derivation of thermodynamics from statistical mechanics principles, equation of state for ideal and real gases, Gibbs paradox.

Text Books:

1. Callen, H. B., *Thermodynamics and Introduction to Thermostatistics*, 2nd edition, (Wiley Student Edition).
2. Zemansky, M. W. and Dittman, R. H., *Heat and Thermodynamics*, 7th edition, (Tata McGraw-Hill International, 2007).

Suggested Readings:

1. Reif, F., *Fundamentals of Statistical and Thermal Physics*, (Tata McGraw-Hill, 1985).

PD 218: Modern Physics **(L2-T0-P1-CH4-CR3)**

Course Outcomes:

CO1: The students will be familiar with various important topics of Modern Physics.

CO2: The students will learn about the particle-like properties of e.m. radiation and wave-like properties of particles.

CO3: The students will learn about one-dimensional time independent Schrödinger equation and it's solutions in simple problems. Moreover they will be familiar with different models of the atom.

Course Content:

Particle-like properties of electromagnetic radiation: Electromagnetic spectrum, electromagnetic waves, blackbody radiation, the photoelectric effect, the Compton effect, Bremsstrahlung and X-ray production.

Wave-like properties of particles: deBroglie hypothesis, uncertainty relationships for classical waves, Heisenberg uncertainty relationships, wave packets.

One-dimensional time independent Schroedinger equation, probabilities and normalization, applications to the free particle, particle in a box (1-D and 2-D), the simple harmonic oscillator.

Models of the atom: Thompson model, Rutherford model, line spectra, Bohr model, Franck-Hertz experiment, the correspondence principle, deficiencies of Bohr atomic model, vector model, intrinsic spin, Stern-Gerlach experiment, hydrogen atom energy levels, Zeeman effect, fine structure, electronic states in many-electron atoms, X-rays.

Expansion of universe, background radiation, big bang cosmology, the future of the universe.

Text Books:

1. Krane, K. S., *Modern Physics*, (John Wiley & Sons, 1983).
2. Bernstein, J., Fishbane, P. M. and Gasiorowicz, S. G., *Modern Physics*, 1st edition, (Prentice-Hall, 2000).

Suggested Readings:

1. Beiser, A., *Concepts of Modern Physics* (McGraw-Hill, 2002).

PD 298: Physics Lab-IV **(L0-T0-P4-CH8-CR4)**

Course Outcomes:

CO1: The students will be able to learn practically the experiments using laser, optical fibre etc..

CO2: The students will also learn how to use the optical bench.

CO3: The students will get motivated to develop small experiments related to these techniques and develop their physical understanding.

Course Content:

1. To determine the resistivity of the given semiconductor sample by Four Probe method.
2. To determine the susceptibility of the given sample by Quince tube method.
3. To determine the Planck constant using different wavelength of light using Planck constant kit.
4. To study interference and diffraction with a laser beam at a single slit, double slit, three slits and four slits, and measure the slit separations.
5. To measure the spot size of a beam from a He-Ne laser and a diode laser and to calculate the M parameter.
6. To study the p-n junction characteristics and obtain output voltage at different frequencies.
7. To study connector losses in optical fibers:
    a. loss due to diameter mis-match,
    b. loss due to lateral off-set,
    c. loss due to angular misalignment
8. To measure the refractive index of a sample with a Michelson interferometer.
9. Determination of the focal length and hence the power of a convex lens by displacement method on an optical bench.
10. To find out the velocity of ultrasonic waves in a medium using ultrasonic interferometer.

ED 203: Contemporary Issues in Education **(L2-T0-P1-CH4-CR3)**

Course Outcomes:

CO1: The student will be able to contextualise education in promotion of constitutional values and utilize information about human rights to formulate policies in education.
CO2: The student will be able to recognise the intersection between gender and other socio-cultural identities and develop inclusive classroom environment.
CO3: The student will be able to understand the concept and importance of yoga education and demonstrate basic asanas and pranayams for holistic development.
CO4: The student will be able to identify factors that give rise to conflict and war and suggest strategies to promote peace through education.

Course Contents:

Unit-1: Indian constitution and Human Rights

Human Rights- Definition, Historical Background, United Nations and Universal Declaration of Human Rights, Right to Child Protection, Constitutional provisions, National Human Rights Commission, State Human Rights Commission, Role of Voluntary organizations and Educational Institutions, Constitutional provisions for Universalization of Elementary Education, Right to education and its implications for Universalization of Secondary Education (USE).

Unit-2: Gender Issues in Education

Gender Culture and Institution: Intersection of class, caste and religion, Construction of Gender in Curriculum Framework since Independence: An Analysis, Gender and the hidden curriculum, Gender in Text and Context (textbooks inter-sectionality with other disciplines, classroom processes including pedagogy),

Meaning of Equality of Educational Opportunities, provision and outcomes; constitutional provisions for ensuring equity; Nature and forms of inequality including dominant and minor groups, gender.
Inequality in schooling: public-private schools; Rural-urban-tribal schools, and differential school systems – schools for education of the challenged, idea of Common School System.

Unit-3: Inclusive Education
Definition, concept and importance of inclusive education; Historical perspectives on education of children with diverse needs; Difference between special education, integrated education and inclusive education. Advantages of inclusive education for education for all children, International& National Initiatives.
Current Laws and Policy Perspectives supporting IE for children with diverse needs.

Unit-4: Yoga Education

Origin of Yoga & its brief development, Yoga as a Science or Art (Yoga Philosophy and essential).
Meaning of Yoga, Objectives, Types, importance of yoga and yogic Asanas; Meditation – Objectives, types, effect on body, mind and soul, Yogic therapies and modern concept of Yoga.

Unit-5: Peace Education
Peace as a dynamic Social Reality; Relevance of Peace: regional, national and international contexts; Dangers to Social Security: terrorism, war, natural calamities and impact on quality of life. Peace context: conditions for promotion of peace, UNESCO's concerns on Peace and Understanding, National Integration, International Understanding; Role of education in promotion of peace: implications for pedagogy, Teacher role in promoting peace.

School Based Activities
Analysis of school textbooks from gender equality perspective. Survey of students on awareness of gender equality concerns. Students will visit the schools and identify the children with special needs and find out the extent to which they are benefited by the current laws and policy perspectives. Students will learn basic aasanas and pranayama during practical period and visit a school and give Yoga training to the students, Survey of students on awareness of human rights.

Text Books:

1. Gupta, S. *Education in Emerging India* (Shipra Publications, Delhi, 2008)
2. Rao, V. K. and Nayak, A.K. *Secondary Education* (A.P.H. Publishing Corporation, New Delhi, 2002).

Reference Books:

1. Kumar, Arvind. *Environmental challenges of the 21st century* (APH Publishing Corporation, New Delhi,2003).
2. Govt. of India *National Policy on Education* (Min. of HRD, New Delhi, 1986)
3. Govt. of India.*Programme of Action* (NPE). (Min of HRD, New Delhi, 1992)
4. UNESCO.*Education for All: The Quality Imperative*. EFA Global Monitoring Report. (UNESCO, Paris, 2004)

ED 204: Assessment and Evaluation (L2-T0-P1-CH4-CR3)

Course Outcomes:
CO1: The student will be able to critically analyse the recent trends and scope of assessment and evaluation.
CO2: The student will be able to examine the contextual roles of different forms of assessment in schools.
CO3: The student will be able to explore the different dimensions, procedures, tools and techniques related to assessment.
CO4: The student will be able to examine the issues and concerns of assessment and evaluation practices in schools.
CO5: The student will be able to apply the statistical tools for analysis and interpretation in educational assessment process.

Course Contents:

Unit 1: Perspectives on Assessment and Evaluation

Conceptual overview of assessment and Evaluation; Meaning, Principles and Purposes of Assessment and Evaluation; Forms of assessment: based on purpose: prognostic, formative, diagnostic and summative, nature of information gathered: qualitative, quantitative, nature of interpretation: norm referenced, criterion referenced.

Unit -2: Tools and Techniques for Assessment and Evaluation

Different Types of Tests; Paper pencil tests, Oral tests, and Performance tests, Construction of an Achievement Test and Diagnostic test.

Different Types of Tests; Rating scale, Check list, Anecdotal records , Socio-metric technique, Interview, Questionnaire and Inventory.

Use of Projects, Assignments, Work sheets, Practical work, Seminars and Reports as assessment devices.

Self-assessment and peer-assessment practices, Developing and maintaining a comprehensive learner profile.

Unit-3: Reforms in Evaluation

Recent trends and practices prevailing in assessment and evaluation: online assessment, open book exam, participatory assessment, performance based assessment, Rubrics & Portfolios: Meaning and significance in evaluation; Continuous and comprehensive evaluation, Credit system and Grading - direct and indirect.

Unit- 4: Issues, Concerns and Trends in Assessment and Evaluation

Issues and Problems: Marking Vs Grading, No detention policy, Objectivity Vs Subjectivity; Policy perspectives on examinations and evaluation: Recommendations in National Policies of Education and curriculum frameworks. Impact of entrance test and public examination on teaching and learning.

Unit-5: Elementary Statistics in Educational Evaluation

Need and importance of statistics in education; Classification and tabulation of data; Graphical representations of data.

Measures of central tendency, Measures of variability, Measure of Relative Position: Percentiles and Percentile Ranks; Normal distribution - normal probability curve and its characteristics.

Engagement with the Field/Practicum/Activity: The Students may undertake any one of the following activities:

Design a Questionnaire or Interview Schedule in a selected topic, Design different types of questions items and identify the reliability of the test. Present the report of student: using a portfolio or rubrics.

Text Books:

1. Sidhu, K.S. (2009).*New Approaches to Measurement and Evaluation*, Sterling Publishers, New Delhi
2. Lal, J.P. (2006) *Educational Measurement and Evaluation*. New Delhi: Anmol Publications
3. George, D. (2005) *Modern Trends in Examination System*. New Delhi: Commonwealth Publication

Reference Books:

1. Reid, Howard M. (2013). I*ntroduction to Statistics-Fundamental Concepts and Procedures of Data Analysis.* New Delhi: SAGE Publications Pvt Ltd.
2. Gardner, John (2012). *Assessment and Learning* -2nd edition. New Delhi: SAGE Publications India Pvt. Ltd.
3. Pearson *Series in Education (2012) Essentials of Educational Technology and Management*, New Delhi, Pearson Education
4. Quinlan, Audrey M. A (2012). *Complete Guide to Rubrics: Assessment Made Easy for Teachers*, K. D. College, USA: Rowman Littlefield Education.

