CURRICULUM AND SYLLABUS FOR THE INTEGRATED TEACHER EDUCATION PROGRAMME (ITEP)

B. Sc. B. Ed. (Chemistry, Mathematics, Physics)

2024 Onwards

National Institute of Technology
Tiruchirappalli – 620 015

CONTENTS

CURRICULUM

B.Sc. B.Ed. (CHEMISTRY)

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B.Sc. B.Ed. (CHEMISTRY)

Course Code	Course Title	L	T	P	C
SEMESTER – IV					
CHPC41	Transition Metal Chemistry	3	0	0	3
CHPC42	Statistical Thermodynamics, Chemical Kinetics and Equilibrium Processes	3	0	0	3
CHLR41	Physical Chemistry Laboratory	0	0	2	2
PHAL41	Physics – II	3	0	1	4
EDPC41	Philosophical and Sociological Perspectives of Education – I	4	0	0	4
EDPC42	Content cum Pedagogy of Chemistry at Secondary Stage – I	4	0	0	4
EDPC43	Art in Education (Performing and Visual) - II	1	0	1	2
		Total			**22**
SEMESTER – V					
CHPC51	Organometallic and Bioinorganic Chemistry	3	0	0	3
CHPC52	Quantum Chemistry, Group Theory and Photochemistry	3	0	0	3
CHPC53	Chemistry of Carbonyls and Nitrogen Compounds	3	0	0	3
CHPE	Program Elective /Online Courses	3	0	0	3
EDPC51	Content cum Pedagogy of Chemistry at Secondary Stage – II	4	0	0	4
EDPC52	ICT in Education	1	0	1	2
EDPC53	Internship in Micro-Teaching	0	0	2	2
EDPC54	Pre-Internship Practice	0	0	2	2
		Total			**22**
SEMESTER – VI					
CHPC61	Spectroscopy and Applications	3	0	0	3
CHPC62	Heterocycles and Natural Products	3	0	0	3
CHPE	Program Elective /Online Courses	3	0	0	3
EDPC61	Assessment and Evaluation	2	0	0	2
EDPC62	Inclusive Education	2	0	0	2
EDPC63	Content cum Pedagogy of Chemistry at Secondary Stage – III	4	0	0	4
EDPC64	Mathematical and Quantitative Reasoning	1	0	1	2
EDPC65	School Observation (Field Practice)	0	0	2	2
		Total			**21**

Course Code	Course Title	L	T	P	C
SEMESTER – VII					
EDPC71	Perspective on School Leadership and Management	2	0	0	2
EDPC72	Secondary Stage Curriculum Planning and Development	2	0	0	2
EDPC73	Sports, Nutrition and Fitness	2	0	0	2
EDPC74	School-Based Research Projects	0	0	2	2
EDPC75	Internship in Teaching	0	0	10	10
		Total			**18**
SEMESTER – VIII					
EDPC81	Philosophical & Sociological Perspectives of Education – II	4	0	0	4
EDPC82	Education Policy Analysis	2	0	0	2
EDPE81-88	Elective Course in Education	4	0	0	4
EDPC83	Yoga and Understanding Self	2	0	0	2
EDPC84	Citizenship Education, Sustainability, and Environmental Education	2	0	0	2
EDPC85	Post Internship (Review and Analysis)	2	0	0	2
EDPC86	Creating Teaching Learning Material/Work Experience (Educational Toy Making, Local/Traditional Vocations, etc)	0	0	2	2
		Total			**18**
Total Credits					**162**

Program Electives					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
CHPE51	Nano Science and Technology	3	-	-	3
CHPE52	Medicinal Chemistry	3	-	-	3
CHPE53	Environmental Chemistry	3	-	-	3
CHPE61	Biocatalytic processes in Chemical Industries	3	-	-	3
CHPE62	Lanthanide and Actinide Chemistry	3	-	-	3
CHPE63	Polymer Chemistry	3	-	-	3
	NPTEL, SWAYAM, Coursera, edX Online courses				

CHPC11	Structure and Bonding	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able

- To understand the atomic structure and principle.
- To understand periodic table and it's trends
- To understand chemical bonding concepts and weak chemical forces.
- To understand the chemical properties and reactions of s-block and p-block elements
- To understand the chemical properties of d & f block elements

COURSE CONTENT

Atomic Structure & The Ionic Bond: Bohr's model of atom - Heisenberg's Uncertainty Principle- Schrodinger wave equation - Shapes of s-p-d- f orbitals - Hund's rule, Pauli's exclusion principle and Aufbau principle. Periodicity - Slater's rules– Pauling and Mullikan Scales. Ionic bonding, Octect rules and its limitations **-** Ionic compounds of type AX, AX_2 – Metallic Bond – Theories of bonding in metals - Lattice energy and Crystal defects – Born Lande Equation – Born Haber cycle

The Covalent Bond: Lewis structures- Valence Bond Theory, concept of resonance – Hybridization - VSEPR theory – Shapes of molecules and ions containing lone pairs and bond pairs – MO Theory and LCAO - sigma – pi & delta bonds – molecular orbitals and diagrams of homonuclear and heteronuclear molecules. - Polarizing power and Polarizability, Ionic potential, Fajan's rules. – Occurrence and isolation of elements – Extractive metallurgy

Chemistry of s- & p- Block Elements-I: Alkali & Alkaline Earth metals and their compounds. Diagonal relationship of Li with Mg. Anomalous behavior of Be. Preparation and structure of diborane. Chemistry of borax. Extraction, isolation and purification of some S& P block metals. Carbon-di-sulphide – Preparation, properties, structure and uses. Percarbonates, per monocarbonates and per dicarbonates.

Chemistry of s- & p- Block Elements-II: General characteristics of elements of Group 15; Chemistry of nirogen and Phosporus containing compounds. General properties of elements of group16 - Allotropy of elements - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur - Chemistry of Halogens: -Inter-halogen compounds -pseudo halogens - $(SN)_x$- borazine, Phosphazenes & other inorganic rings

Noble gases & d & f Block elements: Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$ - clathrate compounds -Isolation and extractive metallurgy of different metals (Cr, Mr, Fe, Ni, Cu, Zn) in the d – block - manufacture of Steel - Occurrence and isolation of Lanthanides and actinides – Electronic configuration and oxidation states - Lanthanide contraction and consequences - Preparation of Actinides

REFERENCE BOOKS

1. Lee, J. D. (1991). Concise inorganic chemistry, (4th Ed.). ELBS William Heinemann.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry - Vishal Publishing Co.; (2025)
3. Prakash. S., Tuli. G. D., Basu. S. K. & Madan, R. D. (2022). *Advanced inorganic chemistry,* Vol. 1. S. Chand & Company.

COURSE OUTCOMES

Upon completing the course the student will be able to understand

CO1	The atomic structure and principle
CO2	The periodic table and it's trends
CO3	The chemical bonding concepts and weak chemical forces.
CO4	The chemical properties and reactions of s-,p-,d-,f- block elements

CHLR11	Inorganic Qualitative Analysis Lab	L	T	P	C
		0	0	2	2

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able

- To develop the skill on systematic analysis of simple acid radicals.
- To develop the skill on systematic analysis of interfering acid radicals.
- To eliminate interfering acid radicals and identify the group of radicals.
- To analyse basic radicals
- To develop the skill on systematic analysis of mixture of inorganic salts.

COURSE CONTENT

Semi-Micro Qualitative Analysis

1. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, thiosulphite, chloride, bromide, iodide, nitrate
2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate, arsenate, arsenite.
3. Elimination of interfering acid radicals and identifying the group of basic radicals
4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, arsenic, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Systematic Analysis of a mixture - I to VIII containing two cations and two anions (of which one is interfering type) (max. 10 Mixtures)

REFERENCE BOOKS

1. Venkateswaran.V., Veeraswamy, R., & Kulandaivelu, A. R. (1997). *Basic Principles of Practical Chemistry*, (2nd Ed.). New Delhi, Sultan Chand and Sons.
2. V. V. Ramanujam, *Inorganic Semi-micro Qualitative Analysis*, 3rd Edition, National Publishing Company, 1990.
3. G. Brauer (Ed.), *Handbook of Preparative Inorganic Chemistry (Vol. I and II)*, Academic Press, 1963.

COURSE OUTCOMES

Upon completing the course the student will be able to

CO1	develop the skill on systematic analysis of simple acid radicals.
CO2	develop the skill on systematic analysis of interfering acid radicals.
CO3	eliminate interfering acid radicals and identify the group of radicals.
CO4	analyse basic radicals develop the skill on systematic analysis of mixture of inorganic salts.

CHPC21	Organic Chemistry: Fundamentals and Mechanism	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- The basic properties of organic molecules
- The preliminary concept of reaction mechanism
- The basic concept of stereochemistry
- The chemistry of organic acid, bases and alkynes

COURSE CONTENT

POLARITY OF BONDS AND PHYSICAL PROPERTIES: Inductive effect, Field effect, Mesomeric effect, steric effects, steric inhibition of resonance, hyperconjugation and their influence on acidity and basicity of organic compounds. Hybridization: effects on bond length, angle (including Baeyer's strain), dissociation energy. Covalent and non-covalent interaction: Melting- boiling point, solubility of common organic molecules. Heat of hydrogenation -combustion - formation.

REACTION MECHANISM: Types of Mechanisms: ionic, radical (homolytic and heterolytic) and pericyclic - Types of reactions: addition, elimination, and substitution reactions - electrophiles and nucleophiles - electrophilicity and nucleophilicity. Reactive intermediates: carbocation, carbanion, carbene. Nucleophilic substitution: SN1, SN2, SNi mechanisms. Eliminations reactions: E1, E2, E1CB, Ei mechanisms. Elimination versus substitution reactions, energy profile diagrams-transition states

STEREOCHEMISTRY-1: Stereochemistry and stereoisomerism, Optical activity - Chirality and it elements, the chiral centre, enantiomers, Enantiotopic and diastereotopic atoms-the racemic modification- Molecules with more than one asymmetric center.- groups and faces. Stereo specific and stereo selective synthesis - Specification of configuration: R and S, Sequence rules- D/L, erythrose, threose, geometrical isomerism - E/Z nomenclatures, syn/anti nomenclature.

ORGANIC ACID AND BASES: Structural, substituent and solvent effect on acidity and basicity; proton sponge; gas-phase acidity and basicity; Nucleophlicity and basicity; HSAB principle; thermodynamic principles in acid-base equilibria.

CHEMISTRY OF ALKENES AND ALKYNES : Addition reactions (electrophilic and free radical), hydration, hydroxylation, iodolactonization, hydroboration, oxy-/ de-mercuration, epoxidation, ozonolysis, hydrohalogenation and polymerization. Conjugated and isolated dienes: 1,2- versus 1,4-addition. Birch reduction, reactions of terminal alkynes (explaining the acidity).

REFERENCE BOOKS

1. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2nd Edn., Vikas Publishing House, New Delhi, 2004.
2. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3rd Edn., Vishal Publishing Company Co., 2010.
3. R. T. Morrison, R. N. Boyd, *Organic Chemistry*, 7th Edn., Pearson Education, New Delhi, 2013.
4. I. L. Finar, *Organic Chemistry,* Vol. I, 5th Edn., Pearson Education, New Delhi, 2013.
5. Jerry March, *Advanced Organic Chemistry*, 5th Edn., John Wiley & Sons, New York, 2004.

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	learn the basic properties of organic molecules
CO2	understand the elementary idea of reaction mechanism
CO3	learn the concepts of stereochemistry
CO4	identify the nature of organic acids and bases alkenes and alkynes

CHPC22	Basic Concepts of Physical Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARINING OBJECTIVES

Upon completion of the course the student will be able to

1. Understand the behavior of ideal and non-ideal gas.
2. Understand fundamental thermodynamic properties and processes
3. Apply thermodynamic principle to elucidate properties of liquids.
4. Apply thermodynamic principles to understand ionic conductivity in solutions.
5. Understand the function of an electrochemical cell.

COURSE CONTENT

Gaseous State: *Ideal gas*- Calculation of pressure and temperature using kinetic theory. Maxwell's velocity distribution equation. Equipartition theorem. Average/Mean/RMS/Most Probable speed calculation. *Real gas*- Van der Waals equation of state. Virial equation of state, critical state variables, liquefication of a gas, compressibility factor, Boyle temperature, Law of corresponding states, fugacity

Thermodynamics: System and environment, *Zeroth law*- Reversible and irreversible processes. *First law*- Calculation of internal energy, enthalpy, and heat capacity. Joule-Thompson coefficient. Relationship between C_p and C_v. *Second law*- Thermodynamical and statistical definitions of entropy, Carnot cycle and its efficiency, Clausius inequality, Gibbs-Helmoltz equation, criteria of spontaneity, *Third law*- Concept of absolute zero.

Liquid State: *Properties of liquid* - Radial distribution function, physical properties of liquids, vapour pressure, surface tension and coefficient of viscosity, their determination, effect of various solutes and temperature, cleansing action of detergent. *Solutions* - Thermodynamic description of liquid mixtures, ideal solutions, Roult's law and Henry's law, *Colligative properties*- relative lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmosis, and osmotic pressure, applications in calculating molar masses of solutes in solution.

Ionic Equilibrium: *Conductance* - specific/molar/eq. conductance. Arrhenius's theory and Ostwald dilution law. Conductance measurement: Kohlrausch's law. Debye-Hückel limiting law and activity coefficient. Transport number, Principles of Hittorf's and Moving-boundary method, Relaxation effect, and electrophoretic effect. Wien effect, Debye-Falkenhagen effect, Walden's rule. Applications of conductivity measurements: Applications of conductivity measurements:

Electrochemistry: Different classes of reversible chemical cells and their mechanisms. Salt bridge. Liquid junction potential. Electrical double layer, polarization, and overvoltage**.** Chemical cells with and without transport. *Thermodynamic approach*- Electromotive force. Nernst equation. Standard electrode potential and calculation of cell potentials. Electrochemical series. Measurement of enthalpy, entropy, equilibrium constant, activity coefficients, and pH values using a glass electrode.

REFERENCE BOOKS

1. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, Oxford University Press (Latest Edition).
2. Puri B. R., Sharma L. R., Pathania M. S., Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co. (Latest Edition).
3. Viswanathan M., Principles of Physical Chemistry I, University of Kerala, Jai Sai Publications (Latest Edition).
4. Viswanathan M., Principles of Physical Chemistry II, University of Kerala, Jai Sai Publications (Latest Edition).

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	Apply kinetic theory to explain the behaviour and the distribution of molecular speeds of gasses
CO2	Understand the concept of energy flow and calculate changes in thermodynamic properties such as potential, enthalpy, internal energy, entropy etc.
CO3	Apply thermodynamic principle to elucidate the effect of solute concentration on solution properties
CO4	Understand ionic conductivity in solutions. concepts of electrochemistry and development of an electrochemical cell.

CHLR21	Organic Qualitative and Quantitative Analysis	L	T	P	C
		0	0	2	2

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- Practical determination of melting point
- Practical determination of boiling point
- Separation of organic compounds
- Detection of elements

COURSE CONTENT

1. Melting point determination: oxalic acid, succinic acid, *m* – dinitro benzene, *p*-dichlorobenzene
2. Boiling point determination: aniline / nitrobenzene /chlorobenzene
3. Crystallization: Benzoic acid from hot water, naphthalene from ethanol
4. Separation of components using like water (cold, hot), dil. HCl, dil. NaOH, dil. NaHCO3, etc., Purification of one of components by crystallization. (Benzoic acid/p-Toluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/p-Anisidine)
5. Distillation of water – alcohol mixture using water condenser; Distillation of chlorobenzene – nitrobenzene mixture using air-condenser
6. Systematic Analysis and preparation of a Solid derivative- Detection of extra elements (N, S and halides) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, alcohols, amines, amides, nitro and anilides). (Minimum 10 compounds)

REFERENCE BOOKS

1. B. Dey and M. V. Sitharaman, *Laboratory Manual of Organic Chemistry*, Revised by T. R. Govindachari, Allied Publishers Ltd., New Delhi, 4th Revised Edn., l992, ISBN: 9788170232520.
2. Vogel, *Text book of Practical Organic Chemistry*, 5th Edn., ELBS, London, l989. ISBN: 978-8177589573
3. F. G. Mann, B. C. Saunders, Practical Organic Chemistry, 4th Edn., Pearson Education, Noida, 2011

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	develop practical skills in different organic compounds analysis methods
CO2	Learn crystallization techniques
CO3	learn hands-on experience in separation and purification techniques.
CO4	Identify organic functional groups and prepare their derivatives

CHPC31	Analytical and Instrumental methods in Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Higher Secondary Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand:

1. The errors of chemical analysis and its statistical data analysis.
2. To familiarize experimental techniques in Qualitative Inorganic Analysis
3. To introduce the basic principles, working and applications of separation techniques like Solvent extraction, Chromatography and Electrophoresis.
4. To introduce the basic principles, working and applications of Electroanalytical techniques like Potentiometry, Polarography, Coulometry and Conductometry.
5. To introduce the basic principles, working and applications of Atomic Spectroscopic techniques like AAS, plasma spectroscopy and Flame emission spectrometry.

COURSE CONTENT

Fundamentals of Analytical Chemistry: Role of analytical chemistry - apparatus - unit operations of Analytical chemistry- Calibration of Apparatus- Errors in chemical analyses-Accuracy and propagation of errors- Statistical data analysis and evaluation: Significant digits – graphing of data – precision and accuracy - Confidence intervals- statistical aids to hypothesis testing- analysis of variance and Regression analysis.

Classical methods of Analysis: Molecular mass- molar volume – equivalent mass – applications of solubility product and common ion efffect in the precipitation of cations- inter group separations and interfereing ions – Titirimetric analysis – fundamental conepts – Weight percentage – molality – molarity – molefraction – Normality – ppm – ppb. Primary and secondary standards. Quantitative dilution. Indicators - Titirations in Analytical chemistry, Complex acid base systems and precipitation reactions – introdcution to electro chemical methods.

Experimental Techniques: Gravimetric methods of Analysis, Unit operations in gravimetric analysis – Illustrations based on Iron and barium estimation - Dry tests, Wet reactions, macro apparatus and analytical operations on a macro scale, Semimicro apparatus and semimicro analytical operations, Micro apparatus and microanalytical operations and Spot test analysis.

Separation Techniques: Introductions to Analytical separations, Filteration, crystalization, precipitation and distillation **-** Solvent extraction – Principles and applications**,** Chromatography Principles of absorption- Column chromatography, thin layer chromatography, Rf- value and significance - Ion exchange chromatography, HPLC- Gas chromatography – basic instrumental set up-carriers, columns, detectors.

Atomic Spectroscopy: Atomic absorption spectrometry (AAS) - absorption of characteristic radiation, instrumentation- Hollow cathode lamp-sampling - quantitative measurements and interferences- Atomic emission-– sources, instrumentation- Inductively coupled plasma - Flame emission spectrometry - flame characteristics & processes-applications of flame photometry – Introduction to ICP and AES.

REFERENCE BOOKS

1. G. H. Geeffery et al., *Vogel's Text Book of Quantitative Chemical Analysis*, ELBS Edn, 1989.
2. D. A. Skoog, D.M. West, F.J Holler, S.R Crouch, *Fundamentals of Analytical Chemistry*, 8th edition, Thomson Brooks Cole, 2004.
3. D. A. Skoog, E. J. Holler, S. R. Crouch, *Principles of Instrumental Analysis*, 6th edition, Thomson Brooks Cole, 2007.

COURSE OUTCOMES

Upon completing the course, the student will be able to understand

CO1	To know the importance of error analysis and its statistical treatment
CO2	To understand sampling methods of the analytes to be measured.
CO3	To get familiarize with the principles, operation and uses of these instruments in industry.
CO4	To conduct demonstration experiments in industry with real samples.

CHPC32	Chemistry of functional groups and aromaticity	L	T	P	C
		3	0	0	3

PRE-REQUISITE: CHPC21

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- the details of reaction mechanism and stereochemistry
- the chemistry of alcohols, phenols and carbonyl compounds
- the aromaticity and pericyclic reaction

COURSE CONTENT

REACTION MECHANISM –II: Neighbouring group participation. Nucleophilic aromatic substitution. Tautomerism (keto-enol, amido-imidol, nitroso-oximino, diazo-amino and enamine-imine).

STEREOCHEMISTRY II: Conformational analysis, Sawhorse, Newman, Flying-wedge and Fischer projections (interconversion), Rotation about C-C single bond. conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems, substituted cyclohexanes, and polycyclic (cis and trans decalins) systems. Torsional strain in conformation of n-butane Conformation of cycloalkanes, Equatorial and axial bond in cyclohexane, stereoisomerisms of cyclic compounds, cumulene (even and odd carbon), allene, spiro compounds, alkylidinecycloalkanes, biphenyls (Ra/ Sa, P, M). prostereoisomerism.

CHEMISTRY OF ALCOHOLS AND PHENOLS: Monohydric alcohols: Nomenclature, properties - Preparation-reduction of aldehydes, ketones, carboxylic acids and esters., acidic nature and reactions of alcohols. Dihydric alcohols: chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols – Nomenclature, preparation and reactions - Phenols -Nomenclature, structure and bonding, Preparation of phenol, resorcinol and 1- 2- naphthols. Reactions of phenols - Electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Gatterman synthesis, Houben- Hoesch reaction, and Reimer-Tiemann reaction

CARBONYL COMPOUNDS-I: Preparation: From alcohols, cyanides, acid chlorides and Etard's reaction. Nucleophilic addition reactions – With HCN, H_2O, alcohols, NH_3, hydroxyl amine, hydrazine, semicarbazide, sodium bisulfate and DNP reagent. Wittig reaction, Oxidation – acidified $K_2Cr_2O_7$, $KMnO_4$, CrO_3; Oppenauer oxidation. Distinguishing aldehydes and ketones (Tollen's reagent, Fehling's solution); Reduction – Catalytic hydrogenation, Wolf-Kishner, Clemmensen, metal hydride ($LiAlH_4$ and $NaBH_4$) and MPV reduction.

AROMATICITY AND PERICYCLIC REACTIONS: The Huckel [4n+2] rule, Effect of substituent group, Electron release via resonance, Determination of relative reactivity, Classification of substituent group, Electrophilic aromatic substitution,

Mechanism of nitration, sulphonation, Friedal-Craft alkylation, Friedal-Craft acylation. Ipso substitution.
Pericyclic reactions: FMO theory, electrocyclic and cyclo addition reactions, Woodward-Hoffmann rules. Problem solving

REFERENCE BOOKS

1. S. M. Mukherjee, S. P. Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan, 1984.
2. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2*nd* Edn., Vikas Publishing House, New Delhi, 2004.
3. R. T. Morrison, R. N. Boyd, *Organic Chemistry*, 7th Edn., Pearson Education, New Delhi, 2013.
4. I. L. Finar, *Organic Chemistry,* Vol. I, 5 th Edn., Pearson Education, New Delhi, 2013.
5. Jerry March, *Advanced Organic Chemistry*, 5 th Edn., John Wiley & Sons, NewYork, 2004.

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	learn the deep insights of reaction mechanism
CO2	understand the details of stereochemistry
CO3	learn the chemistry of alcohols and phenols
CO4	understand chemistry of carbonyl compounds aromaticity and pericyclic reaction

CHLR31	Quantitative and Analytical Chemistry Lab	L	T	P	C
		0	0	2	2

PRE-REQUISITE: CHLR11

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able

- To prepare std. solutions and dilution
- To develop the skill on estimation of salts using volumetric analysis
- To develop the skill on complexometric estimations.
- To prepare inorganic compounds
- To estimate the inorganic salts using gravimetric analysis

COURSE CONTENT

1. Acidimetry and alkalimetry
Strong Acid Strong base
Strong acid weak base
Strong base Weak Acid
Estimation of Na_2CO_3 and $NaHCO_3$ in a mixture
Estimation of Ammonia

2. Complexometric Titrations
Estimation of Zn, Mg, Ng and Ca in a mixture

3. Redox titrations
Permaganometry – Ferrous iron, oxalic acid, calcium
Dichrometry - Ferrous iron – internal & external indicator
Ferric iron – internal & external indicator
Iodimetry and iodometry – Copper and Arsernious oxide

4. Gravimentric Analysis
1. Estimation of lead as lead chromate
2. Estimation of as Fe_2O_3
3. Estimation of nickel as nickel-DMG complex
4. Estimation of copper as copper (I) thiocyanate
5. Estimation of barium as barium sulphate

REFERENCE BOOKS

1. Venkateswaran.V., Veeraswamy, R., & Kulandaivelu, A. R. (1997). *Basic Principles of Practical Chemistry*, (2nd Ed.). New Delhi, Sultan Chand and Sons.
2. Nad, A. K., Mahapatra, B., & Ghoshal, A. (2007). *An advanced course in practical chemistry*, (3rd Ed.). New Central Book Agency.
3. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.; Pearson Education Ltd: New Delhi, 2000.

COURSE OUTCOMES

Upon completing the course the student will be able to

CO1	prepare std. solutions and dilution
CO2	develop the skill on estimation of salts using volumetric analysis
CO3	develop the skill on complexometric estimations
CO4	prepare inorganic compounds & estimate the inorganic salts using gravimetric analysis

CHPC41	TRANSITION METAL CHEMISTRY	L	T	P	C
		3	0	0	3

PRE-REQUISITE: CHPC11

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able

- To understand the basic chemistry of acids and bases.
- To infer about the nature of transition and inner transition elements.
- To outline the basics of coordination chemistry.
- To predict the structure and stability of complexes.
- To correlate the electronic transition and structure of complexes.

COURSE CONTENT

Acid-Base Reactions: Arrhenius concept, theory of solvent system (in H_2O, NH_3, SO_2 and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling rules. Amphoterism. Lux-Flood concept, Lewis concept. Superacids, HSAB principle. Acidbase equilibria in aqueous solution and pH. Acid-base neutralisation curves; indicator, choice of indicators.

Reactivity of d-Block Elements: Electronic configurations - variation of atomic and ionic radii –variable oxidation state - Electrode Potentials – oxides, halides, chromte and dichromate, permanganate - synthesis and reactivity - complexing tendency

Coordination Chemistry-I: Coordination compounds - Werner's theory - coordinate bond, coordination number, chelate complexes and chelate effect - EAN rule - coordination sphere, geometries, oxidation state of the metal ion - ligands - types of ligands – IUPAC nomenclature of coordination compounds - Isomerism in coordination compounds

Coordination Chemistry-II: Valence bond theory (VBT), Crystal field theory - splitting of d-orbitals in Oh ,Td and square planar environments -calculation of CFSE - effects of crystal field splitting - lattice energy, enthalpies of hydration - Jahn - Teller distortion -MO theory of Oh complexes

Electronic Spectra & Magnetism Of Complexes: Energy levels in atoms - coupling of orbital momenta - coupling of spin momenta - spin -orbit coupling - terms and termsymbols - determining the ground state terms - terms arising from p and d configurations - calculation of number of microstates. Electronic spectra of transition metal complexes & lanthanides- selection rules and intensity – Correlation diagrams – magnetic properties of Complexes

REFERENCE BOOKS

1. Madan, R. D., & Prakash, S. (2019). *Modern inorganic chemistry*, (Revised Edition.). S. Chand & Company.
2. Lee, J. D. (1991). *Concise inorganic chemistry*, (4th Ed.). ELBS William Heinemann.
3. Catherine E. Housecroft; Alan G. Sharpe. (2018). *Inorganic Chemistry*, (5^{th} Ed.). Pearson Education Limited.
4. Huheey, J. E., (1993). *Inorganic chemistry: Principles of structure and reactivity*, (4^{th} Ed.). Addison-Wesley Publishing Company.

COURSE OUTCOMES

Upon completing the course the student will be able to understand

CO1	the basic chemistry of acids and bases
CO2	the nature of transition and inner transition elements
CO3	the basics of coordination chemistry electronic transition and structure of complexes
CO4	predict the structure and stability of complexes

CHPC42	Statistical Thermodynamics, Chemical Kinetics and Equilibrium Processes	L	T	P	C
		3	0	0	3

PRE-REQUISITE: CHPC22

COURSE LEARNING OBJECTTIVE

Upon completion of the course the student will be able to

1. Understand the activity and its relation to concentration, pressure and equilibrium
2. Understand the principles dictating equilibrium in single and multicomponent systems.
3. Understand the concept of the statistical nature of thermodynamic properties.
4. Understand the fundamental concepts of kinetics and reaction mechanisms
5. Understand the general concept of adsorption and heterogeneous catalysis.

COURSE CONTENT

Chemical Equilibrium: Concept of Chemical Potential. Gibbs-Duham equation. Entropy of mixing. Maxwell's relations. Definition of activity and activity coefficients. *Concept of Chemical Equilibrium* – reaction Gibbs energy, condition of equilibrium, exergonic and energonic reactions, dependence of reaction Gibbs energy on the reaction quotient, relationships between K_p – K_c and K_{eq} – ΔG. Calculation of equilibrium constants, LeChatelier's principle, the van't Hoff equation,

Phase Equilibrium: Phase transitions, cooling curve**,** Phase rule. Clausius-Clapeyron equation. Ehrenfest equation. Phase diagram of one-component systems H_2O/S/CO_2, Two component systems - of binary Solids systems: Eutectic mixture, congruent and incongruent melting. Phase diagrams of binary liquids systems: two component (phenol-water)/three-component (H_2O-$CHCl_3$-AcOH) systems, Lever rule, Azeotropic solution. *Liquid Crystals*- Classifications and applications.