Online/Web Resources/eBooks (Links):

1. Hickey, D. & Itow, R. C. (2012). Participatory assessment for participatory teaching and learning in school contexts**.** *Designing with Teachers: Participatory Approaches to Professional Development and Education*,78-88. https://dmlhub.net/wp-content/uploads/2012/08/designing-with-teachers.pdf
2. Northern Illinois University Center for Innovative Teaching and Learning. (2012). Rubrics for assessment. *Instructional guide for university faculty and teaching assistants.* https://www.niu.edu/citl/resources/guides/instructional-guide
3. Davis, M. H., & Ponnamperuma, G. G. (2005). Portfolio assessment. *Journal of Veterinary Medical Education*, *32*(3), 279–284. https://doi.org/10.3138/jvme.32.3.279
4. Brualdi A. (2000). Implementing Performance Assessment in the Classroom. *Classroom Leadership, 3*(5) http://www.ascd.org/publications/classroom leadership/feb2000/Implementing-Performance-Assessment-in-the-Classroom.aspx

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Semester-V

PD 303: Physical and Geometrical Optics (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be able to understand basic concepts and calculations of geometrical and physical optics.

CO2: The students will be able to apply the laws of reflection and refraction to plane and spherical surfaces and will be able to understand and recognize aberrations.

CO3: The students are expected to understand wave propagation of light as well as to explain fringe patterns of various experiments and observations.

Course Content:

Basic Geometric Optics: law of reflection, reflection from planar and curved surfaces, Snell's law; refraction at the planar and curved surfaces, thin lens, prisms.

Matrix methods: matrix optics concepts and basic matrices, cascading matrices: thin lens, thick lens, principal planes and imaging, study of a compound lens.

Aberrations: monochromatic and chromatic aberrations, Seidel aberrations: spherical aberration, coma, astigmatism, field curvature and distortion, chromatic aberrations, examples.

Polarization: light as a transverse wave, linear and circular polarizations, methods of producing and analyzing polarized light, linear polarizers and wave plates, Fresnel reflection and transmission coefficients, total internal reflection, Jones vectors and matrices for the ploarizer and wave plate, Stokes vectors and Muller matrices.

Interference: division of wavefront and amplitude, intensity distribution in an interference pattern, visibility of fringes, Young's double-slit interferometer, Michelson interferometer, Rayleigh interferometer, multiple beam interference: Fabry-Perot etalon and interferometer, resolving power.

Diffraction: Fresnel-Huygens theory of diffraction, Fresnel and Fraunhofer regions of diffraction, diffraction at a straight edge, Fraunhofer diffraction at the slit, circular and rectangular apertures, resolving power of a telescope, diffraction at multiple slits, grating, resolving power of a grating.

Holography: recording and reconstruction of a wave, characteristics of the diffracted waves from the hologram, diffraction efficiency, types of the holograms, zone plate analogy of the hologram.

Fourier Optics: simple concepts.

Text Books:

5) Subrahmanyam, N., Lal, B. and Avadhanulu, M. N., *A Textbook of Optics*, (S. Chand & Co. Ltd., 2012).
6) Mathur, B. K. and Pandya, T. P., *Principles of Optics*, (Tata McGraw-Hill International, 1981).

Suggested Readings:

4) Chakraborty, P. K., *Geometrical and Physical Optics*, 3rd edition, (New Central Book Agency(P) Ltd., 2005).
5) Hecht, E., *Optics*, 4th Edition, (Addison-Wesley Pub. Co., 2001).
6) Born, M. and Wolf, E., *Principles of Optics*, 7th edition, (Pergamon Press Ltd, 2000).
7) Jenkins, F. A. and White, H. E., *Fundamentals of Optics*, 4th edition, (Tata McGraw-Hill International, 1981).
8) Sirohi, R. S., *Wave Optics and Applications*, (Orient Longman, 1993).

PD 202: Introductory Quantum Mechanics (L2-T1-P0-CH4-CR3)

Course Outcomes:

CO1: The students will be familiar with the various introductory topics of Quantum Mechanics. They are expected to learn about the origin of quantum theory and inadequacy of classical ideas.

CO2: The students will learn about wave-particle duality and de Broglie's hypothesis with related experiments. Students are expected to learn about uncertainty relation, wave function and its probabilistic interpretation.

CO3: The students will learn about Schrodinger equation and it's solutions in various simple situations.

Course Content:

Origin of quantum theory, inadequacy of classical ideas, Planck's quantum hypothesis, photoelectric effect, Compton scattering.

Wave-particle duality, deBroglie's hypothesis, experimental evidence for deBroglie's hypothesis, Davisson-Germer experiment, Thompson experiment.

Simple consequences of uncertainty relation, wave function and its probabilistic interpretation, wave packet and uncertainty relation.

Schrodinger equation, solution of one-dimensional Schrodinger equation for an infinite square well potential, reflection and transmission at potential steps, qualitative treatment of barrier penetration for simple rectangular barriers.

The quantum harmonic oscillator.

Text Books:

1. Schiff, L. I., *Quantum Mechanics*, 3rd edition, (McGraw-Hill, New Delhi, 1968).
2. Ghatak, A. and Lokanathan, S., *Quantum Mechanics*, 5th edition, (Macmillan, 2004).

Reference Books:

1. Merzbacher, E., *Quantum Mechanics*, 2nd edition, (John Wiley, New York, 2005).

2. Richtmyer, F. K., Kennard E. H. and Lauritsen, T., *Introduction to Modern Physics*, 5th edition, (McGraw-Hill, 1976).
3. Waghmare, Y. R., *Fundamentals of Quantum Mechanics*, 1st edition, (Wheeler publishing, 1996).
4. Mathews, P. M. and Venkatesan, K., *A Textbook of Quantum Mechanics*, 2nd edition, (Tata McGraw-Hill, 1976).

PD 315: Mathematical Physics-II **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to solve the ordinary and partial differential equations, differential equations with special functions and their uses in physics.

CO2: The students will also learn the use of integral transforms in physical problems.

Course Content:

Ordinary differential equations, second-order homogeneous and inhomogeneous equations, Wronskian, general solutions, adjoint of a differential equation, ordinary and singular points, series solution, Legendre, Hermite, Laguerre and the associated polynomials, their differential equations, generating functions, Bessel functions, spherical Bessel equations, integral representation of special functions.

Generating functions, Recurrence relations, Rodrigue's formulae and orthogonality of the special functions, Sturm Liouville problem, elements of hyper-geometric functions, Gauss hyper-geometric and confluent hyper-geometric equations, Dirac delta function, Green function.

Partial differential equations in physical problems: Laplace's equation, Poisson's equation, Heat flow equations, Wave equations, Helmholtz equations, solutions of these equations, eigenvalue problems, boundary value problems, method of separation of variables.

Integral transforms: Laplace transform, Hankel transform, Mellin transform, Fourier transform.

Properties of Laplace and Fourier transforms, application of Laplace and Fourier transforms.

Text Books:

1. Harper, C., *Introduction to Mathematical Physics, (*Prentice Hall, 2009).
2. Arfken, G. B., and Weber, H. J., *Mathematical Methods for Physicists*, (Elsevier Ltd, Oxford, 2005).

Suggested Readings:

1. Spiegel, M. R., *Vector Analysis*, Schaum's outline series, (Tata McGraw-Hill 1979).
2. Morganeau, H. and Purphy, C. M., *The Mathematics of Physics and Chemistry,* (Young Press, 2009).

PD 309: Analog Electronics & Communications **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to acquire the knowledge with facts and figures related to this field for better understanding in higher versions of electronic and communication devices.

Course Content:

Op-Amp with and without feedback: Open loop considerations-inverting, non-inverting, differential, feedback-voltage follower, Practical op-amps: Offset considerations-input offset voltage, input bias current, input offset current, thermal drift, effect of power supply voltage, other temperature sensitive parameters, noise, CMRR, maximum common mode input voltages, op-amp instrumentation circuits.

Linear Applications: Op-amp as ac amplifiers, summing and averaging circuits, integrators, differentiators, voltage-current converter, current-to voltage converter, analog computers, voltage regulators.

Introduction to communication systems: Elements of a Communication System, terminologies in Communication systems, basics of signal representation and analysis. Noise: external, internal, noise calculations, noise figure. Amplitude modulation techniques: Theory and generation of AM, DSBSC, SSB, VSB.

Angle modulation techniques: theory, practical issues and generation of Frequency Modulation (FM) and Phase.

Radio transmitters and receivers: Introduction to – AM, SSB, FM Transmitters. Receiver Types: tuned radio-frequency (TRF) and superheterodyne receiver, AM and FM Receivers.

Radiation and propagation of waves -Electromagnetic Radiation, Effects of the Environment, Propagation of Waves - Ground (Surface) Waves, Sky Waves and Space Waves.

Text Books:

1. Gayakward, R.A., *Op-Amps and Linear Integrated Circuits*, 3rd Edition, (PHI, 2001).
2. Kennedy, G., Bernard D. and Prasanna, S. R. M., *Electronic Communication Systems*, (McGraw-Hill Global Education India, 5th edition, 2011).

Reference Books:

1. Hambley, A. R., *Electronics*, 2nd Edition, (Prentice Hall, 2000).
2. Horowitz, P. and Hill, W. *The Art of Electronics*, 2nd Edition, (Cambridge University Press, 1995).

PD 204: Atomic and Nuclear Physics (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will be familiar with the fundamentals of atomic and nuclear physics.

CO2: The students will be able to take advanced course on atomic and molecular physics and Nuclear and particle physics.

Course Content:

Atomic Physics: The Bohr model of the hydrogen-like atom, brief account of the Sommerfeld model, electron spin; Stern-Gerlach experiment, space and spin quantization, the vector model of the atom, spin-orbit interaction, fine structure of spectral lines, LS and jj coupling, the Zeeman effect, Paschen-Back effect, Stark effect, scattering of light: Rayleigh scattering formula, colour of the sky, polarisation of the scattered light.

Nuclear Physics: General properties of nuclei, concept of nuclear size, spin, parity, magnetic dipole moment and electric quadropole moment of nuclei, nuclear forces and stability of nuclei, concept of packing fraction and binding energy, binding energy curve and its significance.

Natural radioactivity and radioactive decay: Type of radioactive decays, theory of radioactive disintegration, radioactive constants, mean-life of a radio element, radioactive equilibrium, half-life of a radio element, determination of decay constant and half-life.

Nuclear reactions: Types of nuclear reactions, conserved quantities of nuclear reaction, energies of nuclear reaction, Q-value, exoergic & endoergic reactions, nuclear fusion and fission reactions.

Detectors: Principles of detection of charge particles, construction and working principle of gas-filled detectors, ionization chamber, its construction and working principle, interaction of γ-particle with matter, construction and working principles of a scintillating detector.

Text Books:

1. Krane, K. S., *Introductory Nuclear Physics*, (John Wiley, New York, 1987).
2. White, W. H., *Introduction to Atomic Spectra*, (McGraw-Hill, 1934).

Reference Books:

1. Green, A. E. S., *Nuclear Physics*, (McGraw-Hill Book Company, Inc., New York, 1955).
2. Srivastava, B.N., *Basic Nuclear Physics and Cosmic Rays*, (Pragati Prakashan, Meerut, 2011).

PD 399: Physics Lab-V (L0-T0-P4-CH8-CR4)

Course Outcomes:

CO1: The students will be able to understand the theory related to the experiment and their application in their future course of time.

CO2: The students will acquire motivation to develop small experiments related to these techniques and develop their physical understanding.

Course Content:

1. To find out the magneto-resistance of the semiconductor sample as a function of magnetic field and to plot the graph between magnetic field vs. potential developed using magneto-resistance set-up.
2. To plot the gain – bandwidth relation for a negative feedback amplifier using IC 741.
3. To find out the Curie temperature of the given ferromagnetic material ($BaTiO_3$) using Curie temperature kit.
4. To study Malus' law of polarization.
5. To measure optical nonlinearity using z-scan method.
6. To find out the value of Boltzmann constant using Boltzmann Constant kit.
7. To find out the Rydberg constant by observing the Balmer series of Hydrogen using spectrophotometer.
8. To study diffraction at a circular aperture and find the resolving power of a given lens used as an objective of a telescope.
9. a. Develop a clipping and a clamping circuit and determine the output voltage with different DC bias voltage applied.
   b. Design and develop a full wave and a half wave rectifier circuits and find out the ripple factor of the circuits.
10. To study the temperature dependence of Hall coefficient of a semiconductor sample using Hall effect set-up.

ED 301: Teaching Approaches and Strategies (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The student will be able to demonstrate his/her understanding of the role of a teacher at different phases of Instruction.

CO2: The student will be able to demonstrate his/her understanding of different skills and their roles in effective teaching.

CO3: The student will be able to critically reflect on the suitability of learning resources planned in teaching-learning and design ICT integrated learning resources.

CO4: The student will be able to understand and apply Learning Resources for Different Pedagogies.

CO5: The student will be able to understand changing roles and develop competencies of a teacher in technology enhanced learning

Course Contents:

Unit -1: Understanding Teaching

Teaching as a planned activity – elements of planning; An analysis of teacher roles and functions:

i) Pre-active phase: visualizing; decision-making on outcomes, preparing and organization;

ii) Interactive phase facilitating and managing learning;

iii) Post-active phase – assessment of learning outcomes,

Professionalism in teaching, professional ethics, concepts of teaching- skills, competencies and commitments.

Unit- 2: Teaching Approaches and Models of Teaching

Instructional Skills: Structuring, Soliciting and Reacting, Verbal and Non-verbal, Feedback and Reinforcement, Discourse, Demonstration and Modeling.

Advance Organizer Model, Inquiry Strategy as approach to teaching thinking skills and construction of knowledge, Concept Attainment/ Concept Formation, Inductive Thinking, Problem Based Learning/Project Based Learning.

Approaches to Organizing Learning - Approaches to Individualized Instruction: Computer Managed Instruction, Programmed Instruction, and Learning Activity:

Packages; Approaches to Small Group and Whole Group Instruction: Cooperative and Collaborative approaches to learning, Brain storming, Role Play and Dramatization, Group Discussion, Simulation and Games, Debate, Quiz and Seminar.

Unit -3: Learning Resources for Classroom Teaching

Meaning, purpose, steps in development, guidelines for use, and criteria of judging quality of the following resources.

Print Resources: resources for communicating verbal experiences - text book, work book, Case study and self-instructional material.

Audio Resources: resources for communicating audio experiences - educational radio.

Broadcast and audio programmes – an analysis of their formats, strengths and limitations, Visual Resources: Resources for communicating visual experiences.

Non-projected visual Resources: graph, map chart, poster, models and material – nature of experiences provided by them, their making and possibilities of using them as learning resources.

Projected Visual Resources: still visuals – slide, transparency and film-strip, moving visuals –film, video and animation.

Unit-4: Learning Resources for Different Pedagogies

Media selection, utilization and integration into teaching and learning – learning resources for different pedagogies: a classification of learning resources based on teaching objectives.

Principles of self-learning; Ways and means of promoting self-learning: organization, merits and demerits of Computer Assisted Instruction, personalized system of instruction, self-paced activity, Learning activity packages, learning centers, mini courses, modular instruction, and Programmed instruction; Learning to learn skills – An analysis and teacher's role in promoting them.

Unit-5: Technology-Enhanced Learning Resources

ICT and Multimedia as technology-enhanced communication devices in teaching-learning: a comparative review of various learning resources, Flip Class; Interactive white board – its features and advantages.

Computer as a learning resource for presentation, documentation, word processing, evaluation. Animation and other visual presentation options on a computer; Internet as an Information Resource; evaluating information resources on the Internet.

Emerging Internet trends and technologies for facilitating learning; Designing and Developing Technology-enhanced Learning Material; Changing roles and competencies of a teacher in technology enhanced learning.

School Based Activities:

Students will visit the school and observe the learning resources available in the school.

Preparation of at least three teaching-learning resources from those mentioned in Unit 2. Planning and preparation of an ICT integrated presentation for secondary level. Identification and use of an internet resource for learning at the secondary level; Critical analysis of an existing learning resource.

Observe the teachers of various classes and identify the skills they adopt in their interaction with pupils.

Observe a teacher in action in the classroom and list down his/her various behaviors. Observe the transactional mode of teachers who adopt different teaching methods.
Write down the name of a few methods that teachers generally employ for the purpose of teaching and classify them under teacher centered, pupil centered or group centered. Writing instructional objectives for different content categories; Identifying skills incorporated in a lesson plan and judging their appropriateness and Adequacy; Practice of skills in a simulated situation.

Text Books:

1. Kochar, S.K. *Methods and Techniques of Teaching* (Sterling Publishers, New Delhi, 2009).
2. Rao, V.K. and Reddy, R.S (ed.) *Teaching and Learning*. Commonwealth Publishers, New Delhi, 2007.
3. Sampath K. et al *Introduction to Educational Technology* (Sterling Publishers, New Delhi, 2009)

Reference Books:

1. Bloom, B S., Englehart M D, Furst E J, Hill W H and Khrath wohl, D. R. *Taxonomy of Educational Objective Handbook 1, Cognitive Domain, Handbook 2*, Affective Domain Longman, London,1964 .
2. Jangira N K and Ajit Singh Core *Teaching Skills: The Microteaching Approach*. NCERT, New Delhi, 1982.
3. Kumar, K L *Educational Technology*. New Age International (P) Ltd Publishers, NewDelhi, 1996.

ED 302: Classroom Organizations and Management (L2-T0-P1-CH4-CR3)

Course Outcomes:
CO1: The student will be able to analyse the purpose of classroom management for effective teaching-learning process.
CO2: The student will be able to describe various physical facilities required for smooth functioning of school activities.
CO3: The student will be able to explain the role of teachers and the principal in ensuring a vibrant school climate.
CO4: The student will be able to discuss various ways of preventing problems in managing a classroom.
CO5: The student will be able to explain various mechanisms for coordinating the functions of school.

Course Contents:
Unit -1: Classroom Organization
Classroom organization– Meaning and purposes. Seating arrangements and its purposes.
Concept of a smart classroom. Display area and chalk board – other facilities such as OHP and Multimedia in a classroom.
Characteristics of School climate – conducive, learner friendly, inclusive, vibrant, Relation between school policy and school climate

Unit -2: Physical Facilities in a School
Physical resources in a school - physical space (building) with adequate classroom space, adequate furniture, learning resources such as labs, library, sports field, and staffrooms, rest rooms, etc.
Management of physical resources - Cleanliness, appropriate use of each with an intent or Schedule; Streamlining ways of using the facilities: coordination, sharing

Unit-3: School Environment- Teachers' Role
School as an institution with an environment of its own leadership style of the headmaster and its influence on teacher role performance.
Visualize the requirements- procure, maintain and replenish with support of authorities, Teacher self-assessment and accountability – importance of feedback,

Factors affecting school environment - goodwill, acceptance, belongingness, openness, orderliness, and access, both among teaches and between teachers and students, promoting self-esteem among students; Team work and transparency in functioning among teachers

Unit- 4: Classroom Management

Classroom management – concept, need and approaches; Roles of students in a classroom – leader, follower and non-participant.

Role of a teacher in classroom management – relationship between leadership styles of a teacher and classroom discipline.

Managing behavior problems in a classroom– Preventative, Supportive and Corrective. Common - mistakes in classroom behavior management. Establishment of routines, rules and procedures.

Punishment and its legal implications – the rights of a child; Time management in a classroom – allocated time versus engaged time.

Unit – 5: Mechanisms for Coordinated Functioning in School

Planning: annual and long term; annual school calendar; Day to day schedules- time table, notifications, announcements, Monitoring for coordinated functioning: allotment, autonomy and accountability (internal and external)

Staff Meetings: forum for sharing, review and further planning,Regular, documentation of events and activities; Approaches to professional development of teachers in a school.

Mechanisms that promote and hinder school-community and teacher-parent relationship

School Based Activities:

Students will visit the school and:

1. Observe the school environment and identify the problems of the students and interact with head and teachers regarding the solutions**.** Conduct an action research project on secondary school classroom problem.
2. Survey of resources available (human and material) in a school and the manner of their utilization.
3. Draw out a plan of the school building in the area and write a critical report.
4. In consultation with the principal and teachers of a school, prepare an institutional plan.
5. Observe the various activities run in the school to understand the mechanism of school. Assess the existing monitoring mechanism at secondary school and give suggestion for improvement.

Text Books:

1. Krishnamacharyulu. V. (2008), *School Management and system of Education*. Neelkamal publications PVT. LTd.
2. Siddhu, S.K.(1987) *School Organization and Administration*. New Delhi: Sterling Publishers
3. Gupta, S. K. and Gupta S (1991) *Educational Administration and Management* (ManoramaPrakashan, Indore).

Reference Books:

1. Wayne Hoy & Cecil mskel (2012) *Educational Administration: Theory, Research and Practice*. Mcgraw Hill Humanities. (9th edition).
2. Fred.C.Lunenburg& Allan C.Ornstein.(2011).*Educational Administration: Concepts And Practices*,*Cengage Learning*(6th Edition).
3. Marsh, C.(2000).*Handbook for Beginning Teachers. Second Edition* (Pearson Education, Australia.
4. Vashist, Savita(ed.).(1998). *Encyclopedia of School Education and Management* (Kamal Publishing House, New Delhi.
5. Chau, Ta-Ngoc. (2003): *Demographic Aspects of Educational Planning. Paris: International Institute for Educational Planning*.

Semester-VI

PD 307: Basic Material Science **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.

CO2: The students will be able to qualitatively derive a material's elastic property.

CO3: The students will be able to do simple crystallography and diffusion problems.

Course Content:

Fundamentals of crystallography: Bravais lattice, unit cell, crystal systems, Miller indices of crystal planes and directions, point groups.

Typical crystal structures: Simple (sc) cubic, body centered (bcc) cubic and face centered (fcc), cubic and structures, Hexagonal closed packed (hcp), Diamond and Zinc blende (ZnS) closed packed structures, packing factors, NaCl, CsCl and cubic perovskite and wurtzite structures.