Statistical Thermodynamics: Distinguishable and indistinguishable particles. Macrostate & Microstate. Concept of Ensemble: Microcanonical, Canonical, and Grand canonical. Maxwell-Boltzmann distribution. Partition function and its relations with thermodynamic functions of an ideal Gas, Thermodynamic properties of a Two-Energy levels system. *Quantum statistics*- Fermi-Dirac and Bose-Einstein distribution. Comparison between quantum and classical statistics. Einstein's theory of specific heat. *Molecular dynamics*- Concept force-fields. Velocity-verlet equation. Different thermostats and Barostats. Ewald's summation for electrostatic potential calculation.

Chemical Kinetics: Concept of rate, order, and molecularity of a reaction. Derivation of rate equations (0^{th}, 1^{st}, 2^{nd}, n^{th}, and pseudo-first order). Determination of half-life. Effect of temperature, pressure, solvent, catalyst, and other factors on reaction rates. *Activation energy*- Arrhenius equation. *Multi-step reactions*- opposing, consecutive, parallel, and photochemical. Rate-determining step. *Theories of reaction rates*- Steady-state approximation. Lindemann's theory. Collision theory. Basic concepts of transition state theory.

Surface Chemistry and Catalysis: *Adsorption*- Definition, examples, and differences between Absorption vs. Adsorption and Physisorption vs. Chemisorption. Adsorption isotherms (Langmuir, Freundlich, and BET). Surface area measurement. Gibbs adsorption isotherm and surface excess. *Catalysis*- Promoter vs. Inhibitor. Homogeneous vs. Heterogeneous catalysis (single reactant). *Enzyme catalysis*- examples, Lock and key mechanism, Michaelis-Menten equation

REFERENCE BOOKS

1. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, Oxford University Press (Latest Edition).
2. Castellan, G. W. Physical Chemistry, Narosa (Latest Edition).
3. Puri B. R., Sharma L. R., Pathania M. S., Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co. (Latest Edition).
4. Viswanathan M., Principles of Physical Chemistry II, University of Kerala, Jai Sai Publications (Latest Edition).

COURSE OUTCOMES

Upon completing the course, the student will be able to

CO1	Understand the concepts of chemical equilibrium and determine equilibrium constant values
CO2	Draw phase diagram and understand the phase behaviour of single and multicomponent systems
CO3	Understand the fundamentals of thermodynamics and statistical mechanics
CO4	Understand the general concept of adsorption, chemical kinetics and heterogeneous catalysis.

CHLR41	Physical Chemistry – Lab	L	T	P	C
		0	0	2	2

PRE-REQUISITE: CHPC22

COURSE LEARNING OBJECTIVES

Upon completion of the course, the student will be able to

1. Prepare solutions of specified concentration and perform titration by different methods.
2. Construct a phase diagram of two-component systems
3. Apply the principle of the distribution coefficient of a solute for its partitioning between two phases in equilibrium.
4. Understand the concepts of chemical kinetics to determine the rate of a reaction.
5. Prepare buffers based on theoretical concepts.
6. The concept of adsorption.

COURSE CONTENT

1. Determination of Partition coefficients
2. Determination of transtion temperature
3. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
4. Determination of the critical solution temperature (CST) of the phenol-water system.
5. Construction of the phase diagram using cooling curves of a simple eutectic system.
6. Kinetics of acid hydrolysis of methyl acetate with hydrochloric acid.
7. Conductometric titrations
8. pH metric titration of (a) strong acid with a strong base, or (b) weak acid with a strong base. Determine the dissociation constant of a weak acid.
9. Potentiometric titrations
10. Study of the equilibrium of the following reaction by the distribution method: I_2 (aq) + I^- (aq) → I_3^-(aq).
11. Verification of Freundlich isotherm for adsorption of acetic acid on activated charcoal.

REFERENCE BOOKS

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003)

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	Achieve skills in titration methods for determining unknown concentrations
CO2	Construct a phase diagram of two-component systems
CO3	Understand the partitioning of a component between two phases in equilibrium
CO4	Analyze the rate of a chemical reaction

CHPC51	Organometallic and Bioinorganic Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: CHPC41

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able

- To understand organometallic bonding & reaction mechanism principles
- To understand the industrially important homogenous catalytic cycles
- To understand the basics bioinorganic chemistry and nuclear chemistry

COURSE CONTENT

Structure models: Nomenclature of organometallics compounds, 18/16 electron rule - bonding models in organometallic compounds - Metal metal bonding – metal carbonyls - nitrosyls - phosphines - □-bonding ligands – olefin and alkyne complexes –Quadrupole bond – $[Re_2Cl_8]^{2-}$

Bonding in Organometallics: Fischer and Schrock carbenes - structure, bonding - Metallocenes -Electronic structure and bonding in ferrocene- Structure and bonding in Boranes, styx notation; Wade's rule – *closo* – *nido* and *archno* Boranes

Reaction Mechanisms And Catalysis: Ligand substitution - oxidative addition and reductive elimination - C–H activation - 1,1 and 1,2-insertion - addition and elimination reactions – homogeneous catalysis - Wilkinson's catalyst - hydroformylation of olefins- Monsanto acetic acid process - Zeigler Natta catalyst.

Bioinorganic Chemistry: Various elements in organisms - vitamin and coenzyme B12 - functions - photosynthesis - dioxygen uptake, transport and storage - hemoglobin and myoglobin - cytochrome c–iron-sulfur and other non-heme iron proteins - Blue copper protiens – biological function of main group elements.

Nuclear Chemistry: The atomic nucleus- Structure, nuclear forces – packing fraction - modes of decay, binding energy and nuclear stability, alpha decay, radioactive displacement laws, radioactive decay series- liquid drop model - nuclear shell model –induced nuclear reactions, fission, fusion.

REFERENCE BOOKS

1. G.O. Spessard and G. L. Miessler, *Organometallic Chemistry*, 2nd Edn, Oxford University Press.
2. A. K. Das., Bioinorganic Chemistry, Books and Allied Private Limited; 2017th edition (1 January 2017)
3. Huheey, J. E., (1993). Inorganic chemistry: Principles of structure and reactivity, (4th Ed.). Addison-Wesley Publishing Company.

COURSE OUTCOMES

Upon completing the course the student will be able to understand

CO1	The basics of organometallic bonding principles
CO2	The reaction mechanism in organometallic chemistry
CO3	The industrially important homogenous catalytic cycles
CO4	The basics bioinorganic chemistry and nuclear chemistry

CHPC52	Quantum Chemistry, Group Theory and Photochemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

1. Understand the fundamental idea of quantum theory.
2. Exactly solve Schrödinger equation of simple model systems.
3. Use approximation methods for complex systems.
4. Understand the concept of group theory.
5. Understand the concept of photochemistry.

COURSE CONTENT

Introduction to Quantum Mechanics: Failure of classical mechanics, black body radiation, de Broglie waves, uncertainty principle, wave function and Schrodinger equation, postulates of quantum mechanics, operators, eigenfunctions and eigenvalues, probability interpretation.

Exactly Solvable Problems: Free particle, particle in a box (1-D, 2-D, and 3-D box problems), concepts of quantum numbers and degeneracies, quantum tunnelling and scattering, simple harmonic oscillator, particle on a ring, particle on a sphere, angular momentum, hydrogen atom problem (without derivation). Radial and angular plots of atomic orbitals.

The Variation Method and Perturbation Theory: Rayleigh-Ritz method, Slater determinants, Pauli principle, LCAO-MO, molecular orbitals for diatomic molecules, Hückel theory, Formal development of non-degenerate perturbation theory, perturbation treatment of the ground state of the helium atom, comparison with the variation treatment, excited states of the helium atom. *Quantum computation*- Hatree SCF method. The Hatree-Fock equations. Koopmans' theorem. Roothaan equations. Concept of basis set, electron correlation, and configuration interaction.

Basics of Group Theory: Crystal systems, lattice energy of an ionic crystal, law of rational indices, interplanar spacing in a crystal system, X-ray diffraction, Bragg equation, Fourier synthesis of electron density in a crystal, Patterson synthesis, types of crystals – Molecular, covalent and ionic. Group postulates, types of groups, point groups, symmetry elements and symmetry operations, molecular point groups, great orthogonality theorem and its use for construction of character table for molecular point groups, properties of irreducible representation, crystallographic symmetry and crystal systems.

Photochemistry: Laws of photochemistry, Quantum Yield, and its measurement, Jablonski diagram, Qualitative description of Fluorescence, Phosphorescence, Chemiluminescence, Quenching, and Non-radiative processes (internal conversion, intersystem crossing), Theory of energy transfer - resonance and exchange mechanism, triplet-triplet annihilation, photosensitization, and quenching. Fluorescene spectroscopy

REFERENCE BOOKS

1. I. N. Levine, Quantum Chemistry, Pearson; Seventh edition, 2013.
2. Szabo and N. S. Ostlund, Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory, Dover Publications Inc., Revised ed. edition, 1996.
3. P. W. Atkins and R. S. Friedman, Molecular Quantum Mechanics, Oxford University Press; Fifth edition, 2012.
4. Puri B. R., Sharma L. R., Pathania M. S., Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co. (Latest Edition).

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	Understand the fundamental idea of quantum theory.
CO2	Exactly solve Schrödinger equation of simple model systems.
CO3	Use approximation methods for complex systems.
CO4	Understand the concept of crystal structure and group theory & photochemistry.

CHPC53	Chemistry of carbonyls and Nitrogen Compounds	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- the chemistry of carbonyl, and active methylenes
- the properties of N-containing organic molecules

COURSE CONTENT

CARBONYL COMPOUNDS-II: Enols and enolates- formation and stability; Reactions involving α-carbons of carbonyl compounds – Aldol, Cannizzaro, Knoevenagel, Claisen-Schmidt, Dieckmann, Stobbe; Mannich reaction and Perkin reaction, Benzoin condensation, and Perkin's reactions. Haloform reaction. Reformatsky reaction. Michael addition and Robinson's annulations. Stereoselectivity: Cram's rule and Felkin-Ahn model.

ACTIVE METHYLENE COMPOUNDS: Synthesis of ethyl acetoacetate by Claisen condensation and diethyl malonate. Acidity of α – hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthetic applications of malonic ester - dicarboxylic acids – succinic acid and adipic acid; α,β – unsaturated acids – crotonic acid and cinnamic acid; barbituric acid. Synthetic applications of acetoacetic ester - dicarboxylic acids – succinic acid and adipic acid; α, β – unsaturated acids – crotonic acid and cinnamic acid; antipyrine, uracil and acetyl acetone, keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes, alkylation and acylation of enamines

CARBOXYLIC ACIDS AND RELATED COMPOUNDS: Preparation-Oxidation, hydrolysis of nitrile, and with Grignard reagent. Properties-acidity (effect of substituent on the acidity). Reactions – conversion to acid chlorides, esters, amides and anhydrides. Fischer esterification (mechanism), HVZ reaction – Decarboxylation – Kolbe electrolysis (mechanism). Hydroxy acids – Citric acid – preparation by Reformatsky reaction and uses. Lactic acid, Malic acid and Tartaric acid (structure only). Preparation and reaction of unsaturated monocarboxylic acids (cinnamic acid and crotonic acid). *Sulphonic Acids:* Preparation, properties of benzene sulphonic acid. Reactions – Tosylation. Comparison of acidity of alcohols, phenols, carboxylic acids and sulphonic acids

CHEMISTRY OF NITRO AND AMINES: *Nitro Compounds:* Preparation of nitroalkanes and nitroarenes.– Nef reaction (mechanism not required) – Reduction products of nitrobenzene in acidic, neutral and alkaline media. *Amines:* Nomenclature – Isomerism. Preparation: From alkyl halides, nitro compounds, nitriles, isonitriles and amides – Hofmann's bromamide reaction, Schmidt reaction

and Gabriel phthalmide synthesis. Properties: Basicity (effect of substituents), carbylamine reaction, conversion of amine to alkene (Hofmann's elimination with mechanism and stereochemistry), acylation and reaction with nitrous acid. Beckmann rearrangement, Electrophilic substitution reactions of aniline: Halogenation, nitration and sulphonation. Separation of amines by Hinsberg's method.

CHEMISTRY OF NITRILE AND DIAZONIUM SALTS: Preparation and reaction (with mechanism)-Thorpe nitrile condensation, von Richter reaction. Diazonium salts and their related compounds: reactions (with mechanism) involving replacement of diazo group; - Gomberg, Meerwein, Japp-Klingermann.

REFERENCE BOOKS

1. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2nd Edn., Vikas Publishing House, New Delhi, 2004.
2. R. T. Morrison, R. N. Boyd, *Organic Chemistry*, 7th Edn., Pearson Education, New Delhi, 2013.
3. Jerry March, *Advanced Organic Chemistry*, 5th Edn., John Wiley & Sons, NewYork, 2004.
4. J. Clayden, N. Greeves, S. Warren, P. Wothers, *Organic Chemistry*, 2nd Edn., Oxford University Press, New York, 2012.

COURSE OUTCOMES

Upon completing the course, the student will be able to –

CO1	Understand the detail chemistry of carbonyl compounds
CO2	Learn the chemistry of active methylene compounds
CO3	Understand the reactivities of carboxylic acids
CO4	Learn the properties of nitro and amines nitriles and diazonium salts

CHPC61	Spectroscopy and applications	L	T	P	C
		3	0	0	3

Pre requisit: NIL

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- Fundmentals of Spectral transitions
- Applications of different techniques
- Real time analysis and problem solving

COURSE CONTENT

Fundamentals & Rotational spectra: Interaction of radiation with matter– Spectroscopic Transitions-Einstein coefficients- transition probability- Born-Oppenheimer approximation- rotational spectra - selection rules- Factors affecting the Intensity of Spectral lines**:** Diatomic and polyatomic molecules - selection rules, Rigid and non-rigid rotator

Vibrational Spectra: Principles of vibrational spectra of diatomic molecules - rotational character of vibration spectra - Morse potential - selection rules - overtones and combination - Fermi Resonance-Polyatomic molecules - harmonic and anharmonic oscillators - Raman Spectroscopy - Fundamentals

NMR Spectroscopy - Concept and theory–Larmor frequency, Origin of Chemical Shifts, Spin Spin coupling, - chemical shift anisotropy- Pople notations and Spin systems - Relaxation and related phenomena, ^{13}CNMR –chemical shifts and line intensities- Spin decoupling- Nuclear Overhouser effect - Polarization transfer schemes – Introdcution to 2D methods.

Mass spectroscopy: Methods of desorption and ionization (EI, CI, ESI, MALDI, FAB, TOF) –instrumentation- ion cyclotron resonance (FT)- meta stable ions - study of fragmentation pattern- □-bond cleavage- McLafferty rearrangement- retro Alder fragmentation

Applications of Spectroscopy: Structural elucidation in organic Chemistry using combined techniques- Theory of electronic transitions and electronic spectroscopy - Beer- Lambert Law and applications. Woodward–Fieser rules for Organic Molecules.- Introduction to ESR, Mossbauer spectroscopy,

REFERENCE BOOKS

1. D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Introduction to Spectroscopy, 5th Edn., Brooks Cole , 2010.
2. Banwell, C. N. and McCash, E. M. Fundamentals of Molecular Spectroscopy (Tata McGraw Hill, 1994).
3. D. N. Sathyanarayana, Handbook of Molecular Spectroscopy, From Radio waves to gamma rays, I.K international Publishing house Pvt. Ltd, 2015

COURSE OUTCOMES

Upon completing the course the student will be able to know:

CO1	Fundamentals of interactions of electromagnetic radiation with matter & Rotational spectra of diatomic and polyatomic molecules
CO2	A detailed study Vibrational spectroscopy of polyatomic molecules, Raman effect and Raman spectroscopy
CO3	An understanding of NMR spectroscopy
CO4	Fundamentals of other Spectral methods

CHPC62	Heterocycles and Natural Products	L	T	P	C
		3	3	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

Upon completion of the course the student will be able to understand

- the properties of heterocycles, biomolecules and natural products
- the nature of rearrangement reactions and organometallic chemistry

COURSE CONTENT

HETEROCYCLES: Heterocyclic systems: Structure, Sources and reactivities of pyrrole, furan, thiophene, and pyridine. The skraup synthesis, The Bischler–Napieralski synthesis. Vilsmeier-Haack reaction,

BIOMOLECULES: Structure, properties and reactions of mono- and di-saccharides, Structure of amino acids, Amino acids as dipolar ions, Isoelectric point of amino acids, Configuration of natural amino acids, Preparation of amino acids, Peptides. Geometry of the peptide linkage, Secondary structure of protein. Enzyme (definition), Coenzymes, Mechanism of enzyme action. Nucleoproteins and nucleic acids. Introduction, Uric acid, Purine derivatives, Xanthine bases, Nuclic acids, Structure of nucleosides, nucleotides, Ribonucleic acids, Deoxyribonucleic acids.

NATURAL PRODUCTS CHEMISTRY: General introduction, nomenclature, isolation, properties and chemistry of alkaloids, terpenoids and steroids. General methods employed for determining the structure of Adrenaline, Nicotine, Quinine, Citral, α-terpineol, Geraniol, Linalool.

REARRANGEMENT REACTIONS: Rearrangement reactions: Wagner-Meerwin, Demjanov, Pinacol-Pinacolone, Benzil-Benzilic acid, Wolf, Beckmann, Hoffman, Cutius, Schmidt; Favorskii, -Fries, Claisen, Benzidine. - Grignard Reagents, Organolithium reagents, Organocopper reagents.

CONCEPTS OF MULTISTEP SYNTHESIS: Retrosynthetic analysis-disconnections; synthons, donor and acceptor synthons; natural reactivity and umpolung (formyl and acyl anion equivalents); synthetic equivalents; functional group interconversion and addition (FGI and FGA); Atom economy and Green Chemistry, Protection and deprotection of functional groups.

REFERENCE BOOKS

1. Bansal, R. K. Heterocyclic Chemistry, New Age International Publishers.
2. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. J. Clayden, N. Greeves, S. Warren, P. Wothers, *Organic Chemistry*, 2nd Edn., Oxford University Press, New York, 2012.
4. R. R. Carey and R. J. Sundburg, *Advanced Organic Chemistry, Part A and Part B*, Springer, 5th Edn, 2007.

COURSE OUTCOMES

Upon completing the course, the student will be able to -

CO1	Learn the chemistry of heterocycles
CO2	Understand the properties of biomolecules
CO3	Know the chemistry of natural products
CO4	Gain knowledge on Rearrangement reactions and Organometallic chemistry

Programme Electives

CHPE51	Nanoscience and Nanotechnology	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Students with appropriate Chemistry background may be permitted to enroll

COURSE LEARNING OBJECTIVES

To impart the basic knowledge on nanoscience and nanotechnology which includes the exotic properties of materials at nanoscale, various techniques available for the processing and characterization of nanostructured materials, applications in selected fields such as sensors.

COURSE CONTENT

Introduction to nanomaterials, Top down and bottom up paths in nano science – Feynman's hypothesis – moores law - Properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters

Chemical Routes for Synthesis of Nanomaterials: Chemical precipitation and coprecipitation; Metal nanocrystals by reduction, Sol-gel synthesis; Electrochemical synthesis; Photochemical synthesis, Evaporation – sputtering - CVD

Nanostructures: Zero-, One-, Two- and Three- dimensional structure, Size control of metal Nanoparticles and their properties

Structural Characterization: Basics of X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).

Carbon nanostructures: Introduction. Fullerenes, C60, C80 and C240 nanostructures. Properties & applications (mechanical, optical and electrical). Functionalization of carbon nanotubes, reactivity of carbon nanotubes. Nanosensors

REFERENCE BOOKS

1. T. Pradeep, *Nano: The Essentials, Tata McGraw-Hill*, New Delhi, 2007.
2. G. Cao, *Nanostructures and Nanomaterials – Synthesis, Properties and Applications*, Imperial College Press, London, 2004.
3. C. N. R. Rao, A. Muller and A. K. Cheetham, *The Chemistry of Nanomaterials, Volume 1*, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004.

COURSE OUTCOMES

Upon completing the course the student will be able to

CO1	describe important physical methods in the field of nanoscience
CO2	describe important of structures in the field of nanoscience
CO3	describe important experimental tools in the field of nanoscience
CO4	familiarize with the applications of nanotechnology in sensors

CHPE52	Medicinal Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: Nil

COURSE LEARNING OBJECTIVES

1. To introduce the students in the field of medicinal chemistry
2. To provide the students an idea about the classifications of drugs and structure-activity relationship.
3. The students will be able get an idea about the antibiotics (synthesis, bio-activity)
4. The students will be familiar with the structures of enzymes and different types of interactions.

COURSE CONTENT

History of medicinal chemistry, general mechanism of drug action on lipids, carbohydrates, proteins and nuleic acids, drug metabolism and inactivation, receptor structure and sites, drug discovery development, design and delivery systems, gene therapy and drug resistance.

Classification: Drugs based on structure or pharmacological basis with examples, structure of α - methyl dopa, chloramphenicol, griseofulvin, cephelosphorins and nystatin. qualitative and quantitative structure activity relationships.

Antibiotics: Mechanism of action of lactam antibiotics and non lactam anti biotics, antiviral agents, chemistry, stereochemistry, biosynthesis and degradation of penicillins - An account of semisynthetic penicillins

Elucidation of enzyme structure: Mechanism, kinetic, spectroscopic, isotopic and stereochemical studies. Chemical models and mimics for enzymes, design, synthesis and evaluation of enzyme inhibitors.

DNA-protein interaction and DNA-drug interaction: Introduction to rational approach to drug design, physical and chemical factors associated with biological activities, mechanism of drug action.

REFERENCE BOOKS

1. G. L. Patrick, Introduction to Medicinal Chemistry, Oxford Univeristy Press, 2001.
2. Bentley and Driver's Text Book of Pharmaceutical Chemistry revised by L.M. Artherden, Oxford University Press, London, 1977.

COURSE OUTCOMES

Upon completing the course the student will be able to

CO1	Know the history and fundamentals of medicinal chemistry
CO2	Classify the drugs and relationship between structure and activity.
CO3	Understand the bio-mechanism of the antibiotics along with their synthetic routes
CO4	Know the structure of enzymes, their activity and different types of interactions in bio-molecules

CHPE53	Environmental Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

To introduce the underlying concepts of Environmental Chemistry, various aspects of the four main spheres of earth: Atmosphere, Biosphere, Hydrosphere and Lithosphere, their interactions amongst each other and influence on human beings.

COURSE CONTENT

Environmental pollution: Structure of atmosphere- bio geological cycles -oxygen - nitrogen – carbon – phosphorous –sulphur - air pollutions- reactions in atmosphere- primary pollutants -air quality standards - hydrocarbons and particulate matter - particulate pollution –vechicular pollution- greenhouse effect and global warming - climatic changes –ozone- photochemical smog-acid rain - sampling -monitoring – control.

Water pollution: Hydrological cycle- chemical composition - sea water composition - water quality criteria for domestic and industrial uses - BIS and WHO standards - ground water pollution-surface water pollution- lake and river water- eutrophication- marine pollution- water pollutants - biodegradability of detergents –pesticides- endosulfan and related case studies, microplastics.

Water treatment: Principles of water and waste water treatment -aerobic and anaerobic treatment -industrial waste water treatment -heavy metal pollution-hard water - softening - purification of water for drinking purposes - water treatment for industrial use

Water analysis: Colour - odour - conductivity - TDS - pH - acidity - alkalinity - chloride- residual chlorine - hardness- trace metal analysis- elemental analysis -ammonia - nitrite - nitrate - fluoride - sulphide - phosphate -phenols - surfactants - BOD - COD - DO - TOC

Soil pollution: Soil humus - soil fertility- inorganic and organic components in soil -acid - base and ion exchange reactions in soils -micro and macro nutrients -waste and pollutants in soil- - solid waste management- treatment and recycling

REFERENCE BOOKS

1. H. Kaur, *Environmental Chemistry*, 6th Edn, PragathiPrakashan, Meerut, 2011.
2. A. K. De, Environmental Chemistry, 9th Ed, New Age international

COURSE OUTCOMES

Upon completing the course, the student will be able to understand

CO1	Familiarize the basics of Environmental chemistry and its numerous facets.
CO2	Find out the important causes of pollution.
CO3	Will work out the analysis data for its control.
CO4	Know the health hazard in day-to-day life.

CHPE61	Biocatalytic processes in Chemical Industries	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

To introduce the underlying concepts industrial microbiology in chemistry and food related industry. Understand different concepts of Fermentation related techniques applicable to chemistry.

COURSE CONTENT

Industrial microorganisms: Differentiation between procaryotes and eucaryotes; Bacteria, Yeast, Molds and Actinomycetes. Bioprocessing -Fermentation Techniques: Screening procedures; Detection and assay of fermentation products; Fermentation media

Microbial production: Vitamin $B_{12,}$ Glutamic acid, citric acid, Acetic acid, Production of microbial enzymes– production of Alkaloids

Manufacture of food and beverage fermentations – Alcohol based fermentation industries -Production of Vinegar- Manufacture of Bread- Manufacture of Dairy products- - Microbial production of antibiotics - Microbial transformation of steroids - Fermentation of hydrocarbon

Microbial contamination and spoilage: Bio deterioration of textiles, paper, leather, wood, and rubber -Spoilage of milk, alcoholic beverages, fruits -Spoilage of meat, poultry, eggs and fish. Conversion of Renewable resources to Biofuels and fine chemicals.

Microorganisms in industry: Fundamentals, control by physical agents and chemical agents. Microbial Enzymens in Industry– Biocatalysts – Immobilized enzymes and immobilized cells.

REFERENCES

1. Sanjai Saxena, Applied Microbiology, Springer, 2015
2. Anantha Narayan R. and C.K.Panicker, “Textbook of Microbiology” Orient, Longman, New Delhi, 1980.
3. Bull M.J.: “Industrial Microbiology”, Elsevier Scientific Publishing Co., New York, 1982.
4. L. E Casida, “Industrial Microbiology”, 1984.

COURSE OUTCOMES

Upon completing the course, the student will be able to:

CO1	Familiarize the basics industrial microbiology
CO2	Application of microbial techniques in chemical synthesis
CO3	Understanding biocatalysis
CO4	Understanding the applications of microbiology in chemistry

CHPE62	Lanthanide and Actinide Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

The student will be able to in detail understand the chemistry and reactivity of lanthanides and actinides, their properties and applications.

COURSE CONTENT

Lanthanides: Occurrence – Ores- Extraction and separation – The Lanthanide contraction – Electronic configuration – shapes of f – orbitals– simple binary compounds of lanthanides

Lanthanides: Coordination chemistry – Coordination numbers – stability and oxidation states - Magnetic Properties – Electronic Spectra – Luminescence Spectra

Organolanthanide Chemistry: Stability -+3 oxidation state – Alkyls and aryls –- other oxidation states and their organometallic complexes – carbonyl compounds of Sc-Y &Pr

Actinides: Occurrence – Synthesis – Extraction and isolation – Characteristics of the actinides– binary compounds of actinides – stability – structure, coordination number and Magnetic properties of actinide compounds

Unit V: Actinides: Electronic and magnetic properties of actinides – spectra – Organoactinides – cylopentadienyls- carbonyls – synthesis of transactinides – naming.

REFERENCE BOOKS

1. S. Cotton, *Lanthanide and Actinide Chemistry,* John Wiley & Sons, 2006
2. J. J. Katz, G.T. Seaborg and L.R. Morss (eds), *The Chemistry of the Actinide Elements*, 2nd edition, Chapman and Hall, 1986.

COURSE OUTCOMES

Upon completing the course, the student will be able to:

CO1	Learn about Lanthanides and their extraction
CO2	Understand Lanthanide Chemistry and spectroscopy
CO3	Learn about actinides and their extraction
CO4	Learn about actinides and their extraction

CHPE63	Polymer Chemistry	L	T	P	C
		3	0	0	3

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

To introduce the basic concept of macromolecules, polymerization processes, polymer stereochemistry, theory of polymer soultions and speciality polymers.

COURSE CONTENT

Concept of macromolecules: Types of polymers and polymerization. Nomenclature of polymers-based on sources, based on structure (non-IUPAC), IUPAC structure-based nomenclature system, Synthetic schemes. Petroleum and petrochemicals - Naphtha as a source of petrochemicals.

Polymerization processes: Free radical addition polymerization- Cationic and anionic polymerization - Chain transfer. Step growth polymerization - Linear *Vs* cyclic polymerization. Other methods of polymerization- bulk, solution, melt, suspension, emulsion and dispersion techniques.