Structure of solids: linear and planar density, ligancy, packing efficiency, closed pack planes and directions, voids.

Crystal imperfections*:* point imperfections (vacancies and interstitials), Frenkel and Schottky defects, dislocations, grain boundary, grain growth and surface energy calculation.

Crystal binding: Primary and secondary bondings, bond length and bond energy, van der Waals bonding, inert gas crystals, ionic, covalent and metallic bondings, Madelung constant, Madelung energy.

Phase and phase transformation: Melting point of crystalline and amorphous solids, degrees of freedom, phase rule, binary alloys, nucleation and phase transformation.

Elastic properties, Young, bulk and rigidity moduli, yield stress, Poisson's ratio, compressibility, creep and fatigue, plasticity.
Diffusion*:* Fick's first and second laws, thermal diffusion.

Text Books:

1. Callister, W. D., *Materials Science and Engineering*, 5th edition (John Wiley, 2000).
2. Raghavan, V., *Materials Science and Engineering*, 4th edition (Prentice Hall India, 1991).

Suggested Readings:

1. Kittel, C., *Introduction to Solid State physics*, 7th edition, (Wiley Eastern Ltd.,1996).
2. Burns, G., *Solid State Physics*, (Academic press, 1995).
3. Dekker, A. J., *Solid State Physics*, (Macmillan India Ltd., 2003).
4. Ashcroft, N. W. and Mermin, N. D., Solid State Physics, (Saunders, 1976).
5. Smith, W. F., *Principles and Materials Science and Engineering*, 2nd edition (Tata McGraw-Hill Inc., 1990).
6. Patterson, J. D. and Bernard, B., *Introduction to the Theory of Solid State Physics*, 2nd edition, (Springer, 2007).
7. Ghatak, A. K. and Kothari, L.S., *Introduction to Lattice Dynamics*, (Addison-Wesley, 1972).
8. Hall, H. E. and Hook J. R., *Solid State Physics*, 2nd edition, (Wiley, 1991).
9. Azaroff, L. V., *Introduction to Solids*, (Tata McGraw-Hill, 1977).
10. Mathur, D. S., Properties of Matter, (S. Chand & Co., 2010).

PD 317: Basic Computation Techniques **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be skilled in C language programming and develop algorithms and programs to tackle physics problems.

Course Content:

Introduction to computers.

Programming using FORTRAN; programming using C and C^{++}

Simple programming examples from calculus; solution of simple algebraic equations, solution of simple differential equations.

Examples of least squares curve fitting, matrix eigenvalue problems.

Text Books:

5. Gottfried**,** B. S**.,** *Schaum's outline of theory and problems of programming with C***,** (McGraw-Hill Professional, 1996).
6. Mayo, W. E. and Cwiakala, M., *Schaum's Outline of Programming With Fortran 77*, Schaum's Outline series, (McGraw-Hill, 1995).
7. Scheid, F., *Schaum's outline of theory and problems of numerical analysis*, 2nd edition, Schaum's outline series, (McGraw-Hill, 1989).

Suggested Readings:

5. Kanetkar, Y., *Let us C,* (BPB *Publications*, 2012).
6. Mathews, J. H., *Numerical Methods for Mathematics, Science and Engineering*, (Prentice Hall).
7. Narsingh Deo, *System Simulation with Digital Computers*, (Prentice Hall, 1979).

PD 311: Waves and Acoustics (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will acquire the knowledge on the physical treatment of different harmonic waves.

CO2: The students will be able to analyze any harmonic waves mathematically.

CO3: The students will be able to learn various important phenomena of acoustic waves and their applications in diverse fields of research.

Course Content:

Vibrations: Potential energy vs. displacement relation, concept of equilibrium, development of simple harmonic oscillation (SHO) and other anharmonic terms from force equations, damped oscillation, critical damping, Q-factor of an oscillator, forced vibration, resonance, low and high frequency responses, eigen frequency and normal modes, energy transfers between modes, coupled pendulum, Lissajous figures, anharmonic oscillator, Fourier series and Fourier coefficients, Fourier analysis in some simple cases.

Waves: Progressive wave in one-dimension and in three-dimensions, wave equation, plane wave and spherical wave, intensity, dispersion, group velocity, phase velocity, speed of transverse waves in a uniform string, eigen frequencies and eigen modes for plucked and struck strings, speed of longitudinal waves in a field, energy density and intensity of waves.

Superposition of waves: Superposition principle, interference in space and energy distribution, beats, combinational tones, production, detection and applications of ultrasonic waves, Doppler effect, shock waves.

Acoustics: Vibrations in bounded system, normal modes of a bounded system, harmonics, quality of sound, noise and music, intensity and loudness, bel and phon, principle of sonar system, acoustic transducers and

their characteristics, recording and reproduction of sound, measurement of velocity, frequency and intensity, acoustics of halls, reverberation and Sabines formula.

Text Books:

3. Chattopadhyay, D., *Vibration, Waves and Acoustics*, (New Central Book Agency, 2010).
4. Main, I. G., *Vibrations and Waves in Physics*, 2nd edition (Cambridge University Press, 1984).

Reference Books:

1. Randall, R. H., *An Introduction to Acoustics*, Sect. 7-21, 7-22, (Addison-Wesley, 1951).
2. Wood, A. B., *A Textbook of Sound*, 3rd Edition, (Bell & Sons, 1955).
3. Crawford, F. S., *Waves*, *Berkeley Physics Course*, Vol. 3, (Tata McGraw-Hill, 1968).
4. Pain, H. I., *The Physics of Vibrations and Waves*, 6th edition (John Wiley & Sons Ltd., 2005).

ED 308: Pedagogy A: Physical Science-I (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The students will be able to describes the meaning, nature, scope and historical development of physical science and discuss strategies to promote scientific attitude, scientific temper among learners following the steps of scientific method.
CO2: The students will be able to formulate the aims and objectives of teaching and learning physical science.
CO3: The student will be able to design the framework of lesson plan using different teaching methods, approaches and strategies for teaching-learning of physical science.
CO4: The student will be able to develop and use various resources for teaching-learning physical science.
CO5: The student will be able to compare the perspective of science curriculum in the NCFs with prescribed school science syllabus and textbooks.

Course Contents:

Unit -1: Nature and Scope of Physical Science
Nature and Scope of Physical Science, Historical and Developmental Perspectives of Science; Role of Science in Removing Ignorance and Superstition, Bringing Socio-Economic Changes Concern to Environment; Steps in Scientific Method. Developing Scientific Attitude and Scientific Temper; Science process skills.

Unit–2: Aims & Objectives of Teaching and Learning Physical Science
Aims & Objectives of Teaching Physical Science at Secondary School Level. Formation of General and Specific Objectives w.r.t the Taxonomy of Educational Objectives(Bloom's Taxonomy with Anderson & Krathwohl's Revision); Nurturing Curiosity, Creativity and Aesthetic Sense in Physical Science, Development of Problem Solving Skills in Physical Science.

Unit-3: Pedagogy of Physical Science
Criteria of selecting Appropriate Method, Approach and Strategy of Teaching-Learning Physical Science; Methods of Teaching-Learning Physical Science: Teacher Centred and Students Centred.

Approaches and Strategies of teaching-Learning Physical Science: Constructivist Approach, Collaborative Learning Approach, Problem Solving Approach, Concept Mapping, Cognitive conflict, Experiential Learning Approach, Inquiry Approach, Analogy Strategy etc. ICT in Science Education.

Unit-4: Resources for Teaching-Learning in Physical Science
Identification of Learning Resources from Immediate Environment, Community resources in Teaching Learning Physical Science, Handling Hurdles in Utilisation of Resources.

Exploring Alternatives Resources, Collection of Locally Available materials and Improvisation of Apparatus, Science Kits; Laboratory as a Learning resource, Planning and organization of Physical science laboratory; Technology: Use of Various Web Resources (ICT resources) in Physical Science Teaching.

Unit-5: Physical Science Curriculum and Text Book

Place of Physical Science in School Curriculum; Issues and Concerns of Physical Science Curriculum; National Curriculum Frameworks of NCERT with Special Reference to Science Education, Emphasis of NCF-2005 on Transaction of Curriculum.

Analysis of Text Books, School Syllabus and Other Printed Materials in Physical Science (State, NCERT etc.), Characteristics of a Good Text book.

Engagement with the Field/Practicum/Activity: The Students may undertake any one of the following activities: Visit a school and organize a group activity to develop scientific attitude like quiz, role-play, panel discussion etc. Visit a school and organize a science exhibition and poster presentation of scientific concepts. Students will visit the school and identify various components in science laboratory and other related activities. Preparation of low cost and no cost learning teaching aids on any topic. Content analysis of any topics of sciences.

Design & develop at least two learning resources for physical science (one out of them has to be an ICT based learning resource). Design a learning situation in Physical Science by selecting an appropriate strategy. Comparing the science textbooks at Secondary Stage on the basis of different validities of Science Curriculum stipulated in NCF-2005.

Text Books:

1. Vaidya,N. (1999). *Science Teaching for 21st Century*. Deep & Deep Publications.
2. Mohan, R. (2002). *Innovative Science Teaching for Physical Science Teachers*. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Das, R.C. (2009). *Science Teaching in Schools*. Sterling, New Delhi
4. Gupta, S. K. (1985). *Teaching of Physical Science in Secondary Schools*. New Delhi.
5. NCERT (2013). *Pedagogy of Science*, Textbook of B.Ed., Part I&II, National Council for Educational Research and Training, New Delhi.

Reference Books:

1. NCERT (2005). *National Curriculum Framework for School Education*. National Council of Educational Research and Training (NCERT), New Delhi.
2. NCERT (2006). *Position Paper of National Focus Group on Teaching of Science*. New Delhi: NCERT
3. Tobin, K.(1993). *The Practice of Constructivism in Science Education. Lawrence Erlbaum Associates*.
4. Tony L., Matt C., Bernie K. and Judith T.(2010).*Teaching Science*. New Delhi, Sage Publication India Pvt .Ltd.

Online/Web Resources/Websites/eBooks (Links):

1. International Bureau of Education The Chinese National Commission For Unesco (2000). *Science Education For Contemporary Society :Problems, Issues and Dilemmas.* Final Report Of The International Workshop On The Reform In The Teaching Of Science And Technology At Primary And Secondary Level In Asia:Comparative References To Europe.
http://www.ibe.unesco.org/sites/default/files/China_FinalReport.pdf
2. National Academy of Sciences and . 2008. *Science, Evolution, and Creationism*. Washington, DC: The National Academies Press. https://doi.org/10.17226/11876.
3. McFarlane A. & Sakellariou S. (2002). The Role of ICT in Science Education, Cambridge Journal of Education, 32:2, 219-232, DOI: 10.1080/03057640220147568
4. Rocha Fernandes G.W., Rodrigues A.M., Rosa Ferreira C.A. (2019) ICT-Based Science Education: Main Digital Resources and Characterisation. In: Using ICT in Inquiry-Based Science Education. SpringerBriefs in Education. Springer, Cham. https://doi.org/10.1007/978-3-030-17895-6_1

ED 307: Pedagogy B: Mathematics- I **(L2-T0-P1-CH3-CR 3)**

Course Outcomes:

CO1: The student will be able to acquaint with the meaning and nature of discipline mathematics
CO2: The student will be able to internalize the aims and objectives of teaching mathematics and endow with the significance of taxonomy of instructional objectives of teaching mathematics
CO3: The student will be able to inquire into the contribution of eminent mathematicians
CO4: The student will be able to gain perspective on the principles, approaches and the recent trends in mathematics curriculum structuring and the mode of transaction
CO5: The student will be able to apprehend the pedagogy of teaching mathematics and tune themselves as a innovative practitioner

Course Contents:

Unit I: Nature and Scope of Mathematics and Objectives of teaching it
The concept, meaning and Nature of Mathematics; Place and value of Mathematics in the Modern World
Need and importance of Mathematics in school curriculum.

Unit 2: Aims and Objectives of Teaching Mathematics
Aims and Objectives of teaching Mathematics at different stages; Taxonomy of Educational objectives – Cognitive, Affective, Psychomotor; Need and importance of stating instructional objectives and identifying learning outcomes in behavioural terms.

.**Unit 3: History of Mathematics with special reference Indian Mathematics**
Contribution of Indian and Western Mathematicians; Contribution of Arabs and Greeks to the development of mathematics; Correlation of mathematics with other subjects.

Unit 4: Construction and Organisation Mathematics Curriculum
Principles governing the construction and rganization of curriculum; Approaches in curriculum construction- Psychological, Logical, Topical and Spiral; Modern Trends in curriculum construction and analysis of secondary level mathematics curriculum.

Unit 5: Planning of Instruction in Mathematics

Lesson plan – Selecting the content for instruction (facts, concepts, rganizationn, process, Sequencing of content categories), identifying the teacher points, rganization of content.
Choosing the appropriate methodology and teaching aids (Heuristic Method, Analytic-synthetic method, Inductive-deductive method and laboratory method)
Construction of different types of tests and use of appropriate evaluation tools

School Based Activities:
Preparation of biographic sketches of Indian Mathematicians. Observe the mathematics teacher and list down the various strategies, methods, techniques and audio visual materials practiced by them to stimulate the students understanding of concepts.
Preparation of four lessons plans on any topics from prescribed mathematics school texts using 5E/or ICON models.
Preparation of an achievement test on any topic by developing blue print on prescribed text and development of test items in conformity with blue print.
Analyze the achievement test and identify the learning difficulties of students.

Text Books:

1. Chambers, Paul.(2010). *Teaching Mathematics*, New Delhi: Sage South Asia Publishers.
2. Sidhu, K.S. (2006).*The Teaching of Mathematics*, New Delhi: Sterling Publishers Pvt ltd.
3. Malhotra,V. (2006). *Methods of Teaching Mathematics*, New Delhi: Crescent Publishing Corporation.
4. Sudhir Kumar (2000). *Teaching of Mathematics*, New Delhi: Anmol Publications.

Reference Books:

1. Clare Lee, S.,Johnston-Wilder, Robert Ward-Penny .(2012). *A Practical Guide to Teaching Mathematics in the Secondary School*, Routledge Publishers, London
2. Deepka,E.(2007). *Designing assessment for mathematics*.(2nd Ed).Thousand Oaks, CA:Corwin Press.
3. Anderson, L., & Krawth Wohl, D.E. (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives* (Abridged). NewYork: Addison Wesley Longman, Inc.

ED 309: Pedagogy B: Bio Science I (L2-T0-P1-CH4-CR3)

Course Outcomes:

CO1: The student will be able to critically analyse biological science as a dynamic body of knowledge.
CO2: The student will be able to construct meaning and concept related to the changing trends in learning of biological sciences.
CO3: The student will be able to explore the opportunity of developing scientific attitude, values and skills through learning of biological sciences.
CO4: The student will be able to define the concept of pedagogical analysis of biological sciences and apply various strategies of teaching biological sciences.
CO5: The student will be able to describe the importance of professional competencies, professional ethics for a biology teacher and explain the impact of technology on biological science.

Course Contents:

Unit -1: Biological Science as a Dynamic Body of Knowledge
Nature of knowledge in biological sciences; Historical and developmental perspectives of biological sciences; Major scientific achievements in biological sciences; Inter relationship of biology and other disciplines of science and their integration.

Unit -2: The Changing Emphasis in Learning Biological Sciences
The changing trends in goals/objectives of learning biology; Development of process skills in science through learning of biology; Construct meaning and concepts related to biology through observation and exploratory activities in the environment.

Unit - 3: Construction of Knowledge and Skills in Biological Sciences
Constructivist approach in learning biological sciences; Misconceptions in biological sciences and their remedies; Concept mapping of themes related to biology.
Development of scientific attitudes, positive values and identification and development of skills related to biological sciences.
Non formal channel for learning biological science: Arrangement of science exhibition/fairs including state and national exhibition, field trips and excursions, children's science congress.

Unit -4: Pedagogy in Biological Sciences
Pedagogical Analysis: Identification of units, themes, concepts/learning point, generalizations and issues/problems.
Strategies of teaching biological sciences: Inquiry learning, guided discovery, inductive-deductive method, co-operative and collaborative learning.

Unit -5: Professional Development of Biology Science Teacher
Development of professional competencies of biology teacher, Professional ethics of biology teachers, Biological science and gender issues, Biological science and ethical issues, Impact of technology on biological science.

School Based Activities:

Students will visit the school:

1. Explore the possibilities of developing scientific attitude and skills through observation of classroom learning of biology.

2. Observe the classroom for strategies of teaching biological sciences.
3. Observe the classroom and make a report on professional competencies of biology teacher.
4. Identification of the learning difficulties in any topic and prepare remedial programmes.
5. Preparation of low cost and no cost learning teaching aids on any topic.

Text Books:

1. Das, R.C. Science *Teaching in Schools* .Sterling, New Delhi. (2009).
2. Aggarwal .D.D. *Modern Method of Teaching Biology*, Karanpaper backs, New Delhi (2008).
3. Sharma, P.C. *Modern Science Teaching*, New Delhi: Dhanpat Rai Publications(2006).

Reference Books:

1. Sounders, H.N., (1967).*The Teaching of General Science in Tropical Secondary Schools*. London: Oxford University Press.
2. Thurber, W.A. and Collette, A.T. (1970).*Teaching of Science in today's Secondary School*. Boston: Allay and Bacon Inc.,
3. UNESCO: *Modern Trends in Teaching Biological Sciences* Vols III.

ED 303: School Education in North East India (L2-T0-P0-CH2-CR2)

Course Outcomes:

CO1: The student will be able to describe the Education scenario of the North East.
CO2: The student will be able to explain the historical developments in school education in the region
CO3: The student will be able to identify the common problems in the school education in different states of the region
CO4: The student will be able to develop strategies for handling some of the problems by the teachers

Course Contents:

Unit -1: North-East India – A Historical Perspective on Education

North-east India-diversity, common features, phases of education; Contribution of Missionaries towards Educational Development in the region; Brief overview of educational development; Imbalances of education, nature of disparity – caste/gender/urban/rural; Right to Education Act 2010.

Unit -2: School Education of the North-East

Organization of Education - pre-primary, primary, secondary and higher secondary levels. Enrolment, dropout, concept of universalization of education; Role of SSA, curriculum and teacher training; Implementation of SSA, RMSA, MDM, ICT etc.

Unit- 3: Planning School Education

Planning and administration of education at different levels -viz; state boards, central boards and NIOS. Problems, innovations and changes in school education.

Unit -4: Training and Educating School Teachers

Brief historical development of Teacher Education in the North East India; Role of SCERTs in teacher education in the North East India; Functions of IASE, CTE, DIET etc in the North East India; Role of NCTE in regulating teacher education in the North East India.

Unit -5: Inclusive Policy in School Education

Meaning, historical background of social exclusion; Accessibility of school education to SC, ST, Tea garden communities, minority and other marginalized sections of the society; Measures for ensuring inclusion in education including school education; School Based Activities: seminars and group discussions.

Text Book:

1. *Education in North East India: Experience & Challenge*, Edited by: Biloris Lynden and Utpal Kumar De, Pub. By: Concept Publishing Company, New Delhi, 2004.

Reference Book:

1. *Education and Culture in North East India*, Edited by: L.K. Barua. Indian Institute of Advanced Study, Shimla, 2011.

PD 300: Project cum Physics Lab-VI (L0-T0-P4-CH8-CR4)

Course Outcomes:

CO1: After completion of this course students will be able to design and carry out scientific experiments. Students will be able to learn how to report their results in the form of a report.

List of elective papers:

3. PD 220: Renewable Energy
4. PD 221: Nanomaterial Fundamentals and application
5. PD 222: Earth Science

PD 220: Renewable Energy (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The Students will have a good understanding of various small and large scale renewable energy sources.

CO2: The students will be able to learn to harness electricity utilizing these renewable energy sources.

Course Content:

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, 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, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.
Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.
Electromagnetic and Piezoelectric Energy Harvesting, Energy storage and conversion devices: fuel cells, batteries, supercapacitors.
Environmental issues and Renewable sources of energy, sustainability.

Text Books:

1. H. P. Garg and Jai Praksh, *Solar Energy Fundamentals and Applications*, TMH, 2000.
2. J. Twidell and T. Weir, *Renewable Energy Resources*, E & F N Spon, 1986.
3. G. Boyle, (Ed.), *Renewable Energy, Power for a Sustainable Future*, The Open University/Oxford University Press, 1996.
4. R. O. Hayre, S. W. Cha, W. Colella and F. B. Prinz, *Fuel Cell Fundamentals*, Wiley, 2008.
5. B. E. Logan, *Microbial Fuel Cells*, Wiley, 2007.
6. G.D Rai, *Non-conventional energy sources*, Khanna Publishers, New Delhi, 2011.

7. M P Agarwal, *Solar energy*, S Chand and Co. Ltd., 1983.
8. Suhas P Sukhative, *Solar energy: principles of thermal collection and storage*, Tata McGraw - Hill Publishing Company Ltd, 3rd Ed. 2008.

Reference Books:

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1. A. Luque and S. Hegedus (Eds.), *Hand book of Photovoltaic Science and Engineering*, 2nd Edn., John Wiley, 2011.
2. P Jayakumar, *Solar Energy: Resource Assessment Handbook, 2009.*
3. P. Takahashi and A. Trenka, *Ocean Thermal Energy Conversion*, John Wiley, 1994.
4. C. Y. Wereko-Brobby and E. B. Hagan, *Biomass Conversion and Technology*, John Wiley, 1997.
5. J. F. Walker and N. Jenkins, *Wind Energy Technology*, John Wiley and Sons, 1997.
6. D. D. Hall and R. P. Grover, *Biomass Regenerable Energy*, John Wiley, 1987.
7. T. Jiandong, Z. Naibo, W. Xianhaun, H. Jing, and D. Huishen, *Mini Hydropower*, John Wiley, 1996.