Polymer stereochemistry: Configuration and conformation. Tacticity. Chiral polymers. Polymer characterization. Molecular weights- Methods for determining molecular weights- static, dynamic, viscometry, light scattering and GPC. Glass transition temperature and crystalline melting of polymers.

Polymer solutions: Flory-Huggins theory. Chain dimension-chain stiffness. End-to-end chain distance of polymers. Determination of degree of cross linking and molecular weight between cross links. Industrial polymers- synthesis, structure and applications of industrially important polymers.

Specialty polymers: Polymers as aids in organic synthesis. Polymeric reagents, catalysts, substrates. Liquid crystalline polymers- Conducting polymers - Synthesis & applications of polyacetylenes, polyanilines, polypyrroles & polythiophines. Polymers in optical lithography-

REFERENCE BOOKS

1. F.W. Billmayer, *Textbook of Polymer Science*. 3rd Edn, Wiley. N.Y. 1991.
2. J.M.G Cowie. *Polymers: Physics and Chemistry of Modern Materials*. Blackie. London, 1992.

COURSE OUTCOMES

Upon completing the course, the student will be able to about:

CO1	Classification of polymers and its nomenclature.
CO2	Polymerization methods
CO3	Polymerization kinetics
CO4	Uses of polymers for commercial purposes

CURRICULUM

B.Sc. B.Ed. (MATHEMATICS)

CURRICULAR STRUCTURE OF INTEGRATED TEACHER EDUCATION PROGRAMME (ITEP) / B.Sc. B.Ed. (MATHEMATICS)

Course Code	Course Title	L	T	P	C
SEMESTER – I					
MAPC11	Differential and Integral Calculus	3	1	0	4
PHAL11	Physics – I	3	1	0	4
EDLT11 EDLH11 EDLH12	Language – I Tamil Epic Literature and Grammar Language – I Hindi Language Learning (for Non-native Speakers) Language – I Hindi Language Structure and Literature (for Native Speakers)	4	0	0	4
EDPC11	Evolution of Indian Education	4	0	0	4
EDPC12	Art in Education (Performing and Visual) - I	1	0	1	2
EDPC13	Understanding India (Indian Ethos and Knowledge Systems) – I	2	0	0	2
		Total			**20**
SEMESTER – II					
MAPC21	Analytical Geometry and Vector Calculus	3	1	0	4
MAPC22	Theory of Equations and Trigonometry	3	1	0	4
PHAL21	Physics – II	3	0	1	4
EDLE21	Language – II English for Communication	4	0	0	4
EDPC21	Understanding India (Indian Ethos and Knowledge Systems) – II	2	0	0	2
EDPC22	Teacher and Society	2	0	0	2
SWIR21	Fieldwork with Community Engagement (NSS/NCC/NSO)	0	0	0	0
		Total			**20**
SEMESTER – III					
MAPC31	Differential Equations	3	1	0	4
MAPC32	Abstract Algebra	3	1	0	4
CHAL11	Chemistry – I				4
EDPC31	Child Development and Educational Psychology	3	0	1	4
EDPC32	Basic Pedagogy at Secondary Stage	4	0	0	4
		Total			**20**

Course Code	Course Title	L	T	P	C
SEMESTER – IV					
MAPC41	Real Analysis	3	1	0	4
MAPC42	Linear Algebra	3	1	0	4
CHAL41	Concepts in Chemistry				4
EDPC41	Philosophical & Sociological Perspectives of Education – I	4	0	0	4
EDPC42	Content cum Pedagogy of Mathematics at Secondary Stage – I	4	0	0	4
EDPC43	Art in Education (Performing and Visual) - II	1	0	1	2
		Total			**22**
SEMESTER – V					
MAPC51	Complex Analysis	3	1	0	4
MAPC52	Statistics with R	3	1	0	4
MAPC53	Numerical Methods and MATLAB				4
EDPC51	Content cum Pedagogy of Mathematics at Secondary Stage – II	4	0	0	4
EDPC52	ICT in Education	1	0	1	2
EDPC53	Internship in Micro-Teaching	0	0	2	2
EDPC54	Pre-Internship Practice	0	0	2	2
		Total			**22**
SEMESTER – VI					
MAPC61	Programming Language and LaTeX				4
MAPE11/12	Integral Transforms/Operations Research				4
EDPC61	Assessment and Evaluation	2	0	0	2
EDPC62	Inclusive Education	2	0	0	2
EDPC63	Content cum Pedagogy of Mathematics at Secondary Stage – III	4	0	0	4
EDPC64	Mathematical and Quantitative Reasoning	1	0	1	2
EDPC65	School Observation (Field Practice)	0	0	2	2
		Total			**22**
SEMESTER – VII					
EDPC71	Perspective on School Leadership and Management	2	0	0	2
EDPC72	Secondary Stage Curriculum Planning and Development	2	0	0	2

EDPC73	Sports, Nutrition and Fitness	2	0	0	2
EDPC74	School-Based Research Projects	0	0	2	2
EDPC75	Internship in Teaching	0	0	10	10
		Total			**18**
SEMESTER – VIII					
EDPC81	Philosophical and Sociological Perspectives of Education – II	4	0	0	4
EDPC82	Education Policy Analysis	2	0	0	2
EDPE81-88	Elective Course in Education	4	0	0	4
EDPC83	Yoga and Understanding Self	2	0	0	2
EDPC84	Citizenship Education, Sustainability, and Environmental Education	2	0	0	2
EDPC85	Post Internship (Review and Analysis)	2	0	0	2
EDPC86	Creating Teaching Learning Material/Work Experience (Educational Toy Making, Local/Traditional Vocations, etc)	0	0	2	2
		Total			**18**
Total Credit					**160**

Course Code	MAPC 11
Title of the Course	DIFFERENTIAL AND INTEGRAL CALCULUS
Prerequisite	NIL
Credits (L-T-P)	4 (3L + 1T + 0P)
Course Type	Disciplinary Course

Course Learning Objectives: Objective of the course is to

1. discuss the differentiation and higher order derivatives of functions in detail and to study their applications.
2. introduce partial derivatives of functions of several variables.
3. investigate maxima and minima of multivariable functions.
4. learn the topic of the definite integral extensively.
5. study the double and triple integrals and their applications.

Course Content:

Basic review of differentiation – Successive differentiation – Leibnitz's Theorem: higher order derivatives of the product of two functions – Curvature – Radius and centre of curvature – Evolute and involute – Rolle's and Mean Value Theorems (without proofs) - Relative extrema.

Partial derivatives – Chain rules - Directional derivatives and gradients - Tangent planes and normal vectors – Differentiability for functions of several variables – Maxima and minima of functions of two and three variables – Lagrange multipliers.

Riemann sums - The Riemann integral – The Fundamental Theorem of calculus – Area between curves - Volumes by slicing and rotation about an axis - The disk method - The washer method - Volumes by cylindrical shells - Lengths of plane curves.

Double Integrals - Fubini's Theorem - Changing the order of integration - Double integrals in polar form – Changing Cartesian integrals into polar integrals - Finding areas, volumes and centers of mass using double integrals.

Triple integrals in rectangular, cylindrical and spherical Coordinates – Jacobians – Change of variables in multiple integrals – Converting triple integrals from rectangular to cylindrical/spherical coordinates – Finding volume using triple integrals.

Reference Books:

1. J. Hass, C. Heil, P. Bogacki and M.D. Weir, *Thomas' Calculus*, Pearson Education, India, 2024.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, Wiley, New Delhi, 2017.
3. T.M. Apostol, *Calculus Volumes - I and II*, Wiley, New Delhi, 2022.
4. N. Piskunov, *Differential and Integral Calculus Volume – I*, G.K. Publications, New Delhi, 2016.
5. L. Brand, *Advanced Calculus: An Introduction to Classical Analysis,* Dover Publications, New York, 2006.

Course Learning Outcomes: On completion of the course, the students will be able to:

1. find the higher order derivatives of functions and calculate the curvatures and radius of curvatures of curves at the indicated points.
2. compute the partial derivatives of functions and determine maxima and minima of functions of several variables.
3. evaluate definite integrals and apply them to find the length of a curve and the area between curves.
4. compute double integrals and calculate the area of a region and the center of mass of a thin plate using double integrals.
5. evaluate triple integrals and to find the volume of a region.

Course Code	MAPC21
Title of the Course	ANALYTICAL GEOMETRY AND VECTOR CALCULUS
Prerequisite	NIL
Credits (L-T-P)	4 (3L + 1T + 0P)
Course Type	Disciplinary Course

Course Learning Objectives: Objective of the course is to

1. familiarize students with the geometric properties and relationships of lines and planes.
2. equip students with the skills to calculate distances, angles, and intersections in three- dimensional space.
3. explore the geometry of spheres, cylinders, and cones.
4. introduce concepts of line integrals, surface integrals, and volume integrals.
5. enable students to solve real-world problems by applying key theorems of vector calculus.

Course Content:

Revision of two-dimensional analytical geometry. Conic sections: equations of straight line, circle, parabola, ellipse and hyperbola. Pair of straight lines and system of circles. Curves in polar coordinates. Rectangular coordinate axes, distance, centroid of a triangle and tetrahedron.

Straight line: Directional ratios and directional cosines, canonical equation of the line of intersection of two intersecting planes, angle between two lines, distance of a point from a line, co-planarity of two lines, shortest distance between two skew lines. Plane: Equation of a plane passing through the intersection of two planes, angle between two intersecting planes, bisectors of angles between two intersecting planes. Orthogonal projection of a point on a plane. Reflection of a point with respect to a plane.

Sphere: Plane section of a sphere. The intersection of two spheres. Equation of a sphere passing through a given circle. Tangent plane to a sphere. Length of tangent to a sphere from a point. Angle between spheres. Cone and Right circular cone. Cylinder and Right circular cylinder.

Review of vectors in two and three dimensions. Vector operations. Vector-valued functions and their derivatives. Parametric equation of a curve and a surface. Scalar and vector fields. Limit and continuity. Gradient of a scalar field, divergence and curl of a vector field. Conservative, irrotational, solenoidal vector fields.

Line integrals of scalar functions and vector fields. Fundamental theorem for line integrals. Green's theorem and its applications. Surface integrals. Stokes' theorem and its applications. Triple integral of scalar functions and vector fields. Gauss Divergence theorem.

Reference Books:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, 10th Edition, John Wiley & Sons Inc., USA, 2015.
2. J. E. Marsden and A. J. Tromba, *Vector Calculus*, 6th Edition, Freeman and company, New York, 2011.
3. J. Stewart, *Calculus: Early Transcendentals*, 8th Edition, Cengage Learning, Boston, 2015.
4. G. B. Thomas Jr. and R. L. Finney, *Calculus and Analytic Geometry*, 9th edition, Addison-Wesley, New Delhi, 1996.
5. A. A. Albert, *Solid Analytic Geometry*, Dover Publications, New York, 2016.
6. A. C. Burdette, *Analytic Geometry,* Elsevier Science, London, 2014.

Course Learning Outcomes: On completion of the course, the students will be able to:

1. analyse the geometric properties and relationships of lines and planes.
2. solve problems involving distances, angles, and intersections in three-dimensional space.
3. understand the geometry of spheres, cylinders, and cones.
4. evaluate line integrals, surface integrals and volume integrals.
5. apply the major theorems of vector calculus to solve real-world problems.

Course Code	MAPC22
Title of the Course	THEORY OF EQUATIONS AND TRIGONOMETRY
Prerequisite	NIL
Credits (L-T-P)	4 (3L + 1T + 0P)
Course Type	Disciplinary Course

Course Learning Objectives: Objective of the course is to

1. enable the students to analyze and find the roots of a polynomial equation.
2. equip the students to compute the solution of reciprocal, cubic and biquadratic equations.
3. explore the applications of De Movire's Theorem and Euler's theorem.
4. introduce hyperbolic functions, their relations to circular functions, and their inverse functions.
5. solve problems using trigonometric identities and relations.

Course Content:

General properties of polynomial equations, Descartes' rule of signs, Relation between the roots and the coefficients of equations, Symmetric function of the roots, Sum of the powers of the roots of an equation.

Transformation of equations, Solutions of reciprocal equations, Solution of the cubic equations – Cardon's method & Trigonometric method, Solution of the biquadratic equations – Ferrari method.

Inverse circular functions, De Movire's Theorem with deductions, Euler's theorem and its applications.

Hyperbolic and inverse hyperbolic functions, Trigonometrical expansions.

Introduction to sequences and series, Gregory series, Summation of series, Infinite product of sine and cosine.

Reference Books:

1. W. S. Burnside and A.W. Panton, *The Theory of Equations,* Wentworth Press, New South Wales, 2016.
2. L. E. Dickson, *First course in the theory of equations*, Holistence Publications, Turkey, 2024.
3. S. L. Loney, *Plane Trigonometry, Part II*, New Age International Private Limited, India, 2016.
4. R. F. Blitzer, *Algebra and Trigonometry*, 6th Edition, Pearson Publishers, India, 2017.

Course Learning Outcomes: On completion of the course, the students will be able to:

1. apply Descartes' rule of signs in determining the roots of a polynomial equation.
2. formulate the equation with the given roots and determine the solution of cubic and biquadratic equations.
3. extract various results from De Movire's Theorem and Euler's theorem.
4. explain the relationship between circular and hyperbolic functions.
5. solve problems involving infinite sum and product using trigonometric identities and relations.

Course Code	MAPC31
Title of the Course	Differential Equations
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (3rd semester)

Course Learning Objectives: The objective of this course is to

1. familiarize the basic theory as well as applications of differential equations.
2. introduce some problems that lead to differential equations and their solutions.
3. investigate the classification of various types of differential equations.
4. discuss the fundamental concepts of characteristics and canonical forms.
5. explore the use of a variety of tools/methods required to solve differential equations.

Course Content:

Basic mathematical models – Direction fields – First-order differential equations – Separable equations – Linear equations – Necessary and sufficient conditions for the equation to be exact – Integrating factors – Change in variables – Existence and uniqueness of solutions – Picard's theorem.

Second-order linear equations – Homogeneous equations with constant coefficients – Fundamental solutions – Linear independence and the Wronskian – Complex Roots of the characteristic equation – Repeated Roots.

Reduction of order – Linear non-homogenous equations – General theory of n^{th} order linear equations – Method of variation of parameters – Euler's equation.

Order and degree of partial differential equations – Concept of linear and non-linear partial differential equations: Formation – Geometrical interpretation – Lagrange's method – Charpit's method.

Second-order partial differential equations: Classification – Linear second-order partial differential equations with constant coefficients – Reduction to canonical forms.

Reference Books:

1. E. A. Coddington, *An Introduction to Ordinary Differential Equations*, Reprint edition, Dover Publications, New York, 1989.
2. I. N. Sneddon, *Elements of Partial Differential Equations*, Dover Publications, Reprint edition, New York, 2006.
3. G. F. Simmons, *Differential Equations with Applications and Historical Notes*, 3rd edition, CRC Press, New York, 2017.
4. W. E. Boyce and R.C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 10th edition, John Wiley & Sons, USA, 2012.
5. S. J. Farlow, *Partial Differential Equations for Scientists and Engineers*, Reprint edition, Dover Publications, New York, 1993.

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

1. explain and illustrate mathematical modelling using differential equations.
2. recognize different types of differential equations and their defining features.
3. check existence and uniqueness of solutions of first order ordinary differential equations.
4. solve linear homogeneous and non-homogeneous ordinary differential equations.
5. apply various methods to solve first and second order partial differential equations.

Course Code	MAPC32
Title of the Course	Abstract Algebra
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (3rd semester)

Course Learning Objectives: The objective of this course is to

1. introduce the groups and properties of groups.
2. explain the Factor groups and first isomorphism theorem.
3. explore the various types of rings and integral domains.
4. expose the students to ideals and factor rings.
5. introduce fields and their properties.

Course Content:

Binary Operations – Semigroups – Groups – Subgroups – Cyclic groups and properties of cyclic groups – Cosets – Lagrange's theorem.

Normal subgroups – Factor groups – Homomorphisms – Automorphisms – First isomorphism theorem – Cayley's theorem – Permutation groups.

Rings – Subrings – Examples – Characteristics of rings – Polynomial rings –

Integral domain. Homomorphism of rings – Ideals and factor rings – Prime ideal –

Maximal ideal.

Definition of fields – Properties of fields – The field of quotients of an integral domain.

Reference Books:

1. J. A. Gallian, *Contemporary Abstract Algebra*, 10th edition, CRC Press, New York, 2021.
2. D. S. Dummit and R. M. Foote, *Abstract Algebra*, 3rd edition, Wiley, India, 2011.
3. I. N. Herstein, *Topics in Algebra*, 2nd edition, Wiley, India, 2022.
4. M. Artin, *Algebra*, 2nd edition, Pearson, India, 2015.
5. N. Jacobson, *Basic Algebra I and II*, 2nd edition, Dover Publication Inc., New York, 2009.

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

1. explain the properties of groups and normal subgroups.
2. demonstrate factor groups, permutation groups and groups homomorphisms.
3. understand and utilize the rings, polynomial rings, work with integral domains.
4. develop a comprehensive understanding of ideals and factor rings.
5. comprehend the fields and properties of fields.

Course Code	MAPC41
Title of the Course	Real Analysis
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (4th semester)

Course Learning Objectives: The objective of this course is to

1. discuss the concepts of convergent and Cauchy sequences rigorously.
2. study various tests to investigate the convergence or divergence of series.
3. introduce the notions of continuity and uniform continuity of real-valued functions.
4. investigate the theory of differentiation in detail.
5. explore the topic of Riemann integration extensively.

Course Content:

Sets and functions – Countable and uncountable sets – Sequences and their limits – Bounded and monotone sequences – Subsequences – Limit superior and limit inferior - Cauchy sequences – Bolzano- Weierstrass theorem.

Infinite series – Sum of the series – Series of non-negative terms – Comparison test – Alternating series – Absolute and conditional convergence – Tests for convergence of series – Ratio test – Root test – Integral test – Leibnitz's test – Dirichlet's Test – Abel's Test – Rearrangements of series – Power series.

Limits of function at a point – Continuous functions – Sequential criterion for continuity – Properties of continuous functions – Intermediate value theorem – Discontinuities – Uniform continuity – Monotonic functions.

Differentiation – Derivative – Chain rule – Local extrema – Rolle's theorem – Mean value theorem – L'Hospital's rules – Taylor's theorem.

The Riemann integral – Definition and existence – Properties of the integral – Mean value theorem for integrals - Fundamental theorems of calculus – Improper integrals.

Reference Books:

1. R.R. Goldberg, *Methods of Real Analysis*, Oxford and IBH, New Delhi, 2020.
2. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, Wiley, New Delhi, 2021.
3. T. M. Apostol, *Calculus Volumes – I and II*, Wiley, New Delhi, 2022.
4. K. R. Davidson and A. P. Donsig, *Real Analysis and Applications: Theory in practice*, Springer, India, 2014.

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

1. determine the convergence or divergence of sequences and find the limits of convergent sequences.
2. apply several tests to examine the convergence or divergence of series.
3. find the limits and extrema of certain functions and to identify the monotone functions using the results of differentiation.
4. evaluate the integrals and find derivatives of some functions using the fundamental theorem of calculus
5. analyse continuous functions, locate the roots of continuous functions and discuss the types of discontinuity.

Course Code	MAPC42
Title of the Course	Linear Algebra
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (4th semester)

Course Learning Objectives: The objective of this course is to

1. develop a thorough understanding of vector spaces, subspaces and the concepts of linear independence and basis.
2. gain proficiency in eigenvalues and eigenvectors including their properties and applications.
3. explore linear transformations, their matrix representations and related theorems.
4. comprehend inner product spaces and the processes for orthogonalization of basis and projection.
5. understand and apply methods for solving systems of linear equations using matrices.

Course Content:

Vector space – Subspace – Linear span – Linear independence and dependence – Basis and dimension – Extension of a basis of a subspace – Intersection and sum of two subspaces.

Eigenvalues, eigenvectors of matrices and their properties – Characteristic polynomial – Diagonalization of matrices – Cayley Hamilton theorem and applications.

Linear transformation – Matrix representation of a linear transformation – Kernel and range of a linear map – Rank-nullity theorem – Change of basis – Similarity of matrices.

Inner product space – Cauchy-Schwartz inequality – Orthogonal basis – Gram-Schmidt orthogonalization process – Orthogonal projection – Orthogonal complement – Projection theorem.

Matrices and system of linear equations: Representing linear systems with matrices – Gaussian elimination and row reduction – Rank of a matrix – Gauss-Jordon method for finding inverse of a matrix
– Solutions of homogeneous and non-homogeneous systems.

Reference Books:

1. S. H. Friedberg, A. J. Insel and L. E. Spence, *Linear Algebra*, 5th edition, Pearson, India, 2022.
2. S. Axler, *Linear Algebra Done Right,* 2nd edition, Springer, New York, 1997.
3. S. Roman, A*dvanced Linear Algebra,*3rd edition, Springer, New York, 2008.
4. D. C. Lay, S. R. Lay, and J. J. McDonald, *Linear Algebra and Its Applications,* 6th edition, Pearson, India, 2021.

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

1. determine bases and dimensions of vector spaces and subspaces and extend a basis of a subspace.
2. calculate and interpret eigenvalues and eigenvectors of matrices, diagonalize matrices and apply the Cayley-Hamilton theorem in practical problems.
3. identify linear transformations, determine the kernel and range of linear maps. Apply the Rank-nullity theorem and understand the benefits of change of basis.
4. work with inner product spaces, construct orthogonal bases using the Gram-Schmidt orthogonalization process.
5. determine the rank of a matrix and solve both homogeneous and non-homogeneous systems of linear equations.

Course Code	MAPC51
Title of the Course	Complex Analysis
Prerequisite	Nil
Credits (L-T-P)	4 (L – T – P)
Course Type	Disciplinary Course (5th semester)

Course Learning Objectives: The objective of this course is to

1. explore various operations on complex number and do geometry with it.
2. examine properties of analytic functions and harmonic functions.
3. derive Cauchy's integral theorems/formulas and use it to study series expansion.
4. classify singularities and evaluate integrals.
5. study conformal mappings, particularly the bilinear transformation.

Course Content:

Complex numbers: Complex number system – Modulus of a complex number – Some inequalities – Argument of a complex number – Analytic geometry – Point sets.

Analytic functions: Functions – Limit and continuity – Differentiable functions – Analytic functions – Harmonic functions.

Complex integration – Curves and line integral – Cauchy's integral theorem – Cauchy's integral formulas – Evaluation of the integral – Trigonometric integrals – Sequence and series of complex numbers – Sequence and series of complex functions – Taylor series – Laurent series.

Theory of residues and evaluation of real integrals – Singularities and residues – Cauchy's residue theorem – Evaluation of improper integrals – Integrals involving indented contour.

Conformal mappings – Locally univalent functions – Conformal mapping – Some simple mappings – Bilinear transformation.

Reference Books:

1. R. M. Ali and V. Ravichandran, *Complex Analysis*, USM Press, Malaysia, 2008.
2. J.W. Brown and R. V. Churchill, *Complex Variables and Applications*, 8th edition, McGraw-Hill International Edition, New Delhi, 2009.
3. S. Ponnusamy and H. Silverman, *Complex Variables with Applications*, Birkhäuser, Boston, 2006.
4. H.A.Priestly, *Introduction to Complex Analysis*, 2nd edition, Cambridge, 2008.
5. J. Bak and D. J. Newman, *Complex analysis*, 2nd edition, Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

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

1. prove various equalities and inequalities about complex numbers.
2. prove properties about analytic functions.
3. prove Cauchy's integral formula/theorems and apply them to obtain Laurent's series expansions.
4. classify singularities and use Cauchy's residue theorem to evaluate integrals.
5. analyse the given mapping as conformal or not and construct mapping of circles to circles.

Course Code	MAPC52
Title of the Course	Statistics
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (5th semester)

Course Learning Objectives: The objective of this course is to

1. recall the definition of probability and conditional probability.
2. introduce one dimensional random variable.
3. evaluate moment generating functions, characteristic functions and explore some of the special distributions.
4. discuss various types of correlation and regression.
5. introduce R programming language.

Course Content:

Concept of sample Space – Events – Definition of probability (classical, statistical and axiomatic) – Addition and multiplication laws of probability – Independence of events – Conditional probability – Bayes' theorem.

Descriptive statistics – Mean, median and mode – Random variables – Discrete and continuous random variables – Probability mass and density functions – Distribution function – Mathematical expectation – Variance – Moments.

Moment generating function (MGF) – Properties of MGF – Characteristic function – Properties of characteristic function – Special distributions: Binomial distribution – Poisson distribution – Normal distribution.

Correlation and correlation coefficient – Properties – Rank correlation – Regression – Properties – Regression equations.

Introduction to R – Data types and objects – Reading and writing data (import and export) – Data structures: vectors, matrices, lists and data frames – Computation of various statistical measures.

Reference Books:

1. D. C. Montgomery and G. C. Runger, *Applied Statistics and Probability for Engineers*, 7th edition, Wiley, USA, 2018.
2. S. Rakshit, *R for Beginners,* Pearson, McGraw Hill Education, India, 2017.
3. R. V. Hogg, J. W. McKean and A. T. Craig, *Introduction to Mathematical Statistics,* 8th edition, Pearson, USA, 2021.
4. A. M. Mood, F. A. Graybill and D. C. Boes, *Introduction to the Theory of Statistics*, 3rd edition, McGraw Hill, India, 2017.
5. V. K. Rohatgi and A. E. Saleh, *An Introduction to Probability Theory and Mathematical Statistics*, 3rd edition, John Wiley & Sons Inc., India, 2015.
6. J. P. Lander, *R for everyone: Advanced Analytics and Graphics,* 2nd edition, Pearson Education, India, 2018.

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

1. apply Bayes' theorem to practical problems.
2. compute various moments of discrete and continuous random variables.
3. explain some of the special distributions and solve problems based on them.
4. evaluate different types of correlation between the given random variables and interpret them.
5. compute various statistical measures using R.

Course Code	MAPC53
Title of the Course	Numerical Methods
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (5th semester)

Course Learning Objectives: The objective of this course is to

1. introduce various numerical methods to find the roots of transcendental and polynomial equations.
2. provide the basic concepts of numerical methods to solve linear systems.
3. familiarize several methods for the interpolation of data.
4. explore various methods for numerical differentiation and integration.
5. discuss numerical methods to solve ordinary differential equations.

Course Content:

Roots of non-linear equations – Bisection method – Secant method – Regula-Falsi method – Newton- Raphson method – Fixed point iteration method – Newton-Raphson method for solution of a pair of non- linear equations.

Solution of system of linear equations – Gauss elimination method – Gauss Jordon method – LU- decomposition method – Jacobi and Gauss-Seidel methods – Eigen value problem – Power method.

Interpolation – Newton forward, Newton backward, Bessel and Stirling's interpolation – Lagrange interpolation – Divided differences – Newton's divided difference interpolation – Hermite interpolation – Cubic spline interpolation.

Numerical differentiation – First and second order derivatives by various interpolation formulae – Numerical integration – Trapezoidal, Simpsons 1/3 and 3/8 rules with errors and their combinations – Gauss Legendre 2-points and 3-points formulae.

Solution of ordinary differential equations – Taylor's series method – Picard's method – Euler's method – Modified Euler's method – Runge-Kutta method of order 4 – Milne's method – Adams-Bashforth method.

Reference Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, *Numerical Method: For Scientific and Engineering Computation*, New Age International, India, 2019.
2. D. Kincaid and W. Cheney, *Numerical Analysis and Mathematics of Scientific computing*, Brooks/Cole, United States, 1999.
3. K. Atkinson, *Elementary Numerical Analysis*, John Wiley & Sons, New Jersey, 2004.
4. B. S. Grewal, *Numerical Methods in Engineering and Science: (C, C++, and MATLAB)*, Mercury Learning and Information, United States, 2018.
5. J. H. Mathews and K. K. Fink, *Numerical Methods Using MATLAB*, Pearson, India, 2004.

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

1. find the roots of transcendental and polynomial equations.
2. compute the numerical solution of system of linear equations and find dominant eigen values of the matrix.
3. apply various interpolation methods for the given data.
4. carry out numerical differentiation and numerical integration.
5. compute approximate solution of ordinary differential equations.

Course Code	MAPE11
Title of the Course	Integral Transforms
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course

Course Learning Objectives: The objective of the course is to

1. familiarize Laplace transform properties and applications.
2. discuss applications of Laplace transform.
3. explore the fundamentals of Fourier series.
4. analyse Fourier transforms and their relationship with Laplace transforms.
5. teach applications of Fourier transforms.

Course Content:

Laplace transform – Definition and its properties – Rules of manipulation – Laplace transform of derivatives and integrals – Properties of inverse Laplace transform – Convolution theorem – Complex inversion formula.

Solution of differential equations – Simultaneous differential equations – partial differential equations by Laplace transform.

Fourier series – Dirichlet's conditions – Half range Fourier cosine and sine series – Parseval's relation – Fourier series in complex form – Harmonic analysis.