PD 221: Nanomaterial Fundamentals and Applications (L2-T1-P0-CH3-CR3)

Course Outcomes:

CO1: The students will understand the physics behind the exciting properties of nanostructures.

CO2: The students will also learn the techniques to use nanostructures in various devices.

Course Content:

Nanoscale systems: Length scales, 1D, 2D and 3D nanostructures (nanodots, nanowires, nanorods, thin films,), Band structure and density of states of materials at nanoscale, Size effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

Synthesis of nanostructured materials: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots.

Characterization: X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunnelling Microscopy.

Properties of nanomaterials: Dielectric constant for nanostructures. Excitons in direct and indirect band gap semiconductor nanocrystals, absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures. Electron transport in nanostrcutures, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects. Mechanical and thermal properties of nanomaterials.

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices. CNT based transistors. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

Text Books:

1. C.P. Poole, Jr. Frank J. Owens, *Introduction to Nanotechnology* (Wiley-Interscience, May 2003).
2. S.K. Kulkarni, *Nanotechnology: Principles & Practices* (Capital Publishing Company, 2007).
3. K.K. Chattopadhyay and A. N. Banerjee, *Introduction to Nanoscience and Technology* (PHI Learning Private Limited, 2009).
4. Richard D. Booker, Earl Boysen, *Nanotechnology* (John Wiley and Sons, 2005).

Reference Books:

1. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, *Nanoparticle Technology Handbook* (Elsevier, 2007).
2. Bharat Bhushan, *Handbook of Nanotechnology* (Springer-Verlag, Berlin, 2004).
3. Cao Guozhong and Wang Ying, *Nanostructures and Nanomaterials –Sysnthesis, Properties and Applications*, World Scientific Publishing, 2nd edition, 2011.
4. Dieter Vollath, *Nanomaterials: An Introduction to Synthesis, Properties and Applications*, Wiley, 2008.
5. *Nanoscale Materials in Chemistry*, edited by Kenneth J. Klabunde & Ryan Richards, John Wiley & Sons, 2nd edition, 2009.
6. *Nanomaterials: Synthesis, properties and Applications*, Ed. A. S. Edelstein and R.C.Cammarata, IOP (UK, 1996). Characterization of nanophase materials: Ed. Z.L.Wang, Willey-VCH (New York, 2002).
7. *Naostructured Materials*, Ed. Jackie Yi-Ru Ying (Academic Press, Dec 2001).
8. *Nanotechnology: Basic Science and emerging technologies*, Ed. Michael Wilson, K.Kannangara, G. Smith, M. Simmons, and C. Crane (CRC Press, June 2002).

PD 222: Earth Science **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to acquire the fundamental knowledge with adequate facts and illustrations and thereby gathered the requisite expertise in mitigating hazard.

Course Content:

Structure: The Solid Earth: Mass, dimensions, shape and topography, internal structure, Magnetic field, Gravity field, Thermal structure and Heat Flow. Earth's Interior.
The Hydrosphere: The oceans, their extent, depth, volume, chemical composition. River systems.
The Atmosphere: variation of temperature, density and composition with altitude, clouds.
The Cryosphere: Polar caps and ice sheets. Mountain glaciers.

Dynamical Processes: Concept of plate tectonics, sea-floor spreading and continental drift. Earthquake and earthquake belts, Seismic waves, Volcanoes and Tsunamis.
The Atmosphere: Atmospheric circulation. Weather and climatic changes and. Cyclones.
I Climate: Earth's temperature and greenhouse effect, The Indian monsoon system.

Geophysical Exploration: Basic principles of Gravity, Magnetic, Electrical and Seismic Explorations.

Reference Books:

3. *Planetary Surface Processes*, H. Jay Melosh, Cambridge University Press, 2011.
4. *Consider a Spherical Cow: A course in environmental problem solving*, John Harte.University Science Books.
5. *Holme's Principles of Physical Geology*. 1992. Chapman & Hall.
6. Emiliani, C, 1992. Planet Earth, Cosmology, *Geology and the Evolution of Life and Environment*. Cambridge University Press.

Semester-VII

PD 308: Laser Physics **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students are expected to learn the physics behind lasing actions from all kinds of lasers.

CO2: The students will be able to understand various parameters that will determine the nature of light (in terms of its coherence property, output power and wavelength) emitting from a laser system.

CO3: The students will also learn important applications of laser in various fields starting from material science to biological science.

Course Content:

Planck's Law, Absorption, spontaneous emission and stimulated emission, Einstein's A & B coefficients, two-level atomic systems, light amplification, threshold condition.

Line broadening mechanism, pumping methods and laser rate equations, variation of laser power around threshold, optimum output coupling.

Modes of a rectangular cavity and open planar resonator, the quality factor (Q-factor), the ultimate bandwidth of laser, mode selection, Q-switching, mode locking, modes of a confocal resonator, general spherical resonator.

Properties of laser beam; propagation of Gaussian beam and ABCD matrix.

Some laser systems like He-Ne laser, ruby laser, neodymium-based lasers, CO_2 laser, dye laser, fiber laser, semiconductor laser, DFB lasers, DH lasers.

Generation of ultra-fast optical pulses, pulse compression, femto-second laser and its characteristics.

Some applications of lasers like laser cooling, laser tweezers, material processing.

Text Books:

1. Ghatak, A. K. and Thyagarajan, K., *Optical Electronics*, (Cambridge University Press, 2009).
2. Svelto, O., *Principles of Lasers*, 3rd edition, (Springer, 2007).

Suggested Readings:

1. Milonni, P. W. and Eberly, J. H., *Laser Physics*, (John Wiley & Sons, 2010).
2. Yariv, A., *Quantum Electronics*, 3rd edition, (Wiley Eastern Ltd.).
3. Davis, J. H., *Introduction to Low Dimension Physics*, (Cambridge University Press, 1997).

PD 400: Physics Laboratory-VII **(L0-T0-P4-CH8-CR4)**

Course Outcomes:

CO1: The students will be able to connect characteristics properties of the theoretical models.
CO2: The students are expected to get familiarized with various experimental tools and characterization techniques of different experiments in physics.

Course Content:

1. To design and fabricate a phase shift oscillator for the given frequency and to study the output using Op-Amp. 741/ 324 / 325.
2. Determination of thermal conductivity of a substance by Lee's method.
3. Scintillation counter:
   - Find out the resolution and the FWHM of the given Scintillation counter
   - Find out the gamma ray energy of the given radioactive sources
4. Determination of the Young's modulus of a beam by four-point bending.
5. To determine the velocity of sound in (a) dry air, and (b) rods by Kundt's tube method
6. Calculate the difference in wavelength between atomic transition lines and Zeeman lines using Zeeman effect set-up. (SES instruments Pvt. Ltd).
7. To study Talbot imaging and to obtain Talbot distances with moiré interferometry and to measure the focal length of a lens.
8. Determination of the boiling point of a liquid by platinum resistance thermometer and metre-bridge.
9. To measure the diameter of a thin wire using (a) interference, and (b) diffraction and compare the results.

10. To measure the dielectric constant and loss using microwave bench.

ED 408: Pedagogy B: Physical Science-II (L2-T0-P1-CH4-CR3)

Course Outcomes: After the completion of this course, the student teacher:

CO1: The student will be able to design unit plan, lesson plans in physical science based on behaviourist and constructivist approaches and prepares teaching-learning aids in science.
CO2: The student will be able to identify the erroneous concepts in scientific knowledge and design dialogue strategies for communication.
CO3: The student will be able to plan & organises physical science co-curricular activities.
CO4: The student will be able to explain the need of different types of assessment strategies and discuss different tools and techniques of assessment in Physical Science.
CO5: The student will be able to describe the need & importance of professional development for physical science teachers.

Course Contents:

Unit -1: Planning the Process of Teaching-Learning in Physical Science
Need of Planning Teaching-learning Experiences in Physical Science; Designing of Unit Plan and Lesson Plan in Physical Science & Its Significance, Lesson Planning based on Behaviourist & Constructivist Approaches.
Preparation of Various Types of Teaching–Learning Aids/Instructional Aids in Science Teaching, Principles for Selection of Proper Teaching-Learning Aids & their use. Skills of Teaching and Its significance; Simulated Teaching as key component of Teaching Practice Programme, Use of Simulated Teaching to develop Skills of Teaching in teacher trainees.

Unit-2: Exploring Learners and Learning Process
Exploring Learners - generating discussion, involving learner in teaching –learning process Encouraging learner to raise questions, appreciating dialogue amongst peer group; Science as a Discourse of Interdisciplinary learning; Communication in Science Learning
Erroneous Concepts of Scientific Knowledge and Remedies: learner's preconception, sources of misconception, language and misconception, effective remedies.

Unit-3: Planning & Organising Physical Science Co-Curricular Activities
Importance of Science Activities; Planning & Organization of Field Visit/Study Tours, Project Work, Science quiz, Excursion, Science Exhibition: Nurturing Creative Talent at Local Level and Exploring Linkage with District/State/ Central Agencies.
Debate, Discussion, Drama, Poster making Visit to Various Places, Science club, Celebration of specific days, Science Fair etc.

Unit-4: Tools & Techniques of Assessment for Learning Physical Science
Concept of Test, Examination, Measurement, Assessment and Evaluation; Planning Assessment Framework in Physical Science, Learning Indicators in Physical Science; Assessment of Process Skills/Experimental Skills in Science Teaching.
Practicing Continuous and Comprehensive Evaluation/Assessment to test Regular Progress; Tools & Techniques of Assessment in Physical Science- Assessment of Written & Oral Work, Project Work, Laboratory Work, Filed Trips, Journal Writing, Concept mapping, Portfolio, Rubrics etc.

Unit-5: Continuing Professional Development of Physical Science Teachers

Need for Professional Development of Physical Science Teachers; Role of Reflective Practices in Professional Development; Participation in Professional Learning Community and Collaboration with Research Institutes; Need for Pre-service & In-service Professional Development Programmes.

Engagement with the Field/Practicum/Activity: The Students may undertake any one of the following activities:

1. Preparation of a unit plan in Physical Science.
2. Preparation of at least two lesson plans for a particular concept in Physical Science- one based on behaviourist and another on constructivist approach.
3. Develop a simulated lesson plans.
4. Construction of various type of test items/tools for assessment.
5. Debate on any one topics like- Physical Science and Sustainable development; Social and ethical issues related to Physical Science; Role of Language in Physical Science; Gender and Physical Science etc
6. Visit to any of the professional organization and prepare a report on the in-service professional development programmes that they undertake for Science teachers.
7. Visit a nearby school to interact with a few senior teachers of physical science. Seek their opinion on what major area you should focus upon during your pre-service training programme.
8. Identify the institutions and organisations that regularly organise seminars and conferences on various aspects of science and science education. Collect the information about the themes of the seminars and conferences that were organised during last five years.
9. Ask your fellow trainees to observe the practice lessons taken by you and provide their feedback. Refine your presentation in the light of their feedback.
10. Observe some practice lessons taken by your fellow students and try to give them critical feedback about their teaching-learning proceedings.

Text Books:

1. Sharma, R. C. (2006). *Modern Science Teaching. New Delhi:* Dhanpatrai publishing company (P) Ltd.
2. Vaidya, N. (2003). *Science Teaching for the 21st Century*. New Delhi: Deep and Deep Publications.
3. NCERT (2013). *Pedagogy of Science, Textbook of B.Ed*., Part I&II, National Council for Educational Research and Training, New Delhi.
4. Mohan, R. (2002). *Innovative Science Teaching for Physical Science Teachers*. Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books:

1. Prasad, J. (1999). *Practical aspects in Teaching of Science*. New Delhi: Kanishka Publication.
2. NCERT (2005). *National Curriculum Framework for School Education*. National Council of Educational Research and Training (NCERT), New Delhi.
3. NCERT (2006). *Position Paper of National Focus Group on Teaching of Science*. New Delhi: NCERT.
4. *Science & Children*. A Peer Reviewed Journal Published by National Science Teachers Association (NSTA).
5. *The Science Teacher*. A Peer Reviewed Journal Published by National Science Teachers Association (NSTA).
6. NCERT (2000). *Position Paper of National Focus Group on Examination Reforms.* New Delhi: NCERT.
7. NCERT (2012). *Source Book on Assessment* for Classes VI-VIII Science
8. CBSE (2016). *Revised Formative Assessment Manual for Teachers Class-IX Science*

Online/Web Resources/Websites/eBooks (Links):

1. National Academies of Sciences, Engineering, and Medicine. 2015. *Science Teachers' Learning: Enhancing Opportunities, Creating Supportive Contexts*. Washington, DC: The National Academies Press. https://doi.org/10.17226/21836.
2. National Research Council. 1999. *The Assessment of Science Meets the Science of Assessment: Summary of a Workshop*. Washington, DC: The National Academies Press. https://doi.org/10.17226/9588.

3. National Research Council. 1997. *Science Teaching Reconsidered: A Handbook*. Washington, DC: The National Academies Press. https://doi.org/10.17226/5287.
4. Jensen EA and Gerber A (2020) Evidence-Based Science Communication. *Front. Commun.* 4:78. https://doi.org/10.3389/fcomm.2019.00078

ED 407: Pedagogy B: Mathematics II **(L2-T0-P1-CH4-CR3)**

Course Outcomes:

CO1: The student will be able to get acquainted with meaningful pedagogical analysis of various topics in secondary school mathematics
CO2: The student will be able to appreciate the conception and significance of arithmetic and modern mathematics in daily life
CO3: The student will be able to acquire innovative strategies and techniques for successful in teaching and learning modern mathematics.
CO4: The student will be able to explore the diverse backgrounds and interests children bring to the classroom from their environment and experience to promote positive attitude towards modern mathematics concepts.
CO5: The student will be able to get familiarized to the nature and functions of various instructional resources.

Course Contents:

Unit 1: Teaching of Arithmetic with special reference to the following topics:
Number system, complex number, rational and irrational numbers, number line; Decimal fractions, ratio, proportion, percentage, loss and profit, Partnership business, discount, interest, shares, stocks and dividends, bank account and other forms of deposits.

Unit 2: Teaching of Algebra with special reference to the following topics:
Exponents, algebraic expressions, square and cube formulae, Factorisation, HCF, LCM, polynomials, linear equations, linear simultaneous equations, quadratic equation, graphs, logarithms, Surd permutation and combination, A.P. and G.P. series.

Unit 3: Teaching of Geometry with special reference to the following topics:
Triangles, types of triangles theorems on angles of a triangle and on right angled triangles, congruency and similarity of triangles, Circles and related theorems, theorems on concurrency locus, construction and mensuration, Trigonometric ratios of identities, values of trigonometric ratios of some particular angles, heights distances.

Unit 4 : Teaching of Statistics with special reference to the following topics :
Collection, classification tabulation and graphical representation of data and their interpretation, Measures of central tendency, Measures of variability; Flow chart and algorithm for solving computational problems.

Unit 5 : Learning Resources in Mathematics
Types and functions of different learning resources for Mathematics instructional support; Preparation and use of learning resources: Text books, Models, Calculators and Computers. Use of the Mathematics Laboratory for enhancing learning.

School Based Activities:

1. Visit the school library and list the available resources for enriching mathematics teaching.
2. Observe the mathematics laboratory and list the resources available and give suggestions to facilitate the establishment of a mathematics laboratory.
3. Prepare a lesson plan using ICT or prepare a programmed instruction material on any topic.

4. Preparation of low cost and no cost learning teaching aids on any topic.
5. Critical Evaluation of Mathematics Textbook (VI to X)
6. Analysis of unit / chapter in a mathematics text book and identify the concepts, principles, process in the underling mathematical structure.
7. Construct a diagnostic test in mathematics and diagnosing pupils learning difficulties and suggesting remedial measures.

Text Books:

1. Tiwari.D.(2007). *Encyclopaedia of Modern methods of Teaching*, New Delhi: Crescent Publishing Corporation.
2. James, Anice, (2005). *Teaching of Mathematics*: Hydrabad: Neelkamal Publication Pvt. Ltd.
3. Sharma, H.S. & Mangal, U.C. (2005). *Teaching of Mathematics* Agra: Radha Prakashan Mandir.
4. Aggarwal, S.M. (2002): *A Course in Teaching of Modern Mathematics*, Dhanpat Rai, New Delhi.

Reference Books:

1. Kincheloe, J. (2008). *Critical Pedagogy* (2nd Edn). New York: Peter Lang.
2. Sumner, W.L.(1938). *The Teaching of Arithmetic & Elementary Mathematics*. Basil Blackwell, Oxford, https://archive.org/details/dli.ernet.455/page/n5/mode/2up

3. Bender, W.N. (2005). *Differentiating Math instruction strategies that work for K-8 classrooms*. Thousand Oaks, CA: Corwin press.
4. Butler and Wren: (2000), *The teaching of Secondary Mathematics*, MC Graw Hill Book Company.

ED 409: Pedagogy B: Bio Science II **(L2-T0-P1-CH4-CR3)**

Course Outcomes:

CO1: The student will be able to design Lesson Plans for Biological Science.
CO2: The student will be able to plan and organize several activities of biology laboratory.
CO3: The student will be able to describe various issues and concerns of Biological Science Curriculum.
CO4: The student will be able to use textbooks of biological science as source of living and explore other resources available from immediate environment.
CO5: The student will be able to explain the trends and ways of assessment to evaluate creativity and expression of learner.

Course Contents:

Unit-1: Planning for Learning in Biological Sciences
Writing learning objectives ,Steps and advantages of designing lessons; Identification of learning experiences and organizing activities in the classroom use of field experience, Laboratory and ICT; Designing lessons for Biology Content.

Unit-2: Biological Science laboratories and Related Activities
Planning and organization of biology laboratory; Planning and management of practical activities in biology laboratory; Evaluation of student's activities in biology laboratory; Planning and organization of science club activities.

Unit-3: Biological Science Curriculum
Issues and concern of biological science curriculum; various interventions for reformulation of curriculum related to biological science; Emphasis of NCF-2005 on transaction of curriculum: Going beyond biological science text book.

Unit-4: Text Book and Other Learning Resource
Characteristics of a good text book and evaluation of text book; Effective use of text book for elaboration of concepts, activities, reflective thinking small group work etc. Identification of learning resources from immediate environment and preparation and use of learning materials, evaluation of learning resources; Science parks, national parks, museum as resources sites for learning biological sciences.

Supplementary materials work sheets, self-learning materials use of ICT in learning biology (web sides, interactive web sides, on line learning)

Unit-5: Evaluation of Learner's Performance

Practicing continuous and comprehensive evaluation to test regular progress; Developing blue print and framing different types of questions, diagnostic testing; Developing performance parameter for qualitative assessment anecdotal record, portfolio etc. Reporting performance of learner.

School Based Activities:

Students will visit the school:

1. Identification and listing of various components in biological laboratory and other related activities.
2. Interaction with teachers and students for critical analysis of curriculum related to biological sciences at secondary level.
3. Explore and identify learning resources available at school for children and children with special need
4. Identification the learning difficulties in any topic and prepare remedial programmes.
5. Preparation of low cost and no cost learning teaching aids on any topic.
6. Content analysis of any topics of biological sciences.
7. Preparation of blue print on prescribed text and development of test items in conformity with blue print.

Text Books:

1. Das, R.C. *Science Teaching in Schools* .Sterling, New Delhi. (2009).
2. Aggarwal .D.D. *Modern Method of Teaching Biology*, Karanpaper backs, New Delhi (2008).
3. Sharma, P.C. *Modern science teaching*, New Delhi: Dhanpat Rai Publications(2006).

Reference Books:

1. Sounders, H.N., (1967).*The Teaching of General Science in Tropical Secondary Schools*. London: Oxford University Press.
2. Thurber, W.A. and Collette, A.T. (1970).*Teaching of Science in today's Secondary School*. Boston: Allay and Bacon Inc.,
3. UNESCO: *Modern Trends in Teaching Biological Sciences* Vols III.

ED 404: School Internship- I (Four Weeks) (L0-T0-P4-CH8-CR4)

Course Outcomes:

CO1: The student will be able to identify and critically examine the different components, functions and processes of school system.
CO2: The student will be able to evaluate the existing facilities and resources of the school system.
CO3: The student will be able to analyse the school curriculum, annual school calendar, syllabus and textbook.
CO4: The student will be able to develop lesson plan based on innovative methods and approaches.
CO5: The student will be able to examine the role and significance of community as learning resource.

Framework:

The internship will be organized for a continuous period of four weeks in selected schools of the area. The student-teachers will be oriented on the following components of school activities.

a. Understanding and examining the school process and existing facilities.

- Collect the information from school authority and record the observations on physical facilities and social organization of the school.
- Prepare a map of school complex.

b. Examination of school morning assembly

- Evaluation of classroom environment and learning activities. Attend the school assembly and record the observations on the various activities conducted in school assembly and students involvement in it.
- Make a reflection on significance of school assembly by highlighting the values gained through the different activities.

c. Evaluation of classroom environment and learning activities.

- Examine the classroom physical environment and prepare a layout of seating arrangement of the students.
- Describe the classroom management approaches adopted in the school.
- Describe the social organisation of classroom i.e the manner in which students interact with each other and the teacher, opportunities for students to learn formally and informally in the classroom, in the school etc.

d. Evaluation of school co- curricular activities.

- Develop an understanding on the importance of co-curricular activities in child personality development.
- Describe the various co-curricular activities conducted and organised in the school by highlighting its significance.

e. Analysis of existing school library and learning resources.