Fourier Transform – Definition and properties of Fourie sine, cosine and complex transforms – Convolution theorem.

Inversion theorems – Relationship between Fourier transform and Laplace transform – Fourier transform of derivatives – Application of Fourier transform to differential equations.

Reference Books:

1. N. W. McLachlan, *Laplace Transforms and Their Applications to Differential Equations*, Reprint edition, Dover Publications, New York, 2014.
2. E. M. Stein and R. Shakarchi, *Fourier Analysis: An Introduction*, 1st edition, Princeton University Press, United States, 2003.
3. D. V. Widder, *The Laplace Transform: Theory and Applications*, Reprint edition, Dover Publications, New York, 2010.
4. R. N. Bracewell, *Fourier Transform and Its Applications*, 3rd edition, McGraw-Hill, New York, 1999.
5. B. Davies, *Integral Transforms and Their Applications*, 3rd edition, Springer, New York, 2002.

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

1. understand Laplace transform and its properties.
2. solve differential equations using Laplace transform.
3. compute Fourier series for various types of functions.
4. analyse Fourier transforms and their relationship with Laplace transforms.
5. apply Fourier transforms to solve differential equations.

Course Code	MAPE12
Title of the Course	Operations Research
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 1 – 0)
Course Type	Disciplinary Course (6th semester)

Course Learning Objectives: The objective of this course is to

1. introduce the history and principles of operations research and linear programming.
2. develop problem solving skills related to scientific methods of operations research.
3. explore transportation problem and its solution.
4. study assignment problem and its solution.
5. draw the problem as a network to find solution.

Course Content:

Linear Programming Problem: Standard, canonical and matrix forms – Hyperplanes – Extreme points – Convex and polyhedral sets – Problem formulation – Graphical method – Types of solutions – Linear programming in matrix notation – Simplex method of solution of a linear programming problem – Big M-technique.

Two-phase simplex method – Degeneracy – Cycling revised simplex method – Duality theory – Formulation of the dual problem – Duality theorems – Primal-dual method – Dual simplex method – Sensitivity analysis.

Transportation problems: Mathematical formulation – Northwest corner rule – Vogel's approximation method – Method of matrix minima – Algorithm of optimality test – Degeneracy in a transportation problem.

Assignment problems: Mathematical formulation – Mormulation and solution of an assignment problem (Hungarian method) – Degeneracy in an assignment problem – Restrictions on assignment problem.

Sequencing problem: n jobs through 2 machines – n jobs through 3 machines – Two jobs through m machines – n jobs through m machines– Introduction to networks: The difference between Critical Path Method(CPM) and Project Evaluation and Review Technique(PERT).

Reference Books:

1. H. A. Taha, *Operations Research-An Introduction*, Pearson Education Ltd, Malaysia, 2017.
2. S. F. Hillier and J. G. Lieberman, *Introduction to Operations Research,* 10th edition, McGraw-Hill Education (India) Pvt. Ltd, 2015.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, *Operations Research: Principles and Practice*, 2nd edition, Wiley, India, 2007.
4. S. M. Bazaraa, J. J. Jarvis and D. H. Sherali, *Linear Programming and Network Flows*, 4th edition, John Wiley and Sons, USA, 2010.

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

1. formulate LPP and apply graphical method to find solution
2. apply simplex method to find optimal solution for a given LPP.
3. model the real-life problem as transportation problem and find solution.
4. develop the real-life problem as assignment problem and find solution.
5. draw the real-life problem as a network and find solution.

Course Code	MAPC61
Title of the Course	Programming Language
Prerequisite	Nil
Credits (L-T-P)	4 (3 – 0 – 1)
Course Type	Disciplinary Course (6th semester)

Course Learning Objectives: The objective of this course is to

1. understand and write code in language of C for a given problem.
2. analyse the concepts of arrays and tables for storage
3. involve in creating files for the problems.
4. interpret the programs through pointers.
5. study operations to handle character input and output.

Course Content:

The C character set – Identifiers, constants, and keywords – Primitive datatypes – Operators and expressions – Library functions – Data input and output.

Nested control structures – Functions – Function prototypes – Passing arguments to a function – Storage classes – Arrays – Declaration, initialization and accessing array elements – Arrays and strings.

Pointer declarations – Passing pointers to a function – Pointers and one-dimensional arrays – Dynamic memory allocation – Operations on pointers – Pointers and multidimensional arrays – Arrays of pointers – Passing functions to other functions.

Defining a structure – Processing a structure – User-defined datatypes(typedef) – Structures and pointers – Passing structures to functions – Self-referential structures – Data files – Operations – Formatted input and output – Character input and output.

Reference Books:

1. E. Balagurusamy, *Programming in ANSI C*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2017.
2. B. S. Gottfried and J. K. Chhabra, *Programming with C*, Tata McGraw- Hill, New Delhi, 2006.
3. B. W. Kernighan & D. M. Ritchie, *The C Programming Language*, Prentice Hall of India Pvt. Limited, New Delhi, 2006.
4. V. Rajaraman, *Computer Programming in C*, Prentice Hall of India Pvt. Ltd. New Delhi, 2004.

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

1. write structured pseudo codes for a given problem.
2. design programs in C for any given problem.
3. manage writing programs for complex problems.
4. attain the capability of developing files through pointers.
5. handle effectively data files, characters for input and output.

LIST OF DISCIPLINARY AND INTER-DISCIPLINARY COURSES			
DISCIPLINARY COURSES			
S. NO.	**COURSE TITLE**	**SEMESTER**	**CREDITS**
1.	DIFFERENTIAL AND INTEGRAL CALCULUS	I	4
2.	VECTOR CALCULUS AND ANALYTICAL GEOMETRY	II	4
3.	THEORY OF EQUATIONS AND TRIGONOMETRY		4
4.	DIFFERENTIAL EQUATIONS	III	4
5.	ABSTRACT ALGEBRA		4
6.	REAL ANALYSIS	IV	4
7.	LINEAR ALGEBRA		4
8.	COMPLEX ANALYSIS	V	4
9.	STATISTICS		4
10.	NUMERICAL METHODS		4
11.	INTEGRAL TRANSFORMS/OPERATIONS RESEARCH	VI	4
12.	PROGRAMMING LANGUAGE		4
INTER DISCIPLINARY COURSES			
1.	PHYSICS - I	I	4
2.	PHYSICS – II	II	4
3.	FUNDAMENTAL ASPECTS IN CHEMISTRY	III	4
4.	CONCEPTS IN CHEMISTRY	IV	4
INTER DISCIPLINARY COURSES (OFFERED TO OTHER DEPARTMENTS)			
1.	CALCULUS AND DIFFERENTIAL EQUATIONS	I	4
2.	BASIC ANALYSIS AND ANALYTICAL GEOMETRY	II	4

CURRICULUM

B.Sc. B.Ed. (PHYSICS)

B.Sc.B.Ed. (PHYSICS)

Course Code	Course Title	L	T	P	C
SEMESTER - I					
PHPC11	Mechanics	3	1	0	4
MAAL11	Basic Analysis and Analytical Geometry	3	1	0	4
EDLT11 EDLH11 EDLH12	Language – I Tamil Epic Literature and Grammar Language – I Hindi Language Learning (for Non-native Speakers) Language – I Hindi Language Structure and Literature (for Native Speakers)	4	0	0	4
EDPC11	Evolution of Indian Education	4	0	0	4
EDPC12	Art in Education (Performing and Visual) - I	1	0	1	2
EDPC13	Understanding India (Indian Ethos and Knowledge Systems) – I	2	0	0	2
		Total			**20**
SEMESTER – II					
PHPC21	Properties of Matter	3	1	0	4
PHLR21	Mechanics Laboratory	0	0	2	2
PHLR22	Optics Laboratory	0	0	2	2
MAAL21	Calculus and Differential Equations	3	1	0	4
EDLE21	Language – II English for Communication	4	0	0	4
EDPC21	Understanding India (Indian Ethos and Knowledge Systems) – II	2	0	0	2
EDPC22	Teacher and Society	2	0	0	2
SWIR21	Fieldwork with Community Engagement (NSS/NCC/NSO)	0	0	0	0
		Total			**20**
SEMESTER – III					
PHPC31	Thermal and Statistical Physics	3	1	0	4
PHPC32	Electricity and Magnetism	3	1	0	4
CHAL31	Fundamental Aspects in Chemistry	3	0	1	4
EDPC31	Child Development and Educational Psychology	3	0	1	4
EDPC32	Basic Pedagogy at Secondary Stage	4	0	0	4
		Total			**22**

Course Code	Course Title	L	T	P	C
SEMESTER – IV					
PHPC41	Analog and Digital Electronics	3	1	0	4
PHPC42	Waves and Optics	3	1	0	4
CHAL41	Concepts in Chemistry	3	0	1	4
EDPC41	Philosophical and Sociological Perspectives of Education – I	4	0	0	4
EDPC42	Content cum Pedagogy of Physics at Secondary Stage – I	4	0	0	4
EDPC43	Art in Education (Performing and Visual) - II	1	0	1	2
		Total			**21**
SEMESTER – V					
PHPC51	Relativity and Quantum Mechanics	3	1	0	4
PHPC52	Atomic and Nuclear Physics	3	1	0	4
PHLR51	General Physics Laboratory	0	0	2	2
PHLR52	Electronics and Computational Laboratory	0	0	2	2
EDPC51	Content cum Pedagogy of Physics at Secondary Stage – II	4	0	0	4
EDPC52	ICT in Education	1	0	1	2
EDPC53	Internship in Micro-Teaching	0	0	2	2
EDPC54	Pre-Internship Practice	0	0	2	2
		Total			**20**
SEMESTER – VI					
PHPC61	Solid State Physics	3	1	0	4
PHPC62	Project Work and Viva-Voce	0	0	0	4
EDPC61	Assessment and Evaluation	2	0	0	2
EDPC62	Inclusive Education	2	0	0	2
EDPC63	Content cum Pedagogy of Physics at Secondary Stage – III	4	0	0	4
EDPC64	Mathematical and Quantitative Reasoning	1	0	1	2
EDPC65	School Observation (Field Practice)	0	0	2	2
		Total			**22**
SEMESTER – VII					
EDPC71	Perspective on School Leadership and Management	2	0	0	2
EDPC72	Secondary Stage Curriculum Planning and Development	2	0	0	2
EDPC73	Sports, Nutrition and Fitness	2	0	0	2
EDPC74	School-Based Research Projects	0	0	2	2
EDPC75	Internship in Teaching	0	0	10	10
		Total			**18**

Course Code	Course Title	L	T	P	C
SEMESTER – VIII					
EDPC81	Philosophical and Sociological Perspectives of Education – II	4	0	0	4
EDPC82	Education Policy Analysis	2	0	0	2
EDPE81-88	Elective Course in Education	4	0	0	4
EDPC83	Yoga and Understanding Self	2	0	0	2
EDPC84	Citizenship Education, Sustainability, and Environmental Education	2	0	0	2
EDPC85	Post Internship (Review and Analysis)	2	0	0	2
EDPC86	Creating Teaching Learning Material/Work Experience (Educational Toy Making, Local/Traditional Vocations, etc)	0	0	2	2
		Total			**18**
Total Credits					**160**

Semester I
Mechanics
Course Objectives
The course aims to 1. Introduce the Newton's laws of motion and gravitational force. 2. Learn the significance of momentum and energy on dynamics. 3. Impart the role of angular momentum on rigid body motion. 4. Understand the universal features of central force. 5. Learn non-inertial system and the role of fictitious forces.
Course Content
The laws of Newton Algebra of vectors – position and displacement vectors – velocity and acceleration – solution of kinematic equation – motion in plane polar coordinates – Newton's laws – base units and dimensions – dynamics using polar coordinates – law of gravitation – acceleration due to gravity – some phenomenological forces: contact force, tension, normal force, friction, viscosity, spring force. **Momentum, energy and dynamics** Dynamics of system of particles – centre of mass – conservation of momentum – impulse – mass flow – rocket motion – momentum flow – centre of mass of 2D and 3D objects – work and energy – conservation of energy – potential energy – energy diagram – non-conservative forces – small oscillations – stability – normal modes – collision and conservation laws. **Angular momentum and rigid body motion** Angular momentum – moment of inertia – torque – dynamics of fixed axis rotation – pulley – simple pendulum – translation and rotation – work-energy theorem and rotational motion – angular velocity vector – rotation in xy-plane – gyroscope – rotation and tensor of inertia – principle axes – rotational kinetic energy of rigid body. **Central force motion and non-inertial systems** Central force motion as one body problem – universal features – energy equation and energy diagram – planetary motion and elliptical orbits – properties of ellipse – Galilean transformation – uniformly accelerating systems – principle of equivalence – physics in a rotating coordinate system – fictitious forces.
Course Outcomes

Upon completion of the course the students would

1. Appreciate the fundamental nature of the laws of Newton on dynamics.
2. Understand the role of energy on dynamical problems.
3. Learn the conservation laws to simply the complex dynamics of rigid body.
4. Be convinced of the Kepler's law through Newtonian mechanics.
5. Appreciate the emergence of fictitious forces.

Textbook

1. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, Cambridge University Press (2014).

References

1. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).
2. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Wiley (2013).
3. R. Shankar, Fundamentals of Physics, Yale University Press (2014).
4. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati, Engineering Mechanics, McGraw Hill (2017).
5. C. Kittel, W. Knight, M. Ruderman, C. Helmholz, B. Moyer, Mechanics: Berkeley Physics Course, McGraw-Hill (2017).

Semester II

Properties of Matter

Course Objectives

The course aims to

1. Identify and describe the three main states of matter (solid, liquid, and gas) and the characteristics of each.
2. Understand the properties of materials learning concepts in elasticity.
3. Comprehend the nature of oscillations in solid objects.
4. Realize the properties of fluids and their dynamics.
5. Identify the application of surface tension.

Course Content

Elasticity

Stress, strain, and elastic moduli-Poisson's ratio-Hook's law-Moduli of elasticity-Young's modulus, Bulk modulus, rigidity modulus-Bending of a beam-Bending moment-Uniform and Non-uniform bending-Theory and experiment-Determination of Poisson's ratio-Cantilever-Torsional Pendulum.

Oscillations

Simple Harmonic oscillations - Calculation of kinetic energy, potential energy, total energy, and their time-average values - Damped and Forced oscillations – Solution to damped and forced oscillators - Resonance and sharpness of resonance- Laws of transverse vibration of strings.

Fluid Mechanics

Fluids-Pressure in a fluid -Pascal's law - The continuity equation - Bernoulli's equation-Viscosity - Coefficient of viscosity - Critical velocity-Laminar and vortex flow - Poiseuille equation for the flow of liquid through a tube - Poiseuille's method and stokes method - Oswald Viscometer - Determination of Viscosity of gases - Rankine's method.

Surface Tension

Surface Tension - Force energy of a surface and surface tension - Excess pressure inside a liquid drop and inside a soap bubble - Work done in blowing a bubble - Angle of contact - Capillary rise - Experimental determination of surface tension by capillary rise - Pitot tube and Venturi meter-Bernoulli's theorem.

Course Outcomes

After completion of the course, the students would

1. Explain the properties of solids, liquids, and gases, including density, shape, volume, and compressibility.
2. Remember the elastic properties of materials.
3. Know about the oscillatory behavior of solid objects.
4. Realize the properties of fluids and their dynamics.
5. Identify the application of surface tension.

Textbooks

1. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).
2. P. K. Kundu and I. M. Cohen, Fluid Mechanics, Elsevier (2004).

References

1. B. Brown, General Properties of Matter, Springer (1969).
2. H. J. Pain. The Physics of Vibrations and Waves, John Wiley, (2005).
3. A.P French, Vibration and Waves, MIT Introductory Physics, Arnold–Heinmann India (1973).

Semester II
Mechanics Laboratory
Course Objectives
The course aims to 1. To understand the concepts of mechanics and properties of matter through experiments 2. Apply the theoretical concepts in mechanics to practical problems.
Course Content
List of experiments 1. Determination of g, radius of gyration and moment of inertia using the compound pendulum. 2. Determination of g using a simple pendulum. 3. Determination of Young's modulus - non-uniform bending. 4. Determination of Poisson's ratio of a rubber tube. 5. Find the velocity of ultrasonic waves in a solid 6. Verification of Hookes law 7. Verify the laws of transverse vibration using Melde's apparatus. 8. Determine the coefficient of viscosity of water by capillary flow method 9. Rigidity modulus - torsional oscillations without masses. 10. Surface tension of a liquid and interfacial surface tension using the method of drops.
Course Outcomes
After completion of the course, the students would 1. Realize the concepts in mechanics and properties of matter through various experiments. 2. Acquire practical knowledge of concepts such as elasticity and fluid mechanics.
References
1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018). 2. R.K. Shukla, Anchal Srivastava, Practical Physics, New Age International (2011). 3. C.L Arora, B.Sc. Practical Physics, S. Chand & Co. (2012).

Semester II
Optics Laboratory
Course Objectives
The course aims to 1. To understand the concepts of optics and propagation of light through experiments 2. Apply theoretical concepts such as interference, diffraction and polarization in practical problems.
Course Content
List of experiments 1. Determine the dispersive power of a prism 2. Determine the wavelength of the laser using a diffraction grating 3. Find the radius of curvature of lens-Newton's Rings 4. Determine the numerical aperture of an optical fiber 5. Find the specific rotation of a liquid – Half Shade Polarimeter 6. Find the wavelengths of various colors using a white light source – Spectrometer 7. Determine the focal lengths of various lenses 8. Determine the thickness of a thin wire – Air Wedge 9. Determine the velocity of light in solid and liquid media - Snell's law. 10. Verify the interference of monochromatic light through fringe formation.
Course Outcomes
After completion of the course, the students would 1. Realize the concepts in optics through various experiments. 2. Acquire practical knowledge in interference, diffraction and polarization.
References
1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018). 2. R.K. Shukla, Anchal Srivastava, Practical Physics, New Age International (2011). 3. C.L Arora, B.Sc. Practical Physics, S. Chand & Co. (2012).

Semester III

Thermal and Statistical Physics

Course Objectives

The course aims to

1. Understand the concept of temperature and heat.
2. Learn various laws of thermodynamics.
3. Comprehend the topic of chemical equilibrium.
4. Introduce concepts in classical statistical physics.
5. Understand the limitations of classical concepts.

Course Content

The first and second law

System and environment – state and process – reciprocal and reciprocity theorems – work and heat – exact differential – first law – internal energy – ideal gas – Joule's expansion – simple processes – second law – heat engine – Carnot's theorem – absolute temperature.

Entropy and potentials

Clausius inequality – definition of entropy – properties – TS-diagram – revisit of first law – irreversible process – Legendre transformation – enthalpy, Helmholtz energy, Gibb energy – Maxwell's relations – third law.

Chemical equilibrium

Chemical potential – thermodynamic equilibrium – system with many components – Gibbs-Duhem relation – pure substance – Clausius-Clapeyron equation – vapor pressure – phase boundary – three phases – entropy of mixing – Gibbs paradox – chemical reaction – equilibrium constant – van't Hoff plot – activation energy.

Classical statistics

Maxwell-Boltzmann distribution – experimental proof – pressure of ideal gas – mean, rms and most probable velocity – mean free path – viscosity – thermal conductivity – diffusion – equipartition theorem – monatomic and diatomic gases – heat capacity of solid – limitations and need for quantum statistics.

Course Outcomes

After completion of the course, the students would

1. Learn the basic concepts of temperature and heat.
2. Appreciate the laws of thermodynamics that are applicable in various aspects.
3. Understand the topic of chemical equilibrium.
4. Learn concepts in classical statistical physics for higher learning.
5. Understand the limitations of classical concepts and need of quantum ideas

Textbooks

1. M.W. Zeemansky and R.H. Dittman, Heat and Thermodynamics, 8th edition, McGraw Hill India (2013).
2. S.J. Blundell and K.M. Blundell, Concepts of Thermal Physics, Oxford University Press (2008).

References

1. Enrico Fermi, Thermodynamics, Dover Publications (1936).
2. D.V. Schroeder, An Introduction to Thermal Physics, Oxford University Press (2021).
3. C. Borgnakke and R.E. Sontag, Fundamentals of Thermodynamics, Wiley (2017).

Semester III

Electricity and Magnetism

Course Objectives

The course aims to

1. Understand the concept of electric charges and electric potential.
2. Learn the basic principles of capacitors and resistors.
3. Learn the concept of dielectrics and dielectric polarization.
4. Appreciate the laws of magnetism and magnetic phenomena.
5. Apply the concepts of electricity and magnetism in inductors and ac circuits.

Course Content

Electric charge and potential

Coulomb's law- Electric field – point charge – superposition of electric fields – Electric dipoles – force and torque – potential energy – Flux of uniform and non-uniform electric field – Gauss law – point charge inside a spherical and nonspherical surface – Field at the surface of a conductor - Electric potential energy: uniform field – two point charges – several point charges. Electric potential from electric field – Equipotentials and conductors – Potential gradient.

Capacitors and Resistors

Capacitance – parallel plate capacitor – Capacitors in series and parallel – Energy storage and electric field energy – Induced charge and dielectric polarization – Molecular model of induced charge – Gauss's law in dielectrics. Conventional current – Current density – Resistivity and resistance – Electromotive force – internal resistance – Energy and power in electric circuits – Theory of electrical conductivity – Resistors in series and parallel – Kirchhoff's rules – RC circuits – time constant – discharging a capacitor.

Magnetism

Magnetic field - Charged particle in a magnetic field – cyclotron frequency – Biot-Savart Law - Magnetic force on a current carrying conductor – Force and torque on a current loop – magnetic dipole moment – DC motor – the Hall effect – Magnetic field of a moving charge – current element – current carrying conductor – force between parallel conductors – magnetic field of a circular current loop- Amperes law – Bohr magneton – Faraday's law – Lenz's law- Eddy current-induced electric field – Maxwell's equations -Magnetic vector potential.

Inductance and AC circuits

Mutual inductance – Self-inductance and inductors – Energy stored in an inductor – RL circuit – time constant – current decay – The LC circuit – The LCR series circuit – AC circuit – inductor and resistor in AC circuit – Impedance – Phase Angle – Power – Resonance- Filters.

Course Outcomes

After completion of the course, the students would

1. Understand the role of electric charges and electric potential

2. Know the basic principle of capacitors and resistors
3. Understand the concept of dielectrics and dielectric polarization
4. Acquire knowledge of the laws of magnetism and magnetic phenomena
5. Apply the concepts of electricity and magnetism in inductors and AC circuits

Textbooks

1. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).
2. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill (1986).

References

1. D. J. Griffiths, Introduction to Electrodynamics, Cambridge Univ. Press (2017).
2. J.J. Thomson, Elements of the Mathematical Theory of Electricity and Magnetism, Cambridge Univ. Press (2009).
3. R. P. Feynman, R. B. Leighton, M. Sands, The Feynman Lectures on Physics, Vol.2, Addison-Wesley (2005).

Semester IV
Analog and Digital Electronics
Course Objectives
The course aims to 1. Learn basic network theorems in electrical circuits 2. Understand the working principle of semiconductor diodes 3. Realize the applications of semiconductor devices such as transistors 4. Understand the concepts of logic gates 5. Comprehend basic principles in digital electronics
Course Content
Network theorems Ideal Constant-voltage and Constant-current Sources- Star and Delta networks and their Conversion- Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem - Applications to DC circuits. **Semiconductor Diodes** Semiconductors - Doping- Energy Level Diagram - Conductivity and Mobility - Barrier Formation in PN Junction Diode - Static and Dynamic Resistance - Current Flow Mechanism in Forward and Reverse Biased Diode - Half wave and full wave rectifiers - Zener diode. **Transistors** NPN and PNP Transistors - Characteristics of CB, CE and CC Configurations - Current gains α and β Relations between α and β - Load Line analysis of Transistors - DC Load line and Q-point - Physical Mechanism of Current Flow - Active, Cutoff and Saturation Regions - Class A, B and C Amplifiers. **Digital Electronics** Logic states – bits – Gates and truth tables - OR - AND - NAND- NOR -XOR - TTL and CMOS characteristics - Combinational logic - Karnaugh maps minimization - multiplexer - demultiplexer - flip flops – Registers and counters - AD/DA converters.
Course Outcomes
After completion of the course, the students would 1. Comprehend topics in basic network theorems. 2. Realize the working principle of semiconductor diodes. 3. Know various applications of diodes and transistors. 4. Appreciate the concept of logic gates. 5. Acquire fundamental knowledge in digital electronics.
Textbooks
1. P. Horowitz and W. Hill, The art of electronics, Cambridge University Press (1989). 2. L. Thomas Floyd, Digital Fundamentals, Pearson (2003).

References
1. J. Milman and C.C. Halkias, Electronic Devices and Circuits, McGraw-Hill (1981). 2. C. A. Schuler, Electronics: Principles and Applications, McGraw-Hill (2024).

Semester IV

Waves and Optics

Course Objectives

The course aims to

1. Understand the types of waves and their behavior.
2. Learn about the characteristics of electromagnetic waves.
3. Understand the principles of propagation of electromagnetic waves
4. Realize the properties of light waves and their applications in mirrors and lenses.
5. Comprehend the concepts of interference and diffraction.

Course Content

Mechanical Waves

Types of waves – wave function - wave equation – wave intensity – standing waves – normal modes of a string – sound waves – speed in solid and gas – sound intensity – resonance – interference of waves – beats – Doppler effect – ultrasonic waves – Lamb waves - Rayleigh waves - Seismic wave.

Electromagnetic waves

Maxwell equations – the electromagnetic spectrum – electromagnetic wave equation – EM waves in vacuum and matter – electric and magnetic fields of wave – Electromagnetic energy and Poynting vector – radiation pressure – electromagnetic standing waves.

Propagation of light

Laws of reflection and refraction – total internal reflection – dispersion – polarization – Huygen's principle – reflection and refraction at a plane mirror – spherical mirror – spherical refracting surface – lensmaker's equation – focal length and magnification.

Interference and diffraction

Constructive and destructive interference – two slit – amplitude and intensity in two source interference – phase difference and path difference – Michelson interferometer – Diffraction: Single slit – multiple slit – diffraction grating – Diffraction by a circular aperture.

Course Outcomes

After completion of the course, the students would

1. Know about various types of mechanical waves and their behavior.
2. Differentiate between mechanical and electromagnetic waves.
3. Know the principles of propagation of electromagnetic waves
4. Learn the fundamentals of optics and their applications in mirrors and lenses.
5. Appreciate the basic phenomena such as interference, diffraction and polarization.

Textbooks

1. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).
2. A. Ghatak, Optics, McGraw Hill (2020).

References

1. F.A. Jenkins and H.E. White, Fundamentals of Optics, McGraw Hill (2001).
2. H. J. Pain. The Physics of Vibrations and Waves, John Wiley, (2005).
3. A.P French, Vibration and Waves, MIT Introductory Physics, Arnold–Heinmann India (1973).

Semester V

Relativity and Quantum Mechanics

Course Objectives

The course aims to

1. Understand relativity and its consequences.
2. Learn about the necessity for quantum mechanics and basic concepts.
3. Know about Schrödinger wave equation and their applications.
4. Learn the particle in a infinite potential well and the origin of quantum numbers
5. Understnd the Schrödinger wave equation in three dimensions and the hydrogen atom model.

Course Content

Relativity

Classical relativity - Michelson-Morley experiment - Special relativity – time dilation – Doppler effect – Lorentz transformation – length contraction – velocity transformation– twin paradox – relativistic momentum – Mass and Energy – general relativity.

Foundations of quantum mechanics

Failures of classical mechanics- Black body radiation – Planck radiation formula – photoelectric effect – Compton effect – pair production – de Broglie waves – phase and group velocities – Davisson Germer experiment – Uncertainty principle.

The Schrödinger equation

The wave function characteristics - Schrödinger wave equation – time dependent and time independent – linearity and superposition – expectation values – operators – Dirac formalism - Schrödinger equation – infinite potential well - finite potential barrier – tunneling – example of alpha decay – harmonic oscillator.

Hydrogen atom

The Schrödinger equation in three dimensions – infinite well – spherical coordinates - Quantization of angular momentum – vector model – radial functions - selection rules – spin angular momentum – Stern-Gerlach experiment.

Course Outcomes

After completion of the course, the students would

1. Learn classical, special and general relativity concepts.
2. Understand the necessity for quantum mechanics apart from classical mechanics.
3. Learn about the Schrödinger wave equation and its applications.
4. Remember the origin of quantum numbers and other quantum phenomena.
5. Appreciate the Schrödinger wave equation in three dimensions and the hydrogen atom model.

Textbooks
1. A. Beiser, S. Mahajan, S. R. Choudhury, Concepts of Modern Physics, 7th Edn., McGraw-Hill (2017). 2. Kenneth S. Krane, Modern Physics, Wiley (2016).
References
1. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson (2005). 2. R. Eisberg, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley (1985). 3. L. I. Schiff, Quantum Mechanics, MCGraw-Hill (2017).

Semester V
Atomic and Nuclear Physics
Course Objectives
The course aims to 1. Understand the origin of spectral lines and the various atomic models. 2. Learn about light matter interaction and concepts of Lasers. 3. Apply quantum concepts in atomic and molecular physics. 4. Know basic nuclear properties and nuclear models 5. Learn the ideas of elementary particles.
Course Content
Atomic Physics Rutherford experiment – Hydrogen atom energy – Spectral series – The Bohr atom – Origin of line spectra - Correspondence principle – Rutherford scattering formula – The Sommerfeld atom – Millikan's oil drop experiment. **Lasers** Characteristics of laser - spontaneous and stimulated emissions – Einstein coefficients – Construction of laser – He-Ne laser – construction and energy levels – Ruby laser. **Molecular Physics** The molecular bond – the hydrogen molecule – rotational energy levels – vibrational energy levels – Electronic spectra – LS and jj coupling – Zeeman effect. **Nuclear and Particle Physics** Nuclear composition – properties – isotopes – binding energy – nuclear models: liquid drop model – shell model – Yukawa's theory – radioactive decay – half-life – alpha beta and gamma decays – nuclear reactions – reaction cross section– fission and fusion – leptons, hadrons and quarks.
Course Outcomes
After completing the course, the students would 1. Know about various spectral lines and atomic models. 2. Learn about stimulated emission and their application in lasers. 3. Know the basics of atomic and molecular physics. 4. Acquire knowledge about basic nuclear properties and nuclear models **5.** Appreciate the ideas of elementary particles.
Textbooks
1. A. Beiser, S. Mahajan, S. R. Choudhury, Concepts of Modern Physics, 7th Edn., McGraw-Hill (2017). 2. Kenneth S. Krane, Modern Physics, Wiley (2016).
References
1. P. A. Tipler and R. A. Llewellyn, Modern Physics, W. H. Freeman and Co. (2008). 2. William T. Silfvast, Laser Fundamentals, Cambridge University Press (2004) 3. Kenneth S. Krane, Introductory Nuclear Physics, Wiley (1998).

Semester V
General Physics Laboratory
Course Objectives
The course aims to 1. Gain practical exposure to modern physics concepts. 2. Verify the physical properties of materials. 3. Demonstrate experimental skills in electricity and magnetism.
Course Content
List of experiments 1. Determine the field along the axis of a circular coil 2. Study the Hall effect phenomenon in a semiconductor 3. Determine the Curie temperature of a magnetic material 4. Plot the temperature-dependent resistivity of a material 5. Study the Photoelectric effect: photocurrent versus intensity and wavelength of light 6. Determine the magnetic moment of a bar magnet. 7. Characteristics of hydrogen spectrum – Determination of Rydberg's constant 8. Identification of isotopes using GM counter 9. Conversion of galvanometer into ammeter and voltmeter 10. Calibration of Voltmeter – Potentiometer
Course Outcomes
After completion of the course, the students would 1. Acquire practical knowledge of modern physics concepts. 2. Learn about the physical properties of materials. 3. Understand concepts in electricity and magnetism.
References
1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018). 2. R.K. Shukla, Anchal Srivastava, Practical Physics, New Age International (2011). 3. C.L Arora, B.Sc. Practical Physics, S. Chand & Co. (2012).

Semester V
Electronics and Computational Laboratory
Course Objectives
The course aims to 1. Gain practical knowledge of analog and digital electronics concepts. 2. Apply semiconductor fundaments in diodes and transistors. 3. Expose basic programming skills for solving physics problems.
Course Content
List of experiments 1. Construct an LCR circuit and measure its characteristics. 2. Study the function of a diode under forward and reverse bias conditions. 3. Construct a half-wave and full-wave rectifier using a diode. 4. Study IV characteristics of Zener and light emitting diode 5. Study the characteristics of a transistor in CE configuration. 6. Verify truth tables for logic circuits. 7. Construct a flip-flop circuit. 8. Modeling LCR circuit in Matlab: Simulink 9. System of linear equations in PYTHON 10. Interpolation and curve fitting in PYTHON 11. Numerical integration and differentiation in PYTHON
Course Outcomes
After completion of the course, the students would 1. Acquire practical knowledge of analog and digital electronics. 2. Learn about diodes and transistors as semiconductor devices. 3. Solve physics problems using appropriate program codes.
References
1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018). 2. R.K. Shukla, Anchal Srivastava, Practical Physics, New Age International (2011). 3. C.L Arora, B.Sc. Practical Physics, S. Chand & Co. (2012).

Semester VI

Solid State Physics

Course Objectives

The course aims to

1. To understand the basic crystallography and crystal structures.
2. Learn the types of bonds, bonding mechanisms in solids and lattice vibrations.
3. Study about the conducting and semiconducting phenomena in solids.
4. Understnd the classification of magnetic materials
5. Leanr the basic ideas about superconductors and their properties**.**

Course Content

Crystallography

Crystalline and amorphous solids – lattice and unit cell – Reciprocal lattice - seven crystal system and Bravais lattices – symmetry operation – Miller indices – atomic radius – coordination number – packing factor calculation for sc, bcc, fcc – Bragg's law of X-ray diffraction.

Crystal bonds and phonons

Madelung constant – bonding in solids – Weidemann- Franz law – band theory of solids – Fermi energy and Fermi level- lattice vibrations - monoatomic vibration of crystals – First Brillouin zone.

Conductors and Semiconductors

Conductors: classical free electron theory (Lorentz –Drude theory) – Direct and indirect band gap semiconductors – Theory of intrinsic semiconductor at 0 K- Intrinsic semiconductor at room temperature- Intrinsic carriers- Electron and Hole concentrations - extrinsic semiconductors - temperature variation of carrier concentration in extrinsic semiconductors-Extrinsic conductivity - Law of Mass action-Charge neutrality-Fermi level in extrinsic semiconductors-Electrical conduction in extrinsic semiconductors.

Magnetism and Superconductivity

Magnetic materials: Definition of terms – classification of magnetic materials and properties – domain theory of ferromagnetism- hard and soft magnetic materials – applications- Superconductors: definition – Meissner effect – type I & II superconductors – BCS theory (qualitative) – high-temperature superconductors – Josephson effects - applications.

Course Outcomes

After completion of the course, the students would

1. Identify and differentiate various types of crystal structures.
2. Understand the types of bonds, bonding mechanisms in solids and lattice vibrations.
3. Distinguish conductors, semiconductors and superconductors.
4. Learn various types of magnetic materials
5. Know the basics of superconducting materials and their properties.

Textbook

1. C. Kittel, Introduction to Solid State Physics, Wiley (2019).

References

1. A. Beiser, S. Mahajan, S. R. Choudhury, Concepts of Modern Physics, 7th Edn., McGraw-Hill (2017).
2. N. W. Ashcroft and N. D. Mermin, Solid State Physics, Cengage Learning (1976).
3. M. Ali Omar, Elementary Solid State Physics, Pearson India (1999).
4. A. R. West, Solid State Chemistry and its Applications, Wiley (2014).

Semester VI
Project work and Viva-Voce
Course Objectives
The course aims to 1. Introduce independent learning skills through projects. 2. Learn literature survey and identify topics for research. 3. Acquire presentation skills and ability to defend the topic of research.
Course Content
Project work is to be chosen from any research topic familiar to the student. The report should include an introduction of the topic, a literature survey, results and discussion, a conclusion and a list of references. The student has to defend the topic of research before the examiner.
Course Outcomes
After completion of the course, the students would 1. Learn to undertake independent learning of research topics. 2. Ability to conduct literature surveys and identify topics for research. 3. Skills in presenting topics before the audience and comprehend the topic of research.

CURRICULUM
(LANGUAGE)

Language – II

EDLE21	**English for Communication**	**L**	**T**	**P**	**C**
		3	**0**	**1**	**4**

Course Objectives: The Objectives of the course are,

- To improve basic communication skills such as listening, speaking, reading and writing skills among L2 language learners.
- To enhance grammatical knowledge of L2 and enable the students to formulate grammatically correct and contextually appropriate sentences.
- To reinforce students' critical thinking capacities and demonstrate effective communication skills and provide hands on activities to student teachers to develop their linguistic skills through practical sessions.
- To enable a framework for an English Curriculum through self-directed approach to the Fundamentals of language in the context of NEP 2020.

Course Outcomes:

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

	Course Outcomes	Level
CO1	Become proficient in grammar usage for communication.	Understand
CO2	Acquire the significance of listening in communication and Vocabulary development.	Apply
CO3	Think critically and analytically to comprehend the idea and solve problems.	Analyse
CO4	Assess the nuances of public speaking and everyday conversation.	Evaluate
CO5	Understand the use of effective writing for professional and Academic communication.	Skill

Course Content:

English Grammar: Usage and Mechanics

Parts of Speech – Articles – Tenses – Active and Passive voice – Subject-Verb Agreement – Direct and Indirect Speech – Transition words – Collocation – types of sentences

Listening Comprehension

Listening Skill and its importance –Active listening – Listening for specific information – main idea – details – conversational phrases and vocabulary -predicting and recognizing emotions –Listening and comprehending news reports – structured talks – TED talks – Conversation videos – practice notetaking – Barriers to listening and strategies to overcome.

Reading Comprehension

Kinds &Ways of reading – benefits and purpose of read-aloud strategy -traits of a good reader - reading short articles and news reports - understanding sentence structure – main themes and ideas– reading for analytical, critical and creative thinking – understand the connection between paragraphs - cause and effect – vocabulary development.

Art of Talk

Phonetic transcription, Vowels, Consonants and others, Suprasegmental: Stress, Pitch, Tone, Intonation, and Juncture, Acoustic phonetics. Formal Vs. informal conversation – self-intro – anchoring - types of presentation - oral presentation: extempore and extemporaneous speech - present tables, charts and graphs – group discussion – conversation practice: role play – strategies for fluency – barriers and techniques to overcome them.

Effective Writing

Formal Vs. informal writing – note making and summarizing - topic sentence and paragraph making – cohesion and coherence in writing - precise writing —– paraphrasing – effective use of transition words and punctuations – descriptive writing–writing resume - transcoding – letter writing – email writing – writing etiquette.

Directed Study: To be done by the individual student. (Tutorial component)
Language, Society, and Learning: Bi-/Multilingualism and scholastic achievements, need to promote multilingualism, Language variation and Social variation, Languages, Dialects, varieties, Cultural transmission of language, Language and Gender, Language and Identity, Language and Power.

Language acquisition and Language learning, Language learning from mother tongues to other tongues, Advantages of learning other languages, Language and education, Notion of first language, Second language and others.
Constitutional provisions and National Education Policy 2020.

Suggestive Practicum:

- Listen to a recorded speech and classify it based on sounds: vowels, consonants, and others, suprasegmental: stress, pitch, tone, intonation, and juncture, Acoustic phonetics.
- Analyze sentences and their constituents as simple, complex, and compound sentences from written work.

Tasks and exercises will be given depending on the course instructors.

References:

1. A.J. Thomson, A.V. Martinet, A Practical English Grammar, OxfordUniversity Press Murphy, Raymond (2004). Essential English Grammar. 3rd ed., Cambridge UP, Word
2. Power Made Easy- Norman Lewis- Penguin Publishers
3. Hewings, M. (2013). Advanced grammar in use: A reference and practice book for Advanced learners of English. Cambridge UniversityPress.
4. Kallos, Judith. Email Etiquette Made Easy. Online. Killian, Crawford. Writing for the Web. 5th ed., Self Counsel Press, 2015.
5. Howard, Peter, Perfect Your Punctuation, Orient Longman, Delhi.
6. Romaine, Suzanne. Language in Society: An Introduction to Sociolinguistics. New York, Oxford University Press. ISBN: 978-0198731924.

Language – I Tamil

EDLT 11 **Tamil Epic Literature and Grammar** **L T P C**

4 0 0 4

Course Outcomes (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	Level
CO1	காப்பிய இலக்கியத்தின் தோற்றம், பின்புலம் முதலியவற்றை தெரிந்து கொள்தல்	தெரிந்து கொள்தல்
CO2	காப்பியங்களின் அமைப்பு, பாடுபொருண்மை, கவிநயம் போன்றவற்றைக் கண்டுணர்தல்	அறிந்து கொள்ளுதல்
CO3	காப்பிய இலக்கிய வரலாறு குறித்து மொழிதல்	புரிந்து கொள்ளுதல்
CO4	மொழித்திறன்(எழுத்து, சொல்) பயிற்சி பெறுதல்	தெரிந்து கொள்ளுதல்
CO5	எழுத்திலக்கண, சொல்லிலக்கண வரலாற்றைச் சுருக்கமாக புரிந்துகொள்தல்.	அறிந்து கொள்ளுதல்

Course Content

Units	Content	Hrs.
I	**காப்பியங்கள்** அ) சிலப்பதிகாரம் – மதுரைக்காண்டம் - '**அடைக்கலக்காதை**'. ஆ) மணிமேகலை - '**மணிமேகலா தெய்வம் வந்து தோன்றிய காதை**'.	10
II	**பக்திக் காப்பியங்கள்** அ) பெரியபுராணம் - **நமிநந்தியடிகள் நாயனார் புராணம்'.** கம்பராமாயணம் - **கிட்கிந்தா காண்டம் - 'நட்புகோட் படலம்'. (தேர்ந்தெடுத்த பத்துப் பாடல்கள் மட்டும்)** இ) சீறாப்புராணம் - நுபுவத்துக்காண்டம் - **மானுக்குப் பிணை நின்ற படலம்'.** **(தேர்ந்தெடுத்த பத்துப் பாடல்கள் மட்டும்)** ஈ**) தேம்பாவணி** - இரண்டாம் காண்டம் - **'சித்திர கூடப் படலம்'.** (தேர்ந்தெடுத்த பத்துப் பாடல்கள் மட்டும்)	10
III	**இலக்கணம் - எழுத்து, சொல்** **இலக்கணம் (எழுத்து): எழுத்தின் வகைகள், ஒலிப்பு முறைகள், புணர்ச்சி முறைகள், ர-ற; ல-ள-ழ; ந-ன-ண ஆகிய ஒலிகளை வேறுபடுத்தி அறியும் முறை, உயிர்மெய்க் குறில், உயிர்மெய் நெடில் வேறுபாடு அறியும் முறை, ஒலிப்பு முறை)**	9
IV	**இலக்கணம்(மொழிப்பயிற்சி)** **இலக்கணம் (சொல்): தொடரியல் அமைப்பு, சொல்லின் வகைகள் பெயர்ச்சொல்** -அறுவகைப்பெயர், ஆகுபெயர்**; வினைச்சொல்** - தெரிநிலை வினை**; இடைச்சொல் '**-உம்' இடைச்சொல்; **உரிச்சொல்** - மிகுதிப்பொருள் தரும் சொற்கள்), **வேற்றுமைகள்(வகை, உருபுகள்), வடசொற்களைத் தமிழ்ச்சொற்களாக மாற்றும் முறைமை வாக்கிய வகைகள்** (தன்வினை-பிறவினை; செய்வினை-செயப்பாட்டு வினை).	9
V	**காப்பிய வரலாறு, இலக்கண வரலாறு** அ) காப்பியத்தின் தோற்றமும் வளர்ச்சியும் ஆ) தமிழ் எழுத்திலக்கணம், சொல்லிலக்கணம் வரலாறு	9

	பாடநூல்கள் / பார்வைநூல்கள்: **இலக்கணம்:** 1. பரந்தாமனார், அ.கி., நல்ல தமிழ் எழுத வேண்டுமா?, பாரிநிலையம், சென்னை. 1988. 2. பரமசிவம், கு., இக்காலத் தமிழ் மரபு, அடையாளம் பதிப்பகம், சென்னை.2011. 3. வேல்முருகன், ப., எழுத்திலக்கண மாற்றம், தி பார்க்கர் பதிப்பகம், சென்னை. 2006. **இலக்கிய வரலாறு:** 1. சிவத்தம்பி, கா., தமிழில் இலக்கிய வரலாறு, நியூ செஞ்சுரி புக் ஹவஸ், சென்னை. 2000. 2. சிற்பி பாலசுப்பிரமணியம்., தமிழ் இலக்கிய வரலாறு, நறுமலர் பதிப்பகம், சென்னை. 1992. **இலக்கண வரலாறு:** 1. இளவரசு,சோம., இலக்கண வரலாறு, மெய்யப்பன் பதிப்பகம், சிதம்பரம். 2003. 2. புலவர்.இளங்குமரன்.இரா.,இலக்கண வரலாறு., மணிவாசகர் பதிப்பகம்., சிதம்பரம். 1999	

EDLH11	Hindi Language Learning	L	T	P	C
	(For Non native speakers)	4	0	0	4

Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	
CO1	पाठ्यक्रम की इस इकाई से विद्यार्थियों में हिन्दी लिपि की समझ बनेगी ।	
CO2	इस इकाई से विद्यार्थी हिन्दी वाक्य संरचना के बारे में जानकारी प्राप्त करेंगे।	
CO3	इस इकाई से विद्यार्थी हिन्दी की दैनंदिन क्रियाओं के विषय में जानकारी प्राप्त करेंगे।	
CO4	इस इकाई से विद्यार्थी में हिन्दी भाषा में निहित लिंग एवं वचन के संबंध में समझ बनेगी।	
CO5	समूह चर्चा एवं संभाषण के माध्यम से विद्यार्थियों में भाषण - कला	का विकास होगा।	

Course Content

Units	Content	Hrs.
I	• वर्णमाला स्वर), व्यंजन और वारहखड़ी (• फल, फूल, सब्जियों का नाम, पशुपक्षियों का नाम- • दिनों और महीनों का नाम, शारीरिक अंगों का नाम • एक से पचास तक गिनती	
II	• मैं, हम, तुम, आप, यह, वह, ये, वे, • क्या, कौन कितना, कब, क्यों • को, से, का, के, की, में, पर • मेरा, हमारा, तुम्हारा, आपका • चाहिए, पसंद का प्रयोग	
III	• वर्तमान काल (उदाहरण सहित) • भविष्यत् काल (उदाहरण सहित) • भूतकाल (उदाहरण सहित) • ने प्रत्यय का नियम	
IV	• लिंग, वचन, कारक, क्रिया • समानार्थ शब्द, विलोम शब्द • संवाद दुकान में - अस्पताल में, मार्केट में राम, सफर • अनुवाद अभ्यास हिंदी से) अंग्रेज़ी और अंग्रेज़ी से हिंदी (	
V	• कन्याकुमारी, (पाठ (• चाह, एक बूँद (कविता) • भगवान सब का एक है (कहानी) • दोहे - कबीर) 1, तुलसी-1 और रहीम -1)	
	छात्रों के लिए प्रदत्त कार्य जरूरी है- सभी छात्र नियत विषय पर कक्षा संगोष्ठी में प्रपत्र - वाचन करेंगे।	
सभी छात्र नियत विषय-वस्तु पर समूह चर्चा कर अपना	मन्तव्य व्यक्त करेंगे।		

संदर्भ ग्रंथ -

1. हिन्दी वातायण, डॉ. के. एम. चंद्रमोहन, विश्वविद्यालय प्रकाशन, वाराणसी, 2008.
2. होटल प्रबंधन, डॉ. के. पी. राजरत्नम., मैथ क्रियेटर्स, कोयम्बत्तूर, 2021.
3. प्राथमिक पाठ्य पुस्तक, दक्षिण भारत हिन्दी प्रचार | सभा, मद्रास, चेन्नई, 2022.
4. मध्यमा पाठ्य पुस्तक, दक्षिण भारत हिन्दी प्रचार सभा, मद्रास, चेन्नई, 2022.
5. देवनागरी लिपि तथा हिन्दी का मानकीकरण, डॉ अनुराधा सेंगर, केन्द्रीय हिन्दी निदेशालय भारत सरकार, नई दिल्ली, 2019.

EDLH12	Hindi Language structure and literature	L	T	P	C
	(For Native speakers)	**4**	**0**	**0**	**4**

Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	
CO1	पाठ्यक्रम की इस इकाई से विद्यार्थियों में हिन्दी व्याकरण की समझ| बनेगी		
CO2	इस इकाई के माध्यम से विद्यार्थी के शब्द-भंडार में वृद्धि होगी।	
CO3	इस इकाई से विद्यार्थी में विषय-विस्तार एवं विषय-संक्षेपण की कला विकसित होगी।	
CO4	पाठ्यक्रम की इस इकाई से विद्यार्थियों को पत्रकारिता एवं व्यावहारिक हिन्दी की जानकारी प्राप्त होगी।	
CO5	समूह चर्चा एवं संभाषण के माध्यम से विद्यार्थियों में संवाद-कला का विकास होगा।	

Course Content

Units	Content	Hrs.
I	**हिन्दी भाषा का विकास : परिचय** अपभ्रंश, हिन्दी का विकास ; हिन्दी की बोलियाँ ; हिन्दी और हिन्दुस्तानी ;	खड़ीबोली हिन्दी : राष्ट्रभाषा राजभाषा-संपर्क भाषा	
II	**हिन्दी भाषा की संरचना** संज्ञा, सर्वनाम, विशेषण, क्रिया विशेषण, संबंधबोधक, समुच्चयबोधक अव्यय, कारक एवं विभक्तियाँ, लिंग, वचन, काल, वाच्य	
III	**हिन्दी साहित्यका इतिहास : संक्षिप्त परिचय** | आदिकाल - सामान्य परिचय, भक्तिकाल - सामान्य परिचय -रीतिकाल, परिचय सामान्य - काल आधुनिक परिचय सामान्य	
IV	**पाठध्ययन एवं अध्यापन के लिए (प्राचीन पद्य):** 1. कबीरदास साखी)- पाँच दोहे (2. तुलसीदास (दोहे पाँच) 3. सूरदास वर्णन बाल)- दो पद (4. बिहारीलाल (दोहे पाँच)	
V	**पाठाध्ययन एवं अध्यापन के लिए (आधुनिक पद्य):** 1. सूर्यकान्त त्रिपाठी निराला - तोड़ती पत्थर 2. सच्चिदानंद हीरानंद वात्स्यायन 'अज्ञेय - नदी के द्वीप 3. निर्मला पुतुल - उतनी दूर मत ब्याहना बाबा	
	| छात्रों के लिए प्रदत्त कार्य जरूरी है- सभी छात्र नियत विषय पर कक्षा संगोष्ठी में प्रपत्र- वाचन करेंगे। सभी छात्र नियत विषय-वस्तु पर समूह चर्चा कर अपना मन्तव्य व्यक्त करेंगे। **सहायक ग्रंथ:** 1. कामता प्रसाद गुरु, संक्षिप्त हिन्दी व्याकरण, नागरीप्रचारिणी सभा, वाराणसी (2005) 2. बाबू गुलाबराय हिन्दी साहित्य का सुबोध इतिहास, लक्ष्मी नारायण अग्रवाल एजुकेशनल पब्लिशर्स, आगरा 3. विश्व नाथ त्रिपाठी, हिन्दी साहित्य का सरल इतिहास, ओरिएन्ट ब्लैकस्वेन,	हैदराबाद (2007) 4. दंगल झाल्टे, प्रयोजनमूलक हिन्दी : सिद्धांत और प्रयोग, वाणी प्रकाशन, नयी faceft (2015) 5. विनोद गोदरे, प्रयोजनमूलक हिन्दी, वाणी प्रकाशन, नयी दिल्ली (2016) 6. प्रेमचन्द्र, विश्व में हिन्दी, तक्षशिला प्रकाशन, नयी दिल्ली (2015) 7. विद्यानिवास मिश्र (सं.), आज के लोकप्रिय हिन्दी कवि-अज्ञेय, राजपाल एण्ड facell (2002) 8. रामविलास शर्मा (सं.), राग विराग, लोकभारती प्रकाशन, इलाहाबाद (1998) 9. हरेराम समीप (सं.), समकालीन दोहा कोश, शब्दालोक प्रकाशन, दिल्ली (2015) 10. कविताकोश	

CURRICULUM
(EDUCATION)

Table of Contents

Course Code	Course Title	L	T	P	C
EDPC61	Assessment and Evaluation	2	0	0	2
EDPC62	Inclusive Education	2	0	0	2
EDPC63	Content cum Pedagogy of Chemistry at Secondary Stage – III	4	0	0	4
	Content cum Pedagogy of Mathematics at Secondary Stage – III				
	Content cum Pedagogy of Physics at Secondary Stage – III				
EDPC64	Mathematical and Quantitative Reasoning	1	0	1	2
EDPC65	School Observation (Field Practice)	0	0	2	2
		Total			**12**
EDPC71	Perspective on School Leadership and Management	2	0	0	2
EDPC72	Secondary Stage Curriculum Planning and Development	2	0	0	2
EDPC73	Sports, Nutrition and Fitness	2	0	0	2
EDPC74	School-Based Research Projects	0	0	2	2
EDPC75	Internship in Teaching	0	0	10	10
		Total			**18**
EDPC81	Philosophical & Sociological Perspectives of Education – II	4	0	0	4
EDPC82	Education Policy Analysis	2	0	0	2
EDPE81-88	Elective Course in Education	4	0	0	4
EDPC83	Yoga and Understanding Self	2	0	0	2
EDPC84	Citizenship Education, Sustainability, and Environmental Education	2	0	0	2
EDPC85	Post Internship (Review and Analysis)	2	0	0	2
EDPC86	Creating Teaching Learning Material/Work Experience (Educational Toy Making, Local/Traditional Vocations, etc)	0	0	2	2
		Total			**18**

SEMESTER 1

EDPC11	EVOLUTION OF INDIAN EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The course objectives are to,

1. Analyze the historical progression of Indian education systems from ancient to modern times.
2. Evaluate the philosophical foundations and pedagogical approaches of different educational periods.
3. Examine the contributions of major educational thinkers and reformers in shaping India's educational landscape.
4. Interpret the constitutional provisions, policies, and frameworks governing contemporary Indian education.
5. Assess the transformation of educational administration, from traditional Guru-Shishya systems to modern institutional frameworks.

Course Content:

Vedic Education System

Vision and Objectives of Vedic Education - Salient Features of the Educational System- Teaching-Learning Methodologies - Guru-Shishya Parampara - Pedagogical approaches -Educational Institutions - Development and structure - Financial management - Education During Epic Period -Educational values in Ramayana - Educational values in Mahabharata.

Buddhist and Jain Education System

Vision and Objectives - Distinctive Features -. Teaching-Learning Process - Major Educational Centers: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia - Administrative and Financial Management -Notable Guru-Shishya Traditions.

Post-Gupta to Colonial Period

Historical Development Perspective: Educational Vision and Objectives - Salient Features-Teaching-Learning Methodologies - Institutional Management-Financial aspects-Administrative structure.

Colonial Education and Indigenous Responses

Colonial Educational Policies: Woods Despatch-Macaulay Minutes-Westernization impact - Indigenous Educational Interventions - Educational Reformers and Their Contributions: Savitribai and Jyotiba Phule-Rabindranath Tagore-Swami Vivekananda-Mahatma Gandhi-Sri Aurobindo-Gijubhai Badheka-Pt. Madanmohan Malaviya-Jiddu, Krishnamurti-Dr. Bhimrao Ambedkar and others.

Education in Independent India

Constitutional Framework: Educational provisions-Fundamental rights and duties - Citizenship Education-Qualities of good citizenship-Rights and responsibilities; Educational Initiatives: Universal Elementary Education (UEE), Rashtriya Madhyamik Shiksha Abhiyan (RMSA), Right to Education Act 2009; National Education Policy 2020: Vision and objectives-Implementation framework -Future prospects.

Suggestive Practicum:

1. Prepare a report highlighting educational reforms with special reference to school education in the light of NEP 2020.
2. Critically analyze the concept of good citizen from the perspective of education for democratic citizenship.
3. Compare vision, objectives, and salient features of education during different periods.
4. Working out a plan to develop awareness, attitude and practices related to Fundamental Rights or fundamental duties or democratic citizenship qualities execute it in the class and write the details in form of a report.
5. Sharing of student experiences (in groups) related to Indian constitutional values, help them to reshape their concept and enable them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in form of a group report.
6. Analyses of current educational strengths and weaknesses of one's own locality and work out a critical report.
7. Visit to places of educational significance and value centers and develop a project report.
8. Observation of unity and diversity in a social locality and matching it with unity and diversity in the class and work out a plan for awareness for national-emotional integration for class to develop awareness, attitudes, skills, and participatory values, execute it in the class and report the details.

Reference Books:

1. Aggarwal, J. C. (2010). Landmarks in the history of modern Indian education. Vikas Publishing House.
2. Basu, N., & Rahman, S. (2023). Trends and issues of modern Indian education. Global Net Publication.
3. Butt, K. A. (2022). National higher education policy 2020. Atlantic Publishers and Distributors.
4. Chidbhavananda, S. (2017). The Indian national education. Sri Ramakrishna Tapovanam Publications.
5. Iyyer, R. V. V. (2017). History of education policymaking in India (1947-2016) (4th ed.). University Press.

6. Ministry of Human Resource Development. (2020). National Education Policy. Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
7. National Council of Educational Research and Training. (2014). Basics in education: Textbook for B.Ed. course. NCERT.
8. Pathak, R. P. (2021). Education in the emerging India. Atlantic Publishers.
9. Sharma, R. N. (2021). History of education in India. Atlantic Publishers and Distributors.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Articulate the fundamental principles and practices of ancient Indian education systems.
2. Compare and contrast the educational methodologies across different historical periods.
3. Design educational interventions that incorporate the best practices from India's rich educational heritage.
4. Critically analyze current educational policies and reforms, particularly the National Education Policy 2020, and their potential impact on India's educational future.
5. Develop strategies for implementing effective educational practices by synthesizing historical wisdom with contemporary educational requirements.

EDPC12	ART IN EDUCATION (PERFORMING AND VISUAL) - I	L	T	P	C
		1	0	1	2

Course Objectives:

The course objectives are,

1. To understand the arts like classical, folk and contemporary in the teaching.
2. To obtain knowledge about paintings, paper cutting and folding and clay modeling.
3. To know different types of puppets.
4. To understand the visual and performing arts in their teaching process
5. To know different models concerning their teaching activity

Course Content:

Importance of Aesthetics and Art Education

Aesthetics and Art: meaning, dimensions and constituents - Importance of Arts in Education - Types of Arts: visual and performing - Renowned Indian Arts and Artists: Classical, folk and contemporary - Indian festivals and their artistic significance - Value of art in Education - use art as an instrument in education

Visual Arts

Different materials of visual arts: Rangoli, pastels, posters, clay, paintings - Using different methods of visual arts: Paintings, block printing, collage, clay modelling, paper cutting and folding - Listening/viewing performing art forms: music, dance and theatre.

Designing and Performing of Puppets

Puppets: History of Puppets, meaning, definition, Characteristics of Puppets and different types of puppetry in India - Designing, creativity performance of Puppets - Puppets and communication skills: Create a good engaging story and perform with own puppets, performing with small group and to prepare their own skits with the puppets

Performing Arts in Drama

Drama: meaning and definition - Drama as a medium of education- Identification of local performing art forms and their integration in teaching and learning process - Listening/viewing performing arts: skit, mime, one act play or theatre - Evaluation strategies: assessing the different forms of Arts.

Fundamentals of Drawing and Painting

Concept and Types of drawing - Colours and Sketching- understanding of various means and perspectives - Different forms of painting - Drawing and Painting in Education: Uses; Different varieties: Chart making, Poster making, match-stick drawing and other forms, Model making: Clay modeling, Origami, Decorative – Rangoli, and any other local art.

Tasks and Assignments:

Each student is required to submit any four assignments from the following:

1. Textbook analysis to find scope to integrate art forms either in the text or activities or exercises.
2. Preparation of instructional material for education in the arts for secondary school.
3. Documentation of the processes of any one art or craft with the pedagogical basis such as Weaving or printing of textiles, making of musical instruments and Folk performances in the community, etc. - how the artists design their products, manage their resources, including raw materials, it is marketing, problems they face, including historical, social, economic, scientific and environmental concerns.
4. Art and Craft Exhibition.
5. Representative of Art in the Art Club.
6. Case studies of the children's work of art and their understanding of the concept of Art.
7. Select a concept from the school curriculum which includes a social message and identify an appropriate art form to spread the message in public and prepare a report.
8. Identify a local art form and integrate it in teaching an appropriate lesson from school curriculum – Prepare a lesson plan
9. Select an appropriate lesson from the school curriculum and rewrite it in the form of a drama.
10. Organize a show on dance/ music/dramas and Prepare report.

References:

1. Dewey, J. (1934). Art as experience. New York: Minton.
2. Reed, H. (1968). Education through art. New York: Faber and Faber. Eisner, E. W. (1972). Educating artistic vision. New York: Macmillan.
3. John, B., Yogin, C., & Chawla, R. (2007). Playing for real: Using drama in the classroom. New York: Macmillan.
4. Jefferson, B. (1969). Teaching art to children – Continental view point.
5. Boston: Allyn Bacon.Tagore, R. (1962). Lectures and addresses. New Delhi: Macmillan. Coomaraswamy, A. K. (1974). Christian and oriental philosophy of art.
6. New Delhi: Munshiram Manoharlal. Rupali Tripathi, (2004), Teaching of music, New Delhi: Mohit Publication.
7. Dash B.N, (2002), Teacher and Education in the Emerging India Society (Vol. I & II) New Kalaimani Saraswathi, (1994), Bharata Natyakalai, Madras: Thirumagal Nilayam.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Reflect the arts like classical, folk and contemporary in the teaching.
2. Perform paintings, paper cutting and folding and clay modeling.
3. Prepare different types of puppets
4. Perform visual and performing arts in their teaching process
5. Prepare different models concerning their teaching activity

EDPC13	UNDERSTANDING INDIA (INDIAN ETHOS AND KNOWLEDGE SYSTEMS) - I	L	T	P	C
		2	0	0	2

Course Objectives:

The course objectives are,

1. To understand the concept of Indian Knowledge System and its components.
2. To identify and categorize the different types of arts and literature available in ancient India and will use in their teaching processes.
3. To understand the Indian polity system, Indian laws from ancient to Modern India.
4. To familiar with different sources of Indian economy.
5. To discuss the different medicinal practices available in our India through their teaching to the future generation.

Course Content:

Introduction to Indian Knowledge System (IKS)

Indian Knowledge System (IKS): meaning, definition, essential & scope, core elements of IKS, Relevance of IKS knowledge – Ancient Knowledge: meaning and its components – traditions – culture – Need to revisit our ancient knowledge, tradition and culture.

Art and Literature

Arts: meaning, types and scope - Fine arts: traditional art forms, contemporary arts, arts & spirituality, arts and Identity, and art and globalization, - Performing Arts: Indian dance systems, traditional Indian pieces of music, visual arts, folk arts, etc., - Literature: Meaning and Importance: religious literature, Indian poetry, folk literature, and Indian fiction

Indian Polity and Law

Indian polity system: Kingship & types of government (Monarchy, non-monarchy, oligarchies and republics) – Local administrative structure (village administration) - Basis Indian Law: Basics, Dharma & its sources; Criminal Justice: police, jails, and punishments; Lessons from Chanakyaniti and modern-day India: Towards a tradition-driven equitable and just polity and law system.

Indian Economy

Indian Economy: Overview from the Stone Age to the Guptas: Urbanization culture of Economy: castes, guilds, and other economic institutions - Temple economy - Land ownership - land grants & property rights - land revenue systems - Understanding Arthashastra: Ideas & Criticism and relevance in Indian Economy.

Environment, Physical and Mental Health

Understanding Equilibrium between Society & Environment - Society’s perceptions of

natural resources (forests, land, water, and animals) - India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, and Unani

Suggestive Practicum:

1. Practicum will include organization of day trips that help student-teachers watch events relating to visual and performing art; activities that enable student teachers to identify and record through photos, videos, etc. the elements of ancient architecture still existing in the city around them;
2. Organization of Individual and group presentations based on themes such as Polity, Law and Economy etc.,
3. Organization of a 'Knowledge of India' day in the institution to celebrate the culture (food, clothes, etc.) that they would have been explored in lectures and tutorials; interactions with family members, elders, neighbors, and other members of society about the evolution of local systems and economy etc.

Reference Books:

1. Wani, Adil Firdous. (2023). Understanding India. New Delhi: Prabhakar Prakshan Publication.
2. Saluja, Anshul. (2023). Indian knowledge system unveiling. Lucknow: Rivers Publication.
3. Chauhan, Bhag Chand. (2023). IKS: The knowledge system of Bharata. Haryana: Garuda Prakashan Publication.
4. Rana, Ravindra Sing., Purohit, Rajesh., Vishwakarma, Manish., Kumar Soni, Vimlesh, & Rajput, Satish Pal Singh. (2023). Indian knowledge system of materials in science and technology. New Delhi: Walnut Publication.
5. Sen, Sanjay (2023). Understanding India. Guwahati: Ashok Publication
6. Neil DeVotta&sumitGanguly (2021). Understanding Contemporary India (3rdEdn). Lynne Rienner Publishers. ISBN: 978-1-62637-940-4
7. Baliyan, S. (2020). A Compendium of Indian Art and Culture. Oxford University Press, ISBN: 9780199496587.
8. MHRD (2020) National Education Policy, Government of India, pp.33-49. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
9. Upinder Singh (2009). A History of Ancient and early Medieval India: from the Stone Age to the12thCentury. Pearson Education India Publication, ISBN:978-8131716779.
10. Sisir Kumar Das (2005). A History of Indian Literature 5001399 from The Courtly to the Popular, ISBN: 9788126021710.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the concept of Indian Knowledge System and its components.
2. Separate the different types of arts and literature available in ancient India and will use in their teaching processes.
3. Elucidate the Indian polity system, Indian laws from ancient to Modern India.
4. Describe the different sources of Indian economy.
5. Disseminate the different medicinal practices available in our India through their teaching to the future generation.

SEMESTER 2

EDPC21	UNDERSTANDING INDIA (INDIAN ETHOS AND KNOWLEDGE SYSTEMS) - II	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are,

1. To recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it.
2. To apply their acquired research and critical thinking skills in multidisciplinary themes.
3. To summarize and passion their learning to their students of different Indian traditions in an easily digestible manner.
4. To understand the science and technology available in ancient India and cultivate the scientific knowledge and technological skills.
5. To know our linguistic tradition and make pride toward the language is our identity.

Course Content:

Indian Philosophical System

Philosophy, Ethics & Values: Meaning, definitions and importance - Schools of Philosophy: Orthodox, Heterodox and Vedanta - Orthodox School of Philosophy: Vaishesika, Nyaya, Samkhya, Yoga, Purva Mimansa and Vedanta or Uttara Mimansa (theory and the major thinkers) – Heterodox School of Philosophy: Jain, Buddhist, and Charvaka traditions - Vedanta Philosophical systems: Advaita, Vishishtadvaita, and Dvaita.

Ethics and Spirituality

Ethics, morality, and social dilemma (including self-leadership) and their relevance in modern India - Spirituality and Social Responsibility: Importance of Spirituality in current times, value of spirituality in India - Technologically volatile world: use of ethics, leading an ethical and modern life

Culture on Life Style

Culture on Lifestyle: Food (regional cuisines, ayurvedic diet, food and festival, vegetarianism, Jainism in food) – food and hospitality, and globalization - Clothes: traditional Indian clothing, textile arts, religious costumes, clothing status, clothing, gender, globalization in clothing – Sports: traditional Indian sports, martial arts, sports, and gender – sports and globalization – Yoga: life style and adapting ancient lifestyle – A path towards longevity.

Science and Technology in Ancient India

Science and Technology: Number systems, unit of measurements, Arithmetic and logic. Natural sciences: mathematics, physics, metallurgy, and chemistry - Astronomy: India’s contributions to the world - Indian notions of time and space – Technology: economy, agriculture, transportation, etc.

Linguistic Traditions

Linguistic Traditions: History of linguistics in India (conceptualizing ancient Indian linguistics, oral traditions, etc.) - Language: meaning, component of language, Logic for sentence construction and phonetics of language – Language: identity, history and Culture.

Suggestive Practicum:

1. The modes of curriculum transaction will include lectures, Tutorials, and Practicum.
2. Practicum will include organization of day trips that help student teachers watch events relating to visual and performing art; activities that enable student teachers to identify and record through photos, videos, etc. the elements of ancient architecture still existing in the city around them;
3. Organization of Individual and group presentations based on themes such as Polity, Law and Economy etc.,
4. Organization of a 'Knowledge of India' day in the institution to celebrate the culture (food, clothes, etc.) that they would have been explored in lectures and tutorials; interactions with family members, elders, neighbors, and other members of society about the evolution of local systems and economy etc.

Reference Books:

1. Adil Firdous Wani (2023) Understanding India. Prabhakar Prakshan Publication, ISBN: 978- 9356821491.
2. Anshul Saluja (2023). Indian Knowledge System Unveiling Traditions Perspectives and Narratives. Book Rivers Publication, ISBN: 978-9358428384.
3. Bhag Chand Chauhan (2023) IKS: The Knowledge System of Bharata. Garuda Prakashan Publication, ISBN: 979-8885750882.
4. Ravindra Sing Rana, Rajesh Purohit, Manish Vishwakarma, Vimlesh Kumar Soni, & Satish Pal Singh Rajput (2023). Indian Knowledge System of Materials in Science and Technology. Walnut Publication, ISBN: 978-9359114736.
5. Sanjay Sen (2023).Understanding India. Ashok Publication, ISBN:978-9389491746.
6. Neil De Votta & sumit Ganguly (2021). Understanding Contemporary India (3rdEdn). Lynne Rienner Publishers. ISBN: 978-1-62637-940-4
7. Baliyan, S. (2020). A Compendium of Indian Art and Culture. Oxford University Press, ISBN: 9780199496587.
8. MHRD. (2020). National Education Policy, Government of India, pp.33-49. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
9. Upinder Singh (2009). A History of Ancient and early Medieval India: from the Stone Age to the12th Century. Pearson Education India Publication, ISBN: 978-8131716779.
10. Sisir Kumar Das (2005). A History of Indian Literature 500 1399 from the Courtly to the Popular, ISBN: 9788126021710.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Use the vast corpus of knowledge traditions of India in the life situations.
2. Use their acquired research and critical thinking skills in multidisciplinary themes.
3. Apply their learning to their students of different Indian traditions in an easily digestible manner.
4. Utilize the science and technology available in ancient India and use the scientific knowledge and technological skills in their teaching.
5. Follow our linguistic tradition and disseminate the language is our identity.

EDPC22	TEACHER AND SOCIETY	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to,

1. Develop a deep understanding of the personal and professional dimensions that shape teacher identity.
2. Analyze and evaluate various teacher typologies and professional roles.
3. Integrate holistic development principles into teaching practice.
4. Examine and develop teacher agency within educational systems.
5. Evaluate contemporary challenges in education and develop strategies for educational transformation.

Course Content:

Personal Dimensions of a Teacher

Understanding the personal context of teachers - Life history and its influence on teaching practice - Teacher beliefs, values, and aspirations in educational settings - Exploration of diverse teacher identities - Social contexts shaping teacher development - Personal commitment to learning and education - Impact of individual background on teaching philosophy - Formation of teaching identity through personal experiences.

Professional Dimensions and Teacher Typology

Professional qualifications and educational requirements - Development of teaching attitudes and aptitudes - Significance of experience and exposure in teaching - Understanding different teacher types: Charismatic, Communicator, Missionary - Analysis of teacher roles: Competent Practitioner, Reflective Practitioner, Learning Teacher - Professional development through collaborative engagement - Building professional capital in educational settings.

Holistic Teacher Development

Teaching as a multifaceted profession - Character development in teaching profession - Nurturing teachers for human flourishing - Understanding and developing Panchakoshas in teacher development - Formation and evolution of teacher values and beliefs - Contemporary teaching philosophies and their impact - Development of reflective dialogue practices - Implementing pedagogy of care in education.

Teacher Agency and Empowerment

Understanding the concept and importance of teacher agency - Individual dimensions of teacher agency - Cultural aspects influencing teacher agency - Structural components of educational systems - Teacher discourses and philosophical

foundations - Professional networks and relationships - Creative insubordination in educational settings - Strategies for developing teacher agency.

Teacher's Role in Educational Transformation

Challenges in contemporary teaching profession - Impact of performativity on teaching practice - Managing non-academic engagements - Addressing systemic apathy in education - Understanding policy-practice gaps - Teacher's role in educational policy formation - Contribution to educational reforms and practices - Shaping future education systems through teacher leadership-Teacher: An Architect of New India.

Suggestive Practicum:

1. Take up a case study of any one teacher education Institution.
2. Write a biography of any one of your favourite teachers/ Educationists.

References:

1. Bhan, S. (2014). Understanding Learners: A Handbook for Teachers. Prasad Psycho Corporation.
2. Paige, M. A. (2016). Building a Better Teacher. Rowman & Littlefield.
3. Justice, J. E., & Tenore, F. B. (Eds.). (2018). Becoming Critical Teacher Educators: Narratives of Disruption, Possibility, and Praxis. Routledge.
4. Tileston, D. W. (2011). 10 Best Teaching Practices: How Brain Research and Learning Styles Define Teaching Competencies (3rd ed.). Corwin Press.
5. Herro, D., & Quigley, C. (2019). An Educator's Guide to STEAM. Teachers' College Press.
6. Nuijten, E., & Korthagen, F. (2022). The Power of Reflection in Teacher Education and Professional Development: Strategies for In-Depth Teacher Learning. Routledge.
7. Zayas, B., Jukes, I., et al. (2022). Learner Choice, Learner Voice: A Teacher's Guide to Promoting Agency in the Classroom. Routledge.

Course Outcomes:

After successfully completing this course, the prospective teachers will be able to:

1. Demonstrate understanding of how personal and professional experiences shape teaching philosophy.
2. Apply different teaching approaches effectively, showing proficiency in reflective practice.
3. Design and implement holistic teaching strategies that incorporate character development and ethics of care.
4. Exercise effective teacher agency by developing and implementing strategies that address systemic challenges.
5. Analyze and address contemporary societal challenges in education, particularly regarding technology, globalization, and social equity.

SWIR21	FIELDWORK WITH COMMUNITY ENGAGEMENT (NSS/NCC/NSO)	L	T	P	C
		0	0	0	0

Course Objectives:

The Objectives of the course are,

1. Share the experience of community life.
2. Understand the socio-educational challenges and opportunities of community life.
3. Appreciate the role of community in school development programme.
4. Realize the importance of school community symbiosis for school development programme.
5. Appreciate the categorical role of teacher for better school community relationship.

Course Content:

Suggestive Practicum:

1. Report on social customs, traditions and superstition.
2. Survey of a village/town with at least 20 households in order to study the socio-economic and educational status of the villager.
3. Study on facilities for access, enrolment and retention in local schools.
4. Study of an area in regard to consumption of electricity and water and suggest remedial measures.
5. Survey of out of school children, related causes.
6. Tree plantation programme in the campus/nearby village.
7. Survey of parent’s attitude towards education of their children.
8. Organization of campus beautification programme.
9. Identification of problems of parents with respect to education of their children.
10. Aids awareness, electoral awareness, road safety, human rights, child rights, rights of persons with disabilities, women empowerment, literacy programmes in the community.
11. Cleanliness drives in the community and awareness about its needs.
12. Developing awareness about health and nutrition among the community members
13. Identification of possibilities of local employment generation opportunities and awareness on life skill.
14. Exploring the community resources and finding means and ways of using them for school.
15. Many more such exercises could be conceived. Any such activities could be planned and executed at the institutional level. It is suggested that these activities may be conducted individually or collectively under the mentorship of teacher educators. Depending upon the local specificity other relevant activities may be planned.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Conduct a survey alone on Socio Economic and Educational Status at any areal.
2. Organize a tree plantation programme, electoral awareness programme, Aids awareness, road safety, human right and so on.
3. Identify the community resources and utilize it to the school teaching.
4. Execute the cleanliness drives in the community.
5. Identify and solve the problems concerning to the parent on their child education.
6. Organize campus beautician programme.

SEMESTER 3

EDPC31	CHILD DEVELOPMENT AND EDUCATIONAL PSYCHOLOGY	L	T	P	C
		3	0	1	4

Course Objectives:

The Objectives of the course are to:

1. Understand fundamental concepts of psychology and child development from both Western and Indian perspectives.
2. Analyze developmental characteristics and processes across different stages of childhood and adolescence.
3. Evaluate problem-solving strategies and learning approaches in educational contexts.
4. Apply theories of motivation and learning to enhance educational practices.
5. Develop effective classroom management techniques incorporating group dynamics principles.

Course Content:

Foundations of Psychology and Child Development

Psychology: Meaning and definitions. Educational psychology: Scope and significance-Child development process: Biological, cognitive, socio-emotional, and moral domains-Indian concept of self: Mind (मनस्), Intellect (बुद्धि), Memory (चित्त)-Panch-koshIya Vikas (पञ्चकोशीयचिकास)-Educational implications of developmental understanding.

Developmental Stages and Processes

Developmental characteristics during infancy, early childhood, middle to late childhood, and adolescence-Development across domains: Physical, cognitive, language, socio-emotional, aesthetic, and moral development during each stage-Factors affecting development-Individual differences and special needs-Tools and techniques for learner identification- Teacher's role in addressing diverse learning abilities.

Problem Solving and Learning Approaches

Inquiry-based learning principles and applications- Problem-solving methodology and strategies- Factors affecting problem-solving abilities-Learning strategies: Significance and implementation- Techniques for effective learning and knowledge acquisition-Development of critical thinking and problem-solving skills in educational contexts.

Theories of Motivation and Learning

Motivation: Conceptual framework, nature, and significance- Intrinsic and extrinsic motivation-Maslow's theory of motivation and educational implications-Level of

aspiration-Learning theories and their educational applications: Cognitive Theory (Jean Piaget), Behaviourist Theory (Watson, Pavlov, Skinner, Thorndike), Constructivist Theory (John Dewey), and Humanistic Theory (Carl Rogers).

Classroom Management and Group Dynamics

Creating positive learning environments-Space planning for effective learning - Managing behavioural challenges- Understanding classroom as a social group- Group characteristics and dynamics- Sociometry and group interaction analysis- Strategies for facilitating productive group learning-Techniques for maintaining classroom discipline and engagement.

Suggestive Practicum:

1. Spending day with a child and preparing a report based on our observations of children for:
   - A day from different economic status (low and affluent)
   - Focus on various factors: Physical, emotional, social, language, cultural and religious influencing the child on daily basis.
2. Observing children to understand the styles of children learning process.
3. Identifying the Learning Difficulties of Students in Different learning areas and the Possible Reason for them- Case Study Report.
4. Preparing Personalized Intervention plan for Students with Learning Difficulties.
5. Plan to use advanced technology to encourage talented / gifted children.
6. Encouraging gifted / talented students beyond the general school curriculum.
7. Familiarization and Reporting the following Individual Psychological Tests & Experiments.
   - Eysenck Personality Inventory
   - Intelligence Test – Raven’s Progressive Matrices
   - Habit Interference
   - Conditioning of Winking Reflex
   - Aptitude Tests – Differential Aptitude Battery
   - Span of Attention
   - Division of Attention
   - Bilateral Transfer
   - Muller-Lyer Illusion
   - Trial and Error and Insightful Learning

References:

1. Aggarwal, J.C. (2018). Essentials of Educational Psychology (3rd ed.). Vikas Publishing House. ISBN: 978-9325976146.
2. Bhatia, P. R. (2007). Psychology of Teaching Learning Process. Anmol Publisher. ISBN: 978-8126122479.
3. Chauhan, S. S. (2010). Advanced Educational Psychology (7th ed.). S Chand. ISBN: 978-8125919070.
4. Dash, M. (2022). Fundamentals of Educational Psychology. Atlantic Edition. ISBN: 978-8126901883.
5. Lamb, M. E., & Bornstein, M. H. (2007). Developmental Psychology: An Advanced Textbook. Psychology Press. ISBN: 978-0805830729.
6. Mangal, S.K. (2002). Advanced Educational Psychology (2nd ed.). Prentice Hall India Learning Private Limited. ISBN: 978-8120320383.
7. Mangal, S. K., & Mangal, S. (2022). Child Psychology & Development. Sterling Publishers Pvt. Ltd. ISBN: 978-9386245540.
8. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (1993). Introduction to Psychology. Tata McGraw-Hill Publishing Company Limited, New Delhi. ISBN: 0-07-46225-1.
9. Robinson, S. (2009). Foundation of Educational Psychology (2nd ed.). Ane Books Pvt. Ltd., New Delhi. ISBN: 978-8180521546.
10. Santrock, J. W. (2021). Life-span Development(17th ed.). McGraw Hill Education India Pvt. Ltd., Chennai. ISBN: 978-9390727551.
11. Sharma, R. N., & Sharma, R. K. (2022). Advanced Educational Psychology. Atlantic Publishers and Distributors (P) Ltd. ISBN: 978-8171566075.

Course Outcomes:

After successfully completing this course, the prospective teachers will be able to:

1. Apply psychological principles and developmental theories in educational settings while integrating Indian conceptual frameworks
2. Assess developmental patterns across various domains and implement appropriate interventions for different developmental stages.
3. Design and implement effective problem-solving and learning strategies in educational contexts.
4. Utilize motivation theories and learning principles to enhance student engagement and achievement.
5. Create positive learning environments that facilitate effective group dynamics and classroom management.

EDPC32	BASIC PEDAGOGY AT SECONDARY STAGE	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are

1. To build comprehensive understanding of physical, mental, social, and emotional growth of secondary stage learners.
2. To develop skills to observe and recognize the unique capabilities and strengths of secondary stage learner.
3. To discuss the necessary knowledge and skills to implement effective teaching and learning strategies.
4. To develop a deeper understanding of various pedagogical approaches and their impact on learners.
5. To explain the crucial role of pedagogy in facilitating effective learning experiences for students.

Course Content:

Understanding Secondary Stage Learners
Secondary Stage Learners: Understanding the learners and learner background – Growth of Learners: The physical, mental, social, and emotional growth - Thought processes and cognitive skills of learners - Psychological and social orientations of learners - Social and academic lives of learners - Conflicts and challenges of secondary learners - Characteristics of secondary stage learners - Observing the unique capabilities of a secondary learner.

Teaching and Learning Styles
Teaching style: meaning and types – Learning style: visual, auditory and kinesthetic – Leadership styles: Autocratic, Democratic, Laizze faire and charismatic leadership styles – Classroom interaction analysis: dimensions of interaction, theoretical assumptions, - Classroom Interaction Analysis: FIAC and Galloway's systems

Pedagogical Approaches
Pedagogy: Meaning, definition and importance - Types of pedagogy: social pedagogy, critical pedagogy, culturally responsive pedagogy, Socratic pedagogy in inclusive setup - Pedagogical approaches: constructivist approach, collaborative approach, reflective approach, integrative approach, and inquiry - based approach - Other contemporary approaches: art-integrated learning, sports- integrated learning - Role of pedagogy in effective learning: how does pedagogy impact the learner?

Professional Development of Teachers
Professional Development: Meaning and need, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies – Professional development activities: seminars, conferences, Orientation programmes, workshops, online and offline courses, competitions, publications, development of teaching portfolio, capacity building programmes, and teacher exchange programmes.

Issues in Professional Development of Teachers

Issues deal with gender issues, equity and inclusion, ethical issues, environmental issues, human health and well-being, population, human rights, and various issues (emotional, mental, physical issues related to pandemic (for example covid-19).

Suggestive Practicum (Any Three):

1. Analyze NEP-2020 with reference to pedagogical aspects of the concerned subject.
2. Analyze and reflect on the qualities of an 'Innovative Teacher' in Context of National Professional Standards for Teachers (NPST) and National Mentoring Mission (NMM).
3. Explore different platforms such as National Teacher's Portal, NISHTHA, DIKSHA, and SWAYAM for an online course and prepare a report.
4. Participate in a workshop or seminar to explore the concept of Continuous Professional Development (CPD), its significance in lifelong learning and prepare a write up on the findings.
5. Develop teaching learning strategies to address the needs of diverse learners in context of gender, equity and inclusion and prepare a PowerPoint presentation.
6. Raise awareness on the ethical and social challenges in education through field trip and create an e-portfolio.
7. Any other project assigned by HEI.

Suggestive Reading Materials:

1. National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
2. National Education Policy 2020, MoE, Government of India (English and Hindi).
3. National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
4. National Policy on Education 1968, 1986 and 2020.

Reference Books:

1. Chaudhary Murtaza (2017). Teaching Methodology: Pedagogical Principles and Effective Teaching Strategies. Independently Published. ISBN: 979-8681805892.
2. Kok-Sing Tang (2020) Discourse Strategies for Science Teaching and Learning. Routledge. ISBN: 978-0367344245.
3. Mark Reardon, and Seth Derner (2008) Strategies for great Teaching: Maximize Learning Moments. Routledge. ISBN: 978-1593633424.
4. Renato Cagomoc (2020) Continuous Professional Development & Pedagogical Practices of Teachers. Lambert Academic Publishing. ISBN: 978-6202554466.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the physical, mental, social, and emotional growth of secondary stage learners.
2. Use skills to observe and recognize the unique capabilities and strengths of secondary stage learner.
3. Utilize the necessary knowledge and skills to implement effective teaching and learning strategies.
4. Identify and implement the various pedagogical approaches and find out their impact on learners.
5. Implement an innovative pedagogy in facilitating effective learning experiences for students.

SEMESTER 4

EDPC41	PHILOSOPHICAL & SOCIOLOGICAL PERSPECTIVES OF EDUCATION - I	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to,

1. Demonstrate comprehensive understanding of philosophical perspectives in education and their implications for teaching and learning
2. Analyze and compare Indian and Western educational philosophies and their contemporary relevance
3. Evaluate the contributions of prominent educational thinkers and their impact on educational practices
4. Apply philosophical principles to develop value-based educational approaches
5. Integrate traditional wisdom with modern educational needs while addressing 21st-century challenges

Course Content:

Foundations of Educational Philosophy

Introduction to Philosophy of Education - Conceptual Framework and Relationships - Aims of Studying Philosophical Perspectives -Branches of Philosophy: Metaphysics (तत्त्वमीमांसा)-Epistemology (ज्ञानमीमांसा)-Axiology (मूल्यमीमांसा)

Indian Educational Perspectives

Traditional Educational Systems: Vedic Education-Buddhist Education-Jain Education-Sikh Education-Islamic Education - Key Concepts and Terminologies: Darshana, Para and Apara Vidya- Avidya, Shiksha, Samvaad, Gurukulam-Roles: Acharya, Guru, Shishya, Upadhyaya-Practices: Jigyasa, Swadhyaya.

Western Educational Perspectives and Philosophical Schools

Western Educational Theories: Cognitive Theories-Behaviorist Approaches-Developmental Theories -Indian Philosophical Schools: Samkhya, Yoga,Nyaya, Vaisheshika, Mimansa, Vedanta -Western Philosophical Schools: Idealism, Naturalism, Pragmatism, Progressivism.

Educational Thinkers and Their Contributions

Indian Educational Thinkers: Swami Vivekananda, Sri Aurobindo Ghosh, Rabindranath Tagore, J. Krishnamurti, Madan Mohan Malaviya, Mahatma Gandhi,Gijubhai Badheka-Western Educational Thinkers: Jean-Jacques Rousseau, Maria Montessori, Friedrich Froebel, John Dewey.

Value Education and Contemporary Applications

Fundamentals of Value Education: Types and Significance-Indian Traditional Values-Guru-Shishya Parampara Constitutional and Modern Context-Values in Indian Constitution-Taittiriya Upanishad Teachings-NEP 2020 and 21st Century Values Pedagogical Implementation-Teaching Methods-Assessment Strategies-Integration with Modern Education.

Suggestive Practicum:

1. Individual/group assignments/tasks in various forms like writing small paragraphs/brief notes, conceptualizations on specific terms etc.
2. Institutional visits in small groups in coordination to institutions related to different thinker/s and preparation of a report followed by individual/group presentation.
3. Sharing of student experiences (in groups) related to readings on great thinkers help them to reshape their concept and enable them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in form of a group report.
4. Identification and reporting of Indian perspective related to educational aims, student-teacher characteristics, methods, evaluation procedure, convocation etc. based on critical study of life and thoughts of thinkers.

Reference Books:

1. Kasturirangan, K., Kapur, A., Menon, S., Mirchandani, P., Murthy, R. S., Krishnan, R., & Chouksey, M. (2020). NEP 2020: Transforming India's education system. Ministry of Human Resource Development, Government of India.
2. Lal, R. B., & Palod, S. (2016). Philosophical and sociological perspectives of education. R. Lall.
3. Pathak, R. P. (n.d.). Philosophical and sociological perspectives of education. Atlantic Publishers & Dist.
4. Ranganathan, N. (2017). Indian philosophy of education: Contemporary perspectives. Routledge India.
5. Sharma, R. K. (2018). Traditional education systems in India: Historical perspectives. Concept Publishing Company.

Course Outcomes (COs):

After completing this course, students will be able to:

1. Articulate the fundamental concepts of educational philosophy and their relationships with teaching practices
2. Compare and contrast various Indian and Western philosophical schools of thought and their educational implications
3. Design educational strategies based on the teachings of prominent educational thinkers
4. Implement value-based education approaches in diverse educational settings
5. Develop innovative pedagogical approaches that blend traditional wisdom with contemporary educational needs

EDPC42	CONTENT CUM PEDAGOGY OF CHEMISTRY AT SECONDARY STAGE - I	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. To understand the nature, scope and importance of Chemistry.
2. To realize the aims and objectives of teaching chemistry for sustainable development of society.
3. To gain knowledge about different approaches deals in teaching of chemistry.
4. To develop knowledge to select appropriate teaching method for a particular content of chemistry.
5. To develop knowledge to select appropriate innovative and new teaching method for a particular content of chemistry.

Course Content:

Introduction to Chemistry
Chemistry: Meaning, Nature, scope, and its importance - Historical perspective of Chemistry - Contributions of Indian (ancient and modern) and other scientists: Chemistry, society and human and sustainable development - Recommendations/suggestions of various committees, commissions, and policies in reference to Chemistry.

Aims and Objectives of Teaching Chemistry
Teaching Physical Science: Aims, objectives and values - Learning outcomes and competencies of teaching Chemistry at secondary stage – Bloom' taxonomy and Anderson modification of Bloom's taxonomy Linkages of Chemistry with other school subjects and place of the Chemistry in school curriculum - Impact of Physical Science: scientific attitude and appreciating other systems of knowledge / alternative knowledge systems.

Pedagogical Approaches of Chemistry
Physical Science Approaches and its implications: inductive, deductive, constructivist, experiential learning, art integrated learning, sports integrated learning, blended learning, interdisciplinary and multidisciplinary approaches - Analytical pedagogical concerns: fostering higher order thinking skills (critical, creative, communication, decision making, and reflective skills)

Methods of Teaching Chemistry - I
Teaching Methods: Meaning, Definition and basics in selecting teaching methods – Different Teaching Methods: learner-centric and group-centric, lecture cum demonstration, activity based, Team Teaching, discussion, problem-solving, laboratory method.

Methods of Teaching Chemistry - II
Teaching tactics, Personalized System of Instruction, Programmed Learning, Teaching machine, stem and steam, project based, scientific inquiry, hands on activity, discovery, experimentation, concept- mapping, collaborative and cooperative learning, cybernetics, flipped classroom and blended learning.

Suggestive Practicum (Any Three):

1. Explore contributions of Indian scientists in the development of Chemistry and make presentations on historical development of Chemistry.
2. Analyze recommendations of policies/commissions in context of Chemistry.
3. Develop concept maps on different concepts of Chemistry.
4. Identify and integrate values in Chemistry concepts.
5. Demonstrate different pedagogical approaches and strategies for transacting concepts of Chemistry.
6. Prepare write-ups on the teaching of science using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project assigned by HEI.

Suggestive Reading Material:

1. National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
2. National Education Policy 2020, MoE, Government of India.
3. National Steering Committee for National Curriculum Frameworks,(2023). Draft National Curriculum Framework for School Education.
4. NCERT, Textbooks of Physical Sciences at Secondary Stage.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primary and Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. Judith Bennett (2003) Teaching and Learning Science: A guide to recent research and its applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action Basic Books. ISBN: 0465068782.
6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explore the nature, scope and importance of Chemistry.
2. Draft the aims and objectives of teaching Chemistry for sustainable development of society.
3. Select and adopt appropriate approaches in their teaching of physical science.
4. Select appropriate teaching method for a particular content of Physical Science.
5. Select appropriate innovative and new teaching method for a particular content of Physical Science.

EDPC42	CONTENT CUM PEDAGOGY OF MATHEMATICS AT SECONDARY STAGE - I	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Examine the historical development of Mathematics and its contribution to Indian Knowledge Systems
2. Understand the fundamental nature of Mathematics and its significance in human development
3. Analyze educational policies and recommendations pertaining to Mathematics education
4. Develop proficiency in formulating learning objectives and outcomes for Mathematics teaching
5. Master various pedagogical approaches and methods for effective Mathematics instruction

Course Content:

Foundations and Historical Perspectives of Mathematics

Historical development of Mathematics with special emphasis on Indian contributions-Nature of mathematical knowledge including axioms, postulates, and conjectures-Mathematical reasoning: inductive and deductive approaches-Mathematical modelling and its applications- Significance of mathematical knowledge in daily life contexts.

Policy Framework and Curricular Aspects

Analysis of recommendations from various committees and commissions regarding Mathematics education-Detailed examination of National Education Policies and National Curriculum Frameworks with respect to Mathematics teaching at the secondary level-Evolution of Mathematics education policies and their implementation strategies.

Aims, Objectives, and Learning Outcomes

Comprehensive understanding of aims and objectives in Mathematics education at the secondary level-Development of learning outcomes and competencies- Integration of Mathematics with other school subjects-Strategies for value inculcation through Mathematics teaching-Position of Mathematics in the school curriculum framework.

Pedagogical Approaches in Mathematics

Implementation of various teaching approaches including inductive-deductive, analytical-synthetical, and constructivist methods-Integration of blended learning, experiential learning, and trans/inter/multidisciplinary approaches- Development of learner-centric and participative teaching methods including lecture-demonstration, problem-solving, laboratory work, and project-based learning.

Advanced Pedagogical Techniques

Development of higher-order thinking skills through mathematical instruction: critical thinking, creative problem-solving, decision-making, and reflective thinking. Implementation of collaborative and cooperative learning strategies- Integration of various teaching techniques including oral instruction, written work, drill exercises, supervised study, concept mapping, and art/sports integrated learning approaches.

Suggestive Practicum (Any Three):

1. Prepare a collage/ biographic sketch on the contribution of Indian mathematician.
2. Present a paper on comparison of nature of mathematical knowledge with other school subjects.
3. Formulate objectives based on learning outcomes and experiential learning for any one unit of secondary Mathematics.
4. Develop strategy to connect any three topics for value inculcation in teaching of Mathematics.
5. Analyze the content of one chapter of Mathematics textbook and develop concept maps at secondary stage.
6. Select and list approaches and methods for teaching various topics of secondary stage Mathematics.
7. Any other project assigned by HEI.

Reference Books

1. Cooney, T. J., & Others. (1983). *Dynamics of teaching secondary school mathematics*. Boston: Houghton Mifflin. ISBN: 978-0881330618.
2. Iglewiez, B., & Stoyle, J. (1973). *An introduction to mathematical reasoning*. New York: The McMillan Company. ISBN: 978-0023596001.
3. James, A. (2014). *Methods of teaching mathematics*. Hyderabad: Neelkamal Publications Pvt Ltd. ISBN: 978-8183165648.
4. Sahni, M. (2020). *Pedagogy of mathematics*. New Delhi: Vikas Publishing. ISBN: 978-9353383275.
5. Saraswati Amma, T. A. (2017). *Geometry in ancient and medieval India* (2nd ed.). New Delhi: Motilal Banarsidass. ISBN: 978-8120813441.
6. Stillwell, J. (2010). *Mathematics and its history* (Undergraduate Texts in Mathematics). New York: Springer-Verlag New York Inc. ISBN: 978-1441960528.

Course Outcomes:

After successfully completing this course, the prospective teachers will be able to:

1. Integrate Indian mathematical knowledge systems into contemporary teaching practices
2. Apply mathematical principles to solve real-world problems and demonstrate their relevance
3. Implement policy recommendations to enhance Mathematics education at the secondary level
4. Design learning objectives aligned with specific mathematical competencies and outcomes
5. Utilize diverse teaching approaches to foster mathematical understanding and value development

EDPC42	CONTENT CUM PEDAGOGY OF PHYSICS AT SECONDARY STAGE - I	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. To understand the nature, scope and importance of Physics.
2. To realize the aims and objectives of teaching Physics for sustainable development of society.
3. To gain knowledge about different approaches deals in teaching of physical science.
4. To develop knowledge to select appropriate teaching method for a particular content of Physical Science.
5. To develop knowledge to select appropriate innovative and new teaching method for a particular content of Physical Science.

Course Content:

Introduction to Physics

Physics: Meaning, Nature, scope, and its importance - Historical perspective of Physics - Contributions of Indian (ancient and modern) and other scientists: Physics, society and human and sustainable development - Recommendations/suggestions of various committees, commissions, and policies in reference to Physics.

Aims and Objectives of Teaching Physics

Teaching Physical Science: Aims, objectives and values - Learning outcomes and competencies of teaching Physics at secondary stage – Bloom' taxonomy and Anderson modification of Bloom's taxonomy Linkages of Physics with other school subjects and place of the Physics in school curriculum - Impact of Physical Science: scientific attitude and appreciating other systems of knowledge / alternative knowledge systems.

Pedagogical Approaches of Physics

Physical Science Approaches and its implications: inductive, deductive, constructivist, experiential learning, art integrated learning, sports integrated learning, blended learning, interdisciplinary and multidisciplinary approaches - Analytical pedagogical concerns: fostering higher order thinking skills (critical, creative, communication, decision making, and reflective skills)

Methods of Teaching Physics - I

Teaching Methods: Meaning, Definition and basics in selecting teaching methods – Different Teaching Methods: learner-centric and group-centric, lecture cum demonstration, activity based, Team Teaching, discussion, problem-solving, laboratory method.

Methods of Teaching Physics - II

Teaching tactics, Personalized System of Instruction, Programmed Learning, Teaching machine, stem and steam, project based, scientific inquiry, hands on activity, discovery, experimentation, concept- mapping, collaborative and cooperative learning, cybernetics, flipped classroom and blended learning.

Suggestive Practicum (Any Three):

1. Explore contributions of Indian scientists in the development of Physics and make presentations on historical development of Physics.
2. Analyze recommendations of policies/commissions in context of Physics.
3. Develop concept maps on different concepts of Physics.
4. Identify and integrate values in Physics concepts.
5. Demonstrate different pedagogical approaches and strategies for transacting concepts of Physics.
6. Prepare write-ups on the teaching of science using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project assigned by HEI.

Suggestive Reading Material:

1. National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
2. National Education Policy 2020, MoE, Government of India.
3. National Steering Committee for National Curriculum Frameworks,(2023). Draft National Curriculum Framework for School Education.
4. NCERT, Textbooks of Physical Sciences at Secondary Stage.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primary and Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. Judith Bennett (2003) Teaching and Learning Science: A guide to recent research and its applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action Basic Books. ISBN: 0465068782.
6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explore the nature, scope and importance of Chemistry.
2. Draft the aims and objectives of teaching Chemistry for sustainable development of society.
3. Select and adopt appropriate approaches in their teaching of physical science.
4. Select appropriate teaching method for a particular content of Physical Science.
5. Select appropriate innovative and new teaching method for a particular content of Physical Science.

EDPC43	ART IN EDUCATION (PERFORMING AND VISUAL) - II	L	T	P	C
		1	0	1	2

Course Objectives:

The Objectives of the course are,

1. To develop art appreciation with special reference to relevance and place of Art in human life.
2. To acquaint with conceptual understanding of the key ideas of Art Education.
3. To discuss critically the value development in Art Education.
4. To understand the implications of Art in Education.
5. To sensitize towards the problems and pedagogical issues in Art Education.

Course Content:

Art and Education

Art and Education: Conceptual clarity, relationship, and significance of studying art education with special reference to place of art in Human life - Historical development of art education in school education - Goals of studying art education in school curriculum at different stages - Studying art education across the curriculum: Perspective of NEP, 2020 on Art Education.

Theoretical Consideration of Art Education

Theoretical Consideration of Art Education - Philosophical, psychological and sociological perspective of Art Education - Formal and informal theories of art - Indian perspective of art in life - Western perspective of art in life - Critical analysis of theories of Art Education.

Fundamental of Art Education

Fundamentals of Art Education - Literature of Art Education - Conceptual clarity of the following basic concepts of art at school level: aesthetics, criticism and judgment at school level, beauty, reality, idea, truth, taste, sense – Basic requirements of teaching learning art at school across stages - Question of social ethics.

Pedagogical Issues of Art Education

Pedagogical Issues of Art Education - Approaches to teaching-learning process of Art Education - Curriculum of art education with special to challenges of developing curriculum - Material production and its challenges -Assessment and Evaluation strategies with special reference to challenges.

Criteria for Analyzing Art Education

Criterion of analyzing: curriculum of Art Education, teaching-learning material, assessment and evaluation strategies, teaching strategies of art at school level - Values in Art teaching.

Suggestive Practicum:

1. Preparing multimedia material for Art Education in senior secondary schools.
2. Preparation of instructional material for education in the arts for secondary school.
3. Organizing the Art Club.
4. Case studies of the children's work of art and their understanding of the concept of Art.

Reference Books:

1. Rajesh Gill. (2017). A Textbook of Art Education, Paragon International Publishers. ISBN: 978- 9383154524.
2. Janardan Prasad.(2020). Art Education, Kanishika Publishers, Delhi. ISBN: 978-8173917271.
3. Muneesh Kumar, Munish Kumar.(2010). Fundamentals of Visual Arts, Doaba Pulications. ISBN: 978-9391011055.
4. Munesh Mumar. (2019). Mrama and Art in Education, Foundation Publishing House. ISBN:9789388453615.
5. Prasad Janardan. (2016). Art Education, Prasad Janardan. ISBN:9788173917769.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Realizes the appreciation with special reference to relevance and place of Art in human life.
2. Develop new key ideas of Art Education.
3. Improve the values of Art Education.
4. Use concepts of Art Education in their teaching-learning process.
5. Identify the problems and pedagogical issues in Art Education and solve it.

SEMESTER 5

EDPC51	CONTENT CUM PEDAGOGY OF CHEMISTRY AT SECONDARY STAGE - II	L	T	P	C
		4	0	0	4

Course Objectives:
The Objectives of the course are,

1. To know the teaching learning aids / materials and illustrate their importance in teaching learning the concepts of chemistry,
2. To understand the different teaching aids/materials/learning resources,
3. To know the teaching learning aids/material/kits/learning resources for teaching learning the concepts of chemistry,
4. To understand the content of physics text books at secondary stage,
5. To get knowledge of lesson plan based on learning out comes and experiential learning using appropriate strategies.

Course Content:

Micro Teaching
Micro-Teaching: Concept, Definition, need and importance, Merits and demerits, micro-teaching cycle – Feedback devices: definition, types, feedback forms – Teaching Skills: Skill of introduction, explaining, closure, stimulus variation, probing questions, reinforcement, questioning, illustrating with examples, divergent questions, lecturing, discussion, demonstration, interaction, communication, classroom management, using teaching aids and blackboard usage – Integration strategy - link practice: meaning and importance, merits and demerits – Macro-teaching: Meaning, definition, importance, merits and demerits.

Teaching and Learning Resources - I
Teaching-learning aids/materials: concept, definition, role and importance in classroom teaching learning the chemistry – Edger Dale Cone of Experiences – Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print materials - digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Multimedia – Other resources: teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, and worksheets.

Teaching and Learning Resources - II
Digital Resources: Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom - Local Environmental Resources: Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, chemistry clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

Planning For Teaching Physical Science
Pedagogical analysis of content taking examples from topics of chemistry textbooks at secondary stage – Teaching-learning Planning: Concept, types, steps and importance of Annual Planning, Unit Planning and Lesson Planning - Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of chemistry at secondary stage - Steps in planning for

Teaching Physical Science: identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.

Science Teacher and Science Lab

Science Teacher: Essential qualification, Professional Qualification, duty, role, responsibility in student career - Science Laboratory: structure of the lab, storage of equipments, improvised apparatus, first aid box and first aid activities, organizing practical, laboratory manuals, Laboratory blackboard, demonstration table, and laboratory instructional cards- Laboratory Registers.

Suggestive Practicum (Any Three):

1. Develop e-content for the concepts of Chemistry at Secondary Stage.
2. Analyze the content of textbooks of Chemistry (Classes9-12).
3. Identify the learning resources for transiting the concepts of Chemistry.
4. Develop teaching aids/teaching materials for teaching concepts of Chemistry at secondary stage.
5. DeveloplearningoutcomesfortheconceptsofPhysicalsciencesatthesecondary stage.
6. Prepare learning outcomes and experiential learning-based lesson plan for the concepts of Chemistry.
7. DevelopaprojectontheconceptsofPhysicalSciencesusinginterdisciplinaryand multidisciplinary approaches as recommended in NEP 2020.
8. Any other project assigned by HEI.
9. Prepare a model first aid box.
10. Prepare any three improvised apparatus.

Suggestive Reading Materials:

1. Draft National Curriculum Framework for School Education, Laboratory Manual of Science (Grade 9 & 10), NCERT.
2. NationalEducationPolicy2020, MoE, Government of India.
3. National Steering Committee for National Curriculum Frameworks, (2023). NCERT Laboratory Manuals.
4. NCERT Textbooks, Chemistry for Class XI and XII.
5. NCERT Textbooks, Physics for Class XI and XII.
6. NCERT Textbooks, Science for Class IX and XI.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primaryand Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. JudithBennett(2003)TeachingandLearningScience:Aguidetorecentresearchandits applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. CarinAandBRSund(1964),TeachingSciencethroughDiscovery,CharlesE.Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action BasicBooks. ISBN: 0465068782.

6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Identify teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Chemistry,
2. Categorize the teaching aids/materials/learning resources,
3. Develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Chemistry,
4. Analyze the content of chemistry text books at secondary stage,
5. Develop lesson plan based on learning out comes and experiential learning using appropriate strategies.

EDPC51	CONTENT CUM PEDAGOGY OF MATHEMATICS AT SECONDARY STAGE – II	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the nature, types, and importance of teaching-learning resources for Mathematics and utilize them effectively in secondary school classrooms
2. Analyze Mathematics content to identify key concepts and plan structured annual, unit, and lesson plans using appropriate pedagogical strategies
3. Create inclusive classroom environments that cater to diverse learners and foster collaborative Mathematics learning communities.
4. Integrate ICT tools and platforms to enhance teaching, learning, and assessment in Mathematics.
5. Design and manage Mathematics resource rooms, virtual laboratories, and co-curricular activities to support student engagement and learning.

Course Content:

Teaching Learning Resources in Mathematics

Teaching-learning materials: significance and application in secondary Mathematics-Classification and utilization of resources including print media, digital media, and manipulative-Understanding the role of textbooks, teacher manuals, laboratory manuals, charts, models, and web resources in Mathematics instruction.

Resource Management and Organization

Local environment and community resources in Mathematics education-Mathematics resource room organization and management- Virtual laboratories concept and implementation-Mathematics club activities, fairs, and exhibitions- Development of learner communities and resource pooling strategies.

Content Analysis and Lesson Planning

Mathematical content analysis: axioms, concepts, rules, formulas, theorems, and corollaries-Pedagogical content knowledge of arithmetic, algebra, geometry, mensuration, and trigonometry-Development of inclusive lesson plans based on learning outcomes and competencies.

Teaching Strategies and Methods

Annual planning, unit planning, and lesson planning frameworks-Method-based lesson planning strategies: inductive-deductive, analytical-synthetical, lecture-demonstration, problem-solving, laboratory, and project-based approaches-Building mathematical communities in classrooms.

ICT Integration in Mathematics Teaching

ICT implementation in mathematics education: digital repositories, AR/VR/AI resources, open educational resources, and interactive tools-Utilization of educational platforms: GeoGebra, Khan Academy, DIKSHA, SWAYAM-Development of ICT-integrated lesson plans using the TPCK framework.

Suggestive Practicum (Any Three):

1. Develop learning resources for Mathematics teaching-learning.
2. Prepare an annual plan for any secondary class.
3. Prepare a unit plan from the Mathematics textbook at the secondary stage.
4. Prepare learning outcomes-based lesson plan using experiential learning for any one topic of Mathematics at the secondary stage.
5. Develop a lesson plan on a topic of Mathematics at secondary stage by integrating ICT tools.
6. Write a script for developing e-content on any one topic of Mathematics for online teaching.
7. Any other Project assigned by HEI.

Reference Books

1. Cooney, T. J., & Others. (1983). *Dynamics of teaching secondary school mathematics*. Boston: Houghton Mifflin. ISBN: 978-0881330618.
2. Iglewiez, B., & Stoyle, J. (1973). *An introduction to mathematical reasoning*. New York: The McMillan Company. ISBN: 978-0023596001.
3. James, A. (2014). *Methods of teaching mathematics*. Hyderabad: Neelkamal Publications Pvt Ltd. ISBN: 978-8183165648.
4. Sahni, M. (2020). *Pedagogy of mathematics*. New Delhi: Vikas Publishing. ISBN: 978-9353383275.
5. Saraswati Amma, T. A. (2017). *Geometry in ancient and medieval India* (2nd ed.). New Delhi: Motilal Banarsidass. ISBN: 978-8120813441.
6. Stillwell, J. (2010). *Mathematics and its history* (Undergraduate Texts in Mathematics). New York: Springer-Verlag New York Inc. ISBN: 978-1441960528.

Course Outcomes:

After completing this course, students will be able to,

1. Demonstrate the ability to select, create, and use various teaching-learning resources effectively for Mathematics instruction
2. Develop comprehensive annual, unit, and lesson plans using appropriate pedagogical strategies for secondary Mathematics
3. Apply inclusive teaching practices to address diverse learning needs and build a collaborative Mathematics learning environment
4. Utilize ICT tools and platforms to design and deliver engaging Mathematics lessons and assessments
5. Organize and manage Mathematics resource rooms, virtual laboratories, and co-curricular activities to enhance student learning and engagement

EDPC51	CONTENT CUM PEDAGOGY OF PHYSICS AT SECONDARY STAGE – II	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. To know the teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Physics,
2. To understand the different teaching aids/materials/learning resources,
3. To know the teaching learning aids/material/kits/learning resources for teaching learning the concepts of Physics,
4. To understand the content of physics text books at secondary stage,
5. To get knowledge of lesson plan based on learning out comes and experiential learning using appropriate strategies.

Course Content:

Micro Teaching
Micro-Teaching: Concept, Definition, need and importance, Merits and demerits, micro-teaching cycle – Feedback devices: definition, types, feedback forms – Teaching Skills: Skill of introduction, explaining, closure, stimulus variation, probing questions, reinforcement, questioning, illustrating with examples, divergent questions, lecturing, discussion, demonstration, interaction, communication, classroom management, using teaching aids and blackboard usage – Integration strategy - link practice: meaning and importance, merits and demerits – Macro-teaching: Meaning, definition, importance, merits and demerits.

Teaching and Learning Resources - I
Teaching-learning aids/materials: concept, definition, role and importance in classroom teaching learning the physics – Edger Dale Cone of Experiences – Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print materials - digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Multimedia – Other resources: teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, and worksheets.

Teaching and Learning Resources - II
Digital Resources: Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom - Local Environmental Resources: Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, physics clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

Planning For Teaching Physics
Pedagogical analysis of content taking examples from topics of physics textbooks at secondary stage – Teaching-learning Planning: Concept, types, steps and importance of Annual Planning, Unit Planning and Lesson Planning - Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of physics at secondary stage - Steps in planning for Teaching Physical Science: identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.

Science Teacher and Science Lab
Science Teacher: Essential qualification, Professional Qualification, duty, role, responsibility

in student career - Science Laboratory: structure of the lab, storage of chemical, improvised apparatus, first aid box and first aid activities, organizing practical, laboratory manuals, Laboratory blackboard and demonstration table, and laboratory instructional cards – Laboratory Registers.

Suggestive Practicum (Any Three):

1. Develop e-content for the concepts of Physics at Secondary Stage.
2. Analyze the content of textbooks of Physics (Classes 9-12).
3. Identify the learning resources for transiting the concepts of Physics.
4. Develop teaching aids/teaching materials for teaching concepts of Physics at secondary stage.
5. DeveloplearningoutcomesfortheconceptsofPhysicalsciencesatthesecondary stage.
6. Preparelearningoutcomesandexperientiallearning-basedlessonplanforthe concepts of Physics.
7. Develop a project on the concepts of Physical Sciencesusinginterdisciplinaryand multidisciplinary approaches as recommended in NEP 2020.
8. Any other project assigned by HEI.

Suggestive Reading Materials:

1. Draft National Curriculum Framework for School Education, Laboratory Manual of Science (Grade 9 & 10), NCERT.
2. NationalEducationPolicy2020, MoE, Government of India.
3. National Steering Committee for National Curriculum Frameworks, (2023). NCERT Laboratory Manuals.
4. NCERT Textbooks, Chemistry for Class XI and XII.
5. NCERT Textbooks, Physics for Class XI and XII.
6. NCERT Textbooks, Science for Class IX and XI.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primaryand Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. JudithBennett(2003)TeachingandLearningScience:Aguidetorecentresearchandits applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. CarinAandBRSund(1964),TeachingSciencethroughDiscovery,CharlesE.Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action BasicBooks. ISBN: 0465068782.
6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Identify teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Physics,
2. Categorize the teaching aids/materials/learning resources,
3. Develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Physics,
4. Analyze the content of physics text books at secondary stage,
5. Develop lesson plan based on learning out comes and experiential learning using appropriate strategies.

EDPC52	ICT IN EDUCATION	L	T	P	C
		1	0	1	2

Course Objectives:

The Objectives of the course are

1. To know the concept, nature, and scope of ICT in education.
2. To understand the importance of open-source software in education.
3. To gain knowledge about various approaches to the adoption and use of ICT in education.
4. To know the importance of various emerging technologies in education.
5. To understand the use of technological tools for improving teaching-learning-assessment processes.

Course Content:

Introduction to ICT

ICT: Meaning, Nature, importance of Information Technology, Communication Technology & Information and Communication Technology (ICT) and Instructional Technology - Educational Technology and ICT in Education: Difference - Scope of ICT: Teaching, learning, Research & Publication Educational Administration and Assessment.

Engagement with Technology

Internet, Collaborative learning through Online Discussion Forums, group assignments & Peer reviews - System Approach in instructional design: Meaning, components, steps and Uses - Models of Development of Instructional Design: ADDIE, ASSURE, Dick and Carey Model Mason's - Flanders' Interaction Analysis Category System (FIACS) - Challenges relating to Educational Technology.

Emerging Technologies in Education

E-learning Concept, methods, and media - LMS, Virtual Universities, Massive Open Online Course (MOOCs), Indian MOOCs, Types of MOOCs: cMOOCs, xMOOCs& LMOOCs. Open Education Resources (Creative Commons, Concept, and application) - Augmented reality, Virtual reality, Artificial intelligence, Mixed Reality & Gamification in education (Meaning, history, importance, tools and uses) - Cloud Computing & Internet of Things - Meaning, importance and uses - Ethical issues & safety in ICT: Teaching, Learning and Research, Cyber bullying, Cyber security literacy & data protection, Online identity and privacy.

ICT in Teaching-Learning

ICT in Teaching-Learning & Assessment: Concept, Approaches to integrating ICT in teaching and learning: Technological Pedagogical Content Knowledge (TPCK), Technology Integration Matrix (TIM) - Implication of Learning Theories in ICT in Education: Behaviourism, Cognitivism & Constructivism - Developing functional skills to use discipline specific ICT tools: Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping etc.

ICT in Assessment

ICT and Assessment- Electronic assessment portfolio – Concept and types; e-portfolio tools. Online and offline assessment tools – Rubrics, survey tools, puzzle makers, test generators,

reflective journal, question bank. ICT applications for Continuous and Comprehensive Evaluation (CCE).

Suggestive Practicum:

1. Prepare an assessment tool on any one chapter of the textbook.
2. Explore any one online platform for MOOCs and prepare are port highlight in gits structure and courses.

Reference Books:

1. Gwen Solomon, Lynne Schrum. (2014). Web 2.0 How-to for Educators, Second Edition. ISTE.
2. Jean-Eric Pelet. (2014). E-Learning 2.0 Technologies and Web Applications in Higher Education (Advances in Higher Education and Professional Development (Ahepd)). Idea Group: U.S. ISBN: 978- 1466648760.
3. Ronghuai Huang and Kinshuk. (2014). ICT in Education in Global Context: Emerging Trends Report 2013-2014 (Lecture Notes in Educational Technology). Springer: New York. ISBN: 978-3662439265
4. Curtis J. Bonk. (2011). The World Is Open: How Web Technologyis Revolutionizing Education. Jossey- Bass: San Fransisco. ISBN: 978-0470461303.
5. Andrew A Kling. (2010). Web2.0 (Technology 360). Lucent Books: New Delhi. ISBN:978-1420501711.
6. Semenov, Alexy. (2005). Information and Communication Technologies in Schools. A handbook for Teachers. UNESCO.
7. Andrew M.St. Laurent. (2004). Understanding Open Source and Free Software Licensing. Oreilly: Cambridge. ISBN: 978-0596553951.
8. James, K.L.(2003). The Internet: A User's Guide. Prentice Hall of India Pvt. Ltd., NewDelhi. ISBN: 978-8120340299
9. Bharihok Deepak. (2000). Fundamentals of Information Technology. Pentagon Press: New Delhi. ISBN: 978-8174464811
10. Crumlish Christian. (1999). The Internet No Experience Required. BPB Publications: New Delhi. ISBN: 978-8176560535.
11. Evant, M.(1989). The International Encyclopedia of Educational Technology. ISBN:978-0080334097.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the concept, nature, and scope of ICT in education.
2. Describe the importance of open-source software in education.
3. List and explain various approaches to the adoption and use of ICT in education.
4. Describe the importance of various emerging technologies in education.
5. Identify and explore the relationship between the social, economic, and ethical issues associated with the use of ICT.
6. List out the challenges of educational technology in India and find out solution for it.
7. Use various technological tools for improving teaching-learning-assessment processes.

EDPC53	INTERNSHIP IN MICRO-TEACHING	L	T	P	C
		0	0	2	2

Course Objectives:

The Objectives of the course are,

1. To get experience on teaching by observing the micro teaching performed by the teacher educator (demonstration lessons),
2. To acquire experience about the teaching skills and its components,
3. To gain knowledge about to prepare lesson plan through micro lesson plans,
4. To evaluate the teaching skills usage by using different feedback mechanism, and
5. To be prepared for the school observation of real teaching.

Course Content:

Internship Activities:

The internship in micro-teaching is mandatory for the school internship and it will include the teaching practice at micro class level for three to four weeks. The micro class includes 5-6 peer prospective teachers and prospective teacher will practice with one teaching skills for 5 to 6 minutes followed by combination of skills (minimum 3 skills) for 16-20 minutes. At the end of the practice, the prospective teacher will present the impact of the internship either in individual or group.

Suggestive Practicum:

1. Practice of teaching skills' component identification and execution.
2. Practice micro-teaching with minimum of 8 skills separately from the following in the peer group and equip the teaching skills with successful feedback (Assessment/Evaluation forms).
    i. Skill of Set Induction,
    ii. Skill of Explaining,
    iii. Skill of Achieving Closure,
    iv. Skill of Stimulus Variation,
    v. Skill of Reinforcement,
    vi. Skills of Blackboard Usage
    vii. Skill of Probing Questions
    viii. Skill of Illustrating with Examples
    ix. Skill of Divergent Questions
    x. Skill of Lecturing
    xi. Skill of Discussion
    xii. Skill of Demonstration
    xiii. Skill of Interaction
    xiv. Skill of Communication
    xv. Skill of Classroom Management
    xvi. Skill of Using Teaching Aids

3. Minimum of three link practices can be done with the integration of three relative teaching skills.
4. Writing lesson plans for micro-teaching, link practice and macro teaching.
5. Discussion of impact of the practice (individual/group)

Record Writing:

Prospective teachers should submit the record with the introduction of micro-teaching, link practice and macro-teaching with its respective lesson plans followed by the impact of the prerequisite internship, discussion and conclusion.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Execute the teaching skills in their teaching activities.
2. Manipulate the components of the teaching skills in appropriate place the teaching progress.
3. Develop lesson plans for a skill, and integration of skills for their teaching.
4. Update their teaching performance with required skills and its components.
5. Ready to execute the school internship practices.

EDPC54	PRE-INTERNSHIP PRACTICE	L	T	P	C
		0	0	2	2

Course Objectives:

The Objectives of the course are,

1. To acquire various pedagogic practices, classroom management skills, assessment tools and learning standards,
2. To get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons),
3. To gain knowledge about to develop lesson plans to transact them using appropriate pedagogies and learning resources,
4. To develop and practice teaching skills in a guided environment to be an effective teacher,
5. To be prepared for the school internship.

Course Content:

Internship Activities:

The pre-internship will include activities relating to the stage-specific pedagogy courses, ability enhancement and value-added courses and foundation courses transacted during previous semesters. It will also include knowledge of pedagogy, formats of lesson plans, different ICT tools, schooling systems in India, and principles of classroom management, assessment, and other relevant content.

Suggestive Practicum:

1. Orientation of student teachers to different pedagogic approaches like storytelling, art-integrated, sports-integrated, project-based, and ICT-integrated for developing critical thinking, attention to life aspirations, and greater flexibility and classroom management skills.
2. Observation of the lesson demonstrated by teacher educators/experts in the institute.
3. Designing guided activities, including a laboratory for each class/subject based on learning outcomes.
4. Study Secondary Stage Learning Standards in the NCF.
5. Content analysis and development of the unit plan, concept map and lesson plan.
6. Discussion on unit plan and lesson plan with teacher educators/experts.
7. Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
8. Participate in discussions/reflective sessions for conceptualizing teaching-learning practices.
9. Exploring available learning resources and educational videos.
10. Developing local, low-cost, and innovative TLMs.
11. Reading and reflecting on inspiring books on pedagogic practices.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Utilize pedagogic practices, classroom management skills, assessment tools and learning standards in their teaching.
2. Conduct the classes by observing lessons transacted by teacher educators (demonstration lessons).
3. Develop lesson plans to transact them using appropriate pedagogies and learning resources.
4. Develop and practice teaching skills in a guided environment to be an effective teacher.
5. Ready to execute the school internship.

SEMESTER 6

EDPC61	ASSESSMENT AND EVALUATION	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to:

1. Understand the fundamental concepts, significance, and purposes of assessment, measurement, and evaluation in education.
2. Differentiate between various types and forms of assessment and apply them appropriately in the teaching-learning process.
3. Utilize various assessment methods, tools, and techniques to evaluate students' learning.
4. Analyze and interpret assessment data using statistical tools, grading systems, and graphical representations.
5. Explore modern trends, challenges, and ethical considerations in assessment, including the use of AI.

Course Content:

Fundamentals of Assessment and Evaluation

Meaning and importance of assessment, measurement, evaluation, and examination- Differences between assessment, measurement, appraisal, and evaluation- Learning outcomes: concept, importance, and stages- Bloom's Taxonomy (Revised in 2001) and its implications in assessment- Purposes of assessment: assessment for learning, of learning, and as learning.

Types and Forms of Assessment

Concept and characteristics of formative and summative assessment- Diagnostic and prognostic assessment- Internal and external assessment-Authentic assessment, including portfolio assessment, self-assessment, and peer assessment-Online assessment and the role of technology in educational evaluation.

Methods and Tools for Assessment

Approaches to assessment: time-constrained examinations, open/closed book tests, problem-based assignments, practical assignments, and reports-Assessing higher-order thinking skills, including critical thinking, creative thinking, problem-solving, communication skills, decision-making, and ethical reasoning- Tools and techniques of assessment: observation, rating scales, checklists, anecdotal records, interviews, and socio-metric techniques.

Analysis, Interpretation, and Reporting of Assessment

Analyzing student performance using credit and grading systems-Graphical representation of assessment data, including histograms and frequency curves-Interpretation of assessment data and constructive feedback- Documentation and reporting: 360-degree progress reports, cumulative records, portfolios, PTA meetings, and descriptive indicators in report cards.

Innovations and Trends in Assessment and Evaluation

Historical perspectives on educational assessment (1975, 1988, 2000, 2005, 2020)-Emerging trends in educational assessment: competency-based assessment, computerized adaptive

testing, and AI-based assessment tools- Ethical issues and challenges in assessment: bias and fairness in evaluation, ensuring transparency and authenticity in assessment.

Suggestive Practicum (Any Three):

1. Review of various education commission, Policies and reports and NCF 2005 to get a brief view of the recommendations on Assessment and Evaluation.
2. Constructing a unit test using table of specifications.
3. Construction of any one of the tools (rating scale, check list, observation schedule, etc.) and administering it to group of students or using it to observe the school and classroom environment and interpreting it.
4. Analysis of question papers of various Boards.
5. Analysis of report cards - State and Central (CBSE)
6. Preparing format of 360-degree report Card.
7. Review of learning outcomes by NCERT in different subject areas.
8. Interviews with teachers and students to study the assessment practices, issues and problems related to it followed by presentation.
9. Reviewing Assessment Discussions in NPE (2020)

Reference Books

1. Bhatnagar, A. B., & Bhatnagar, A. (2018). *Measurement and evaluation*. R. Lall Publishers & Distributors. ISBN: 9789394132900.
2. Cees, G., Scheerens, J., & Thomas, S. M. (2007). *Educational evaluation, assessment and monitoring*. Routledge Publishers. ISBN: 978-0415447805.
3. Gupta, K. R. (2019). *Statistical methods in education and psychology*. Atlantic Publishers & Distributors Pvt Ltd. ISBN: 9788126921485.
4. Koul, L. (2020). *Methodology of educational research*. Vikas Publishing. ISBN: 978-9353386368.
5. Mangal, S. K., & Mangal, S. (2019). *Assessment for learning*. PHI Learning Pvt. Ltd. ISBN: 9789388028134.
6. Mohan, R. (2016). *Measurement, evaluation and assessment in education*. PHI Learning Pvt Ltd. ISBN: 9789391818876.
7. Reynolds, C. R., Livingston, R., Willson, V., & Jha, A. K. (2017). *Measurement and assessment in education*. Pearson Education. ISBN: 978-9332574502.
8. Sharma, R. S. (2006). *Measurement and evaluation techniques*. ABD Publishers. ISBN: 978-8183760829.
9. Vidyasagar, J. (2016). *Measurement and evaluation in education*. Mahaveer Publications. ISBN: 978-8183166935.

Course Outcomes:

After completing this course, the prospective teachers will be able to,

1. Explain the meaning, significance, and differences between assessment, measurement, and evaluation in the educational context.
2. Design and implement different types of assessments, including formative and summative assessments, to enhance student learning and track progress.
3. Apply appropriate tools and techniques to assess students' cognitive, affective, and psychomotor skills effectively.
4. Analyze student performance using grading systems, histograms, and other statistical representations.
5. Critically examine recent developments and ethical issues in assessment and integrate innovative assessment strategies into their teaching practices.

EDPC62	INCLUSIVE EDUCATION	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to:

1. Understand the concept, significance, and evolution of inclusive education in relation to global and national policies.
2. Analyze various policies, acts, and legal frameworks that support inclusive education, particularly in the Indian context.
3. Identify the diverse learning needs of children with disabilities and marginalized groups and develop appropriate teaching-learning strategies.
4. Apply pedagogical approaches such as Universal Design for Learning (UDL) and curriculum adaptations to foster inclusive classrooms.
5. Develop inclusive assessment strategies that accommodate diverse learners and utilize assistive technology to support evaluation.

Course Content:

Concept and Framework of Inclusive Education

Concept of Inclusive Education: Meaning, significance, and evolution-Relation between Inclusion and Education-UNCRPD (2006) and RPWD Act (2016) with special reference to India-Shifting paradigms: From Disability-Centric to Inclusive View-Bio-centric vs. Human Rights Perspective on Inclusion.

Policies, Acts, and Legal Framework for Inclusive Education

Right to Education Act (2009/2012) and its implications for inclusion-RPWD Act (2016) and its educational impact-National Trust Act (1999): Educational provisions for children with disabilities-National Education Policy (NEP) 2020 and its approach to inclusive education-Frameworks for equity and access in education for marginalized groups.

Understanding Diverse Needs of Learners

Characteristics and educational needs of children with: Sensory impairments (visual, hearing), Cognitive impairments and intellectual disabilities, Physical disabilities, cerebral palsy, and multiple disabilities, Children with behavioural, emotional, and learning disabilities-Health-related issues and their impact on learning-Educational needs of children from marginalized communities

Pedagogical Approaches and Strategies for Inclusion

Conceptual clarity of pedagogical approaches in Inclusive Education-Designing inclusive curricula: Adaptation, modification, differentiation-Universal Design for Learning (UDL) and its application-Creating barrier-free learning environments-Role of assistive devices and technology in inclusive classrooms-Strategies for individualized learning and differentiated instruction.

Assessment and Evaluation in Inclusive Education

Inclusive assessment strategies: Accommodations and modifications-Assessing students with diverse needs: Tools and techniques-Curriculum-based assessment and alternative assessment approaches-Role of formative, summative, and diagnostic assessment in inclusion-Use of technology and assistive devices in assessment-Reporting and documentation in inclusive classrooms

Suggestive Practicum:

1. Developing a checklist for identifying the various needs of children with disabilities.
2. Visiting schools of different categories and talking to parents, teachers, and Children with and without disabilities and listing the problems faced by these children and the families at the local level in gaining access to education.
3. Analyzing RPWD Act 2016 and list its implications for CWD in inclusive settings.
4. Outlining the problems faced by children with Visual Disabilities while learning mathematics and EVS.
5. Giving a few exemplary adaptations based on the Preparatory Level textbooks.
6. Outlining the problems faced by children with hearing impairments while learning language. Give a few exemplar adaptations based on the primary level textbooks.
7. Students work in small groups of 10 or so to prepare a street play highlighting the meaning and provisions of inclusive education.
8. Analyzing the Context of NPE 2020 in the light of Inclusive Education.

Reference Books

1. Maitra, K., & Saxena, V. (2008). *Inclusion: Issues and Perspectives*. Kanishka.
2. Messily, K. (2012). *Confronting Marginalisation in Education: A Framework for Promoting Inclusion*. Routledge.
3. Mithu, A., & Michael, B. (2005). *Inclusive Education: From Rhetoric to Reality*. Viva Books Pvt. Ltd.
4. Oza, D., & Pandit, R. (2011). *Management of behavioural problems of children with mental retardation*. VDM Publication.
5. Premavathy, V., & Geetha, T. (2008). *Integrated and Inclusive Education DSE(VI) Manual*. Krishna Publication.
6. Uppal, S. (2020). *NCERT: Inclusion in Education*. NCERT Campus Sri Aurobindo Marg.

Course Outcomes:

After completing this course, the prospective teachers will be able to,

1. Explain the fundamental concepts, significance, and evolution of inclusive education and its impact on learners
2. Critically examine national and international policies, including RTE (2009), RPWD Act (2016), and NEP 2020, and their implications for inclusive education
3. Design inclusive learning environments that address the needs of children with disabilities and marginalized groups through appropriate curriculum modifications
4. Implement inclusive pedagogical strategies, including Universal Design for Learning (UDL), assistive technology, and barrier-free education
5. Develop and apply effective assessment strategies that ensure equity and inclusivity in evaluating student learning outcomes.

EDPC63	CONTENT CUM PEDAGOGY OF CHEMISTRY AT SECONDARY STAGE - III	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. To understand the significance of acquiring 21st-century skills for Chemistry teaching.
2. To know the need for and importance of assessment and evaluation in the teaching of Chemistry.
3. To gain knowledge of various assessment strategies for continuous assessment in reference to teaching of Chemistry.
4. To obtain knowledge on appropriate tools and techniques for assessment and evaluation in teaching- learning of Chemistry.
5. To identify a problem in the context of Chemistry teaching-learning and plan action research.

Course Content:

21st Century Skill for Learners

21st Century Skills: Need and importance of 21st century skills for learners and teachers of Chemistry – The way to learn 21st century skills - Psychological, sociological, and philosophical perspective of teaching and learning Chemistry - Qualities of a Chemistry teacher as professional for enhancing teaching learning skills - Role of a teacher in facilitating learning and creating dynamic learning environment of Chemistry.

School Activities, Records and Registers

School activities: Organizing assemble activities, curricular and co-curricular activities – Time table: meaning, definition, importance's, principle and types of time table – Records and Registers: admission, teaching, non-teaching and staff attendances, leave registers, movement registers, circular note, stock register, cumulative records, consumable and non-consumable records, sports register, Incoming and outgoing registers, visitors' register, and Anecdotal record

Performance Assessment in Physical Science

Performance assessment: Meaning, definition and uses - assessment of group activities, field observations, recording and reporting, creating platform and portfolio management - Assessment of laboratory: skills, assignments, projects, and presentations – Grading Systems: meaning, definition and advantages – Types: Absolute and relative grading, Merits and demerits of different types of grading.

Tools and Techniques of Assessment and Evaluation

Tools – unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting: planning the test, preparation of items, reviews the items, item analysis – Blueprint –Types of test items and preparing answer key – Basic Statistics: descriptive (mean, median & mode), Deviation Scores (range, average and standard deviation), plateau measure (skewness and kurtosis), item analysis (discrimination and difficult index) and correlation analysis (rho).

Research and Innovative Practices

Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences - Recent trends in research related to teaching learning of Chemistry. - School- based research in Chemistry: case study, cumulative record and action research (meaning, significance, steps and planning).

Suggestive Practicum (Any Three):

1. Prepare, administer, and analyzes cores of an achievement test.
2. Explore AI based assessment tools and prepare an E-Portfolio for a student of Secondary Stage.
3. Conduct Simulated Teaching session for the concepts of Chemistry and observation by self, peer, and teacher.
4. Explore development of multidisciplinary projects and present using PowerPoint.
5. Interpret the concept of Chemistry with Psychological, Sociological and Philosophical Perspective.
6. Apply innovative practices in classroom teaching learning of Chemistry.
7. Make a presentation on the role of Chemistry in sustainable development of society.
8. Plan action research for Continuous Professional Development (CPD) of Chemistry teacher.
9. Any other project assigned by HEI.

Suggestive Reading Material:

1. National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
2. National EducationPolicy2020,MoE,GovernmentofIndia
3. National Steering Committee for National Curriculum Frameworks,(2023). Draft National Curriculum Framework for School Education.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primaryand Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. Judith Bennett (2003) Teaching and Learning Science: A guide to recent research and its applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action Basic Books. ISBN: 0465068782.
6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the significance of acquiring 21st-century skills for Chemistry teaching.
2. Elaborate the need for and importance of assessment and evaluation in the teaching of Chemistry.
3. Appraise with various assessment strategies for continuous assessment in reference to teaching of Chemistry.
4. Utilize appropriate tools and techniques for assessment and evaluation in teaching- learning of Chemistry.
5. Identify recent trends in research related to the teaching and learning and its implications in teaching learning of Chemistry.
6. Prepare unit test item based on TOSS and develop different types of test items.
7. Construct and administer different type of tests.
8. Plan offline and online activities for testing higher order thinking skills in teaching learning of Chemistry.
9. Relate ICT integration and elaborate its use in classroom situations,
10. Identify a problem in the context of Chemistry teaching-learning and find the solution through action research.

EDPC63	CONTENT CUM PEDAGOGY OF MATHEMATICS AT SECONDARY STAGE – III	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the need for 21st-century skills in Mathematics education and apply strategies.
2. Analyze the psychological, sociological, and philosophical perspectives of Mathematics learning and the professional qualities required for Mathematics teachers
3. Develop assessment strategies for Mathematics, including oral, written, and practical evaluations.
4. Explore innovative and research-based approaches to Mathematics teaching, considering diverse student needs and sociocultural influences.
5. Investigate recent trends in Mathematics education, including digital tools, AI applications, and action research.

Course Content:

21st Century Skills in Mathematics Learning and Teaching

Need and importance of 21st-century skills in Mathematics education-

Key skills: Practicing imagination, spatial visualization, mathematical reasoning, and problem-solving-Role of teachers in fostering 21st-century skills-Psychological, sociological, and philosophical perspectives of teaching and learning Mathematics.

Professional Attributes of a Mathematics Teacher

Essential qualities of a Mathematics teacher as a professional-Creating a dynamic and engaging- Mathematics learning environment-Facilitating active learning: Inquiry-based learning, project-based learning, and collaborative strategies-Integrating technology and innovative methods in Mathematics classrooms.

Assessment for Learning in Mathematics

Meaning and need for oral, written, and practical assessments in Mathematics-Types of questions: Objective, short-answer, and long-answer questions-Marking considerations for different question types-Planning and developing teacher-made tests in Mathematics-Table of Specification (TOS), question paper setting, and answer key preparation-Tools to identify learning difficulties and provide corrective measures in Mathematics-360-degree assessment, holistic progress card, and assessment of students' mathematical thinking.

Research and Innovative Practices in Mathematics Teaching

Divergent thinking for innovation in Mathematics education-Research on psychological, sociological, and philosophical perspectives for quality learning experiences-Innovative teaching practices in Mathematics-Exploring gender, class, and cultural issues in Mathematics learning and achievement-Addressing biases, stereotypes, and the "Achievement Gap" in Mathematics classrooms-Constructing learners' identity and engagement in Mathematics education.

Recent Trends and Action Research in Mathematics Education

Emerging research and trends in Mathematics teaching and learning-Digital gaming and digital storytelling for Mathematics education-Use of Artificial Intelligence (AI) in Mathematics teaching and learning-Action research in Mathematics education: Meaning, significance, steps, and planning-Designing action research for solving classroom challenges in Mathematics.

Suggestive Practicum (Any Three):

1. List 21st century skills with reference to various topics of school Mathematics.
2. Writing a paper on recent trends and research related to teaching learning of Mathematics.
3. Prepare a scrap book for 'Mathematics in Print Media'.
4. Prepare a small video for recent trends of Mathematics in social media.
5. Plan a teacher made test for a unit of secondary Mathematics.
6. Prepare a report after using an innovative idea to teach a difficult topic of secondary Mathematics.
7. Plan for action research on any one problem of teaching learning Mathematics.
8. Any other project assigned by HEI

Reference Books

1. Cooney, T. J., et al. (1983). *Dynamics of Teaching Secondary School Mathematics*. Houghton Mifflin.
2. Iglewiez, B., & Stoyle, J. (1973). *An Introduction to Mathematical Reasoning*. Macmillan.
3. James, A. (2014). *Methods of Teaching Mathematics*. Neelkamal Publications Pvt Ltd.
4. Sahni, M. (2020). *Pedagogy of Mathematics*. Vikas Publishing.
5. Saraswati Amma, T. A. (2017). *Geometry in Ancient and Medieval India* (2nd ed.). Motilal Banarsidass.
6. Stillwell, J. (2010). *Mathematics and its History* (Undergraduate Texts in Mathematics). Springer-Verlag New York Inc

Course Outcomes:

After completing this course, the prospective teachers will be able to:

1. Explain the role of 21st-century skills in mathematics education and demonstrate methods to integrate them into teaching practices.
2. Identify and apply professional teaching attributes to create an effective and inclusive Mathematics learning environment
3. Design, implement, and evaluate assessment tools in Mathematics education, ensuring effective measurement of student learning outcomes
4. Apply innovative teaching strategies and conduct research on sociocultural influences, diversity, and engagement in Mathematics classrooms.
5. Utilize recent technological advancements and conduct action research to address challenges in Mathematics teaching.

EDPC63	CONTENT CUM PEDAGOGY OF PHYSICS AT SECONDARY STAGE - III	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. To understand the significance of acquiring 21st-century skills for Physics teaching.
2. To know the need for and importance of assessment and evaluation in the teaching of Physics.
3. To gain knowledge of various assessment strategies for continuous assessment in reference to teaching of Physics.
4. To obtain knowledge on appropriate tools and techniques for assessment and evaluation in teaching- learning of Physics.
5. To identify a problem in the context of Physics teaching-learning and plan action research.

Course Content:

21st Century Skill for Learners

21st Century Skills: Need and importance of 21st century skills for learners and teachers of Physics – The way to learn 21st century skills - Psychological, sociological, and philosophical perspective of teaching and learning Physics - Qualities of a Physics teacher as professional for enhancing teaching learning skills - Role of a teacher in facilitating learning and creating dynamic learning environment of Physics.

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School activities: Organizing assemble activities, curricular and co-curricular activities – Time table: meaning, definition, importance's, principle and types of time table – Records and Registers: admission, teaching, non-teaching and staff attendances, leave registers, movement registers, circular note, stock register, cumulative records, consumable and non-consumable records, sports register, Incoming and outgoing registers, visitors' register, and Anecdotal record

Performance Assessment in Physics

Performance assessment: Meaning, definition and uses - assessment of group activities, field observations, recording and reporting, creating platform and portfolio management - Assessment of laboratory: skills, assignments, projects, and presentations – Grading Systems: meaning, definition and advantages – Types: Absolute and relative grading, Merits and demerits of different types of grading.

Tools and Techniques of Assessment and Evaluation

Tools – unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting: planning the test, preparation of items, reviews the items, item analysis – Blueprint –Types of test items and preparing answer key – Basic Statistics: descriptive (mean, median & mode), Deviation Scores (range, average and standard deviation), plateau measure (skewness and kurtosis), item analysis (discrimination and difficult index) and correlation analysis (rho).

Research and Innovative Practices

Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences - Recent trends in research related to teaching learning of Physics. - School- based research in Physics: case study, cumulative record and action research (meaning, significance, steps and planning).

Suggestive Practicum (Any Three):

1. Prepare, administer, and analyzes cores of an achievement test.
2. Explore AI based assessment tools and prepare an E-Portfolio for a student of Secondary Stage.
3. Conduct Simulated Teaching session for the concepts of Physics and observation by self, peer, and teacher.
4. Explore development of multidisciplinary projects and present using PowerPoint.
5. Interpret the concept of Physics with Psychological, Sociological and Philosophical Perspective.
6. Apply innovative practices in classroom teaching learning of Physics.
7. Make a presentation on the role of Physics in sustainable development of society.
8. Plan action research for Continuous Professional Development (CPD) of Physics teacher.
9. Any other project assigned by HEI.

Suggestive Reading Material:

1. National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
2. National EducationPolicy2020,MoE,GovernmentofIndia
3. National Steering Committee for National Curriculum Frameworks,(2023). Draft National Curriculum Framework for School Education.

Reference Books:

1. Steve Alsop, Keith Hicks (2013). Teaching Science: A Handbook for Primaryand Secondary School Teachers, Routledge. e-ISBN: 9781315042374.
2. Judith Bennett (2003) Teaching and Learning Science: A guide to recent research and its applications, Continuum, London. ISBN: 978-0826465276.
3. Robin Millar (1984) Doing Science: Images of Science in Science Education, Routledge. e- ISBN: 9780203125878.
4. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc. ISBN: 978-0675087186.
5. Donald Schon, (1983) The reflective practitioner, How professionals think in Action Basic Books. ISBN: 0465068782.
6. Donald A. Schon