3. Examine the school library and make an analysis of its organizational structure and management.
4. List out the learning resources available in school and its usage.

f. Examining school laboratory organization and facilities.

- Examine the school laboratory organizational structure and management.
- List out the equipment and instruments available in school laboratory.
- Prepare a layout of school laboratory.

g. Analysis of Existing School academic calendar and Time Table.

- Examine the school annual calendar and time table of any elementary class
- Make a reflection on school annual calendar and time table with respect to the principles of its construction.

h. Analysis of school curriculum

- Make an analysis of existing school curriculum by describing the innovative activities that the school undertakes for child academic progress and personality development.

i. Maintaining student profile

- Record the observation of child information related to age, gender, learning abilities, interests/hobbies, apparent learning styles, apparent cultural/ethnic/racial/backgrounds, apparent socio-economic class, etc.

j. Analysis of school syllabus and textbooks.

- Analyse the syllabus of any elementary school subject and reflect on its organization.
- Review any elementary school textbook of any based on external and internal features.

k. Preparation of Lesson Plans and Unit Plans.

- Understanding the different structure and components of lesson plan.
- Learn to develop lesson plan based on innovative methods and approaches.
- Learn to prepare unit plans on topics from elementary school subjects.

l. Observation of classroom teaching.

- Understand the classroom teaching process and different activities conducted during instruction delivery.
- Record the observation of classroom teaching of regular teachers

m. Examining the community as resource

- Developing an insight into the role and significance of community as learning resource.
- Examine the local community and analyse its beneficial use as a learning resource for school.

Evaluation: Early History: *Science and physics, ancient Greek civilization*, Muslim scientists, medieval years, *Indian and Chinese civilizations.*

Scientific Revolution: *Nicolaus Copernicus*, *Galileo Galilei*, *Johannes Kepler*, Rene Descartes, *Sir Isaac Newton*, early thermodynamics.

Later Developments: Mechanics and its developments, thermodynamics and laws of thermodynamics, electricity and magnetism, James Clerk Maxwell, Maxwell equations.

Birth of Modern Physics: Radiation experiments, *Albert Einstein and theory of relativity*, *special relativity*, *general relativity*, development of quantum mechanics.

Contemporary Particle Physics: Standard model of particle physics, discoveries of particles, quark model, quantum field theory, quantum electrodynamics, quantum chromodynamics, beyond standard model, string theory, quantum gravity and super-symmetry, Higgs Boson.

Influential Physicists: [The instructor will discuss on minimum 10 influential physicists in different branches of Physics]

Optional topics:

(i) A brief introduction to Philosophy of Science, including "falsification" by Karl Popper.
(ii) Ten most famous experiments in Physics
(iii) Ten most fundamental equations of Physics
(iv) Scientific methodology

Text books:

1. Einsten A. and Infeld, L., *The Evolution of Physics*, (The Scientific Book Club, 1999).

2. Simony Karoly, *A Cultural History of Physics*, (CRC Press, Taylor and Francis, 2008).

3. Bernard C.I., *The Birth of a New Physics*, (W. W. Norton and Company, 2011).

References Books:

1. *Great books of the western world*, edited, (Encyclopedia Britanica Publications, 2010).

2. Agar, Jon, *Science in the twentieth century and beyond*, (Cambridge: polity press, 2012).

3. Ben-Claim, Michael, *Experimental philosophy and the birth of empirical science*, (Aldershot: Ashgate, 2004).

4. Dear, Peter, *The mathematical way in the scientific revolution*, (university of Chicago press,1995).

5. Drak, Stillman, *Galileo at Work: His scientific biography*, (University of Chicago press, 1978).

6. Heilbron, J.L., *Electricity in the 17th and the 18th centuries*, (University of California press,1979).

7. Jhiele, Pudiger, *Arabic Sciences and Philosophy*, (Cambridge University press, 2005).

8. Schweber, Silvan, *QED the man who made it*, (Princeton University press, 1994).

9. Kragh, Helge, *Quantum Generations: A history of physics in the twentieth century*, (Princeton University press,1999).

Evaluation will be internal, done by the Department teachers. Evaluation will be done on different components of pre-internship. Student teachers will submit report on each pre-internship activity.

Text Books:

1. National Council for Teacher Education.(2016).*School Internship: Framework and Guidelines*. New Delhi: NCTE.
2. NCFTE. (2010). *National Curriculum Framework for Teacher Education*. New Delhi.

Reference Books:

1. TEACHER EDUCATION, SECOND EDITION. (2019). : PHI Learning Pvt. Ltd.
2. Kochhar, S. K. (2011). *School Administration and Management*. India: Sterling Publishers Pvt. Limited.
3. Savage, J. (2014). *Lesson Planning: Key Concepts and Skills for Teachers*. United Kingdom: Taylor & Francis.

Online/Web Resources/eBooks (Links)

1. Greenberg, E. (1978). The Community as a Learning Resource. *Journal of Experiential Education*, *1*(2), 22–25. https://doi.org/10.1177/105382597800100205
2. Stadler-Altmann, Ulrike. (2015). Learning Environment: The Influence of School and Classroom Space on Education. The Routledge International Handbook of Social Psychology of the Classroom,252-262
3. https://www.researchgate.net/publication/282348767_Learning_Environment_The_Influence_of_School_and_Classroom_Space_on_Education

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Semester-VIII

PD 314: Measurement Physics **(L2-T1-P0-CH3-CR3)**

Course Outcomes:

CO1: The students will be able to interpret data (both theoretical and experimental) and subsequently learn how the important parameters can be derived from a given set of results.

CO2: The students will be able to understand the operational principle of these components while using them for experimental investigations.

CO3: The students will learn the physics of different electronic instrumentations and the ways to improve the signal quality from any electronic circuit.

Course Content:

Data interpretation and analysis, precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test, Measurement of energy and time using electronic signals from the detectors and associated instrumentation, signal processing; multi-channel analyser, Time of flight technique, coincidence measurements, true-to-chance ratio.

Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical), measurement and control, ionization chamber, proportional counter, GM counters, spark chambers, cloud chamber, semiconductor detectors for charged particles and γ-ray detectors, scintillation counters, photodiodes and charge coupled device (CCD) and CMoS cameras for detection of electromagnetic radiation.

Production of low temperature below 1K, adiabatic demagnetisation and magnetic refrigerator, special properties of liquid helium, temperature below 10^{-6}K, nuclear demagnetisation, measurement of low temperatures.

Op-amp based, instrumentation amp, feedback, filtering and noise reduction, shielding and grounding, Fourier transforms, lock-in detector, box-car integrator, modulation techniques.

Text Books:

12. Sayer, M. and Mansingh, A., *Measurement, Instrumentation and Experiment Design in Physics and Engineering*, (Prentice-Hall India, 2000).
13. Nakra, B. C. and Chaudhry, K. K., *Instrumentation Measurement and Analysis* (Tata McGraw-Hill, 1985).

Reference Books:

3. Knoll, G. F., *Radiation, Detection and Measurement*, 3rd edition, (John Wiley & Sons, 2000).
4. Jones, B. E., *Instrumentation measurement and feedback* (Tata McGraw-Hill, 1978).

ED 405: School Internship II (Sixteen Weeks) (L0-T0-P16-CH32-CR16)

Course Outcomes:

CO1: The student will be able to organise different school related events and co-curricular activities.
CO2: The student will be able to develop subject specific lesson plan and teaching learning resources based on innovative methods and approaches
CO3: The student will be able to develop tests to measure the learning achievement and diagnose the learning difficulties in a particular subject area.
CO4: The student will be able to carry out research work specific to child development and school functioning.
CO5: The student will be able to explain the significance and usage of maintaining reflective journal.

Framework:

The internship will be organized for a continuous period of Sixteen weeks in selected schools of the area. One week orientation programme will be organized on the following components of school activities.

a. Practicing microteaching skills

- Developing microlesson plan on each microteaching skill and practicing demonstration classes with respective pedagogy teachers.

b. Organization of school related activities.

- organizing morning assembly meeting during the internship period
- participate and organizing different co-curricular activities like –Yoga camp, Exhibitions, Group Discussion, Quiz, Awareness raising program and Debate etc.

c. Preparation of Lesson Plans

- Develop subject specific lesson plan for each pedagogy based on innovative methods and approaches
- Teaching one lesson every day from any method/subject.

d. Undertake case study on a child.

- Identify a child as case and conduct a case study on intellectual, mental, physical, social and emotional development of the child under the supervision of teacher educator.

e. Conducting achievement test

- Assessment of the performance of the students preparing blue prints and question paper of achievement test.
- Analysing the results of the achievement test.

f. Preparation of a diagnostic tests and organisation of remedial teaching.

- Design and administer diagnostic test for identification of subject -specific learning difficulties
- Oragnisation of remedial classes to overcome the learning difficulties,
- Conduct of post test to assess the effectiveness of the remedial teaching

g. Development of teaching-learning resources.

- Develop subject-specific teaching learning materials and describe its significance and usage.

h. Teaching as a substitute teacher.

- Taking arrangement classes as assigned by the school coordinator.

i. Undertake action research project on at least one problem area of schooling

- Identify one problem in school and carry out action research under the supervision of teacher educator.

j. Maintenance of a reflective diary or journal to record

- recording reflections on day-to-day school activities and own teaching.
- maintaining reports related to curricular and co-curricular activities

Evaluation:

Evaluation of performance during School internship will be done on the basis of assessment by the supervisors of the Department. The distribution of marks/weightage will be determined by the Departmental Advisory Committee. The evaluation of the teaching component will be done by both internal (continuous) and external experts, the ratio of weightage of internal-external being 60:40. The grading will be done according to the principles of evaluation and grading policies adopted by the University.

Text Books:

1. National Council for Teacher Education.(2016).*School Internship: Framework and Guidelines*.New Delhi: NCTE.
2. NCFTE. (2010). *National Curriculum Framework for Teacher Education*. New Delhi.

Reference Books:

1. TEACHER EDUCATION, SECOND EDITION. (2019). : PHI Learning Pvt. Ltd..
2. Kochhar, S. K. (2011). *School Administration and Management. India*: Sterling Publishers Pvt. Limited.
3. Savage, J. (2014). *Lesson Planning: Key Concepts and Skills for Teachers*. United Kingdom: Taylor & Francis.
4. Sagor, R. (2000). *Guiding School Improvement with Action Research*: ASCD.

5. *Measurement, Evaluation and Assessment in Education*. (2016). India: Prentice Hall India Pvt., Limited.

Online/Web Resources/eBooks (Links):

1. Xygkou, A. (2009). CHILD CASE STUDY-ASSESSMENT AND INTERVENTION. 10.13140/2.1.1011.0086.
2. Göker S. D. (2016). Use of Reflective Journals in Development of Teachers' Leadership and Teaching Skills. Universal Journal of Educational Research, 4(12A), 63 - 70. DOI:10.13189/ujer.2016.041309

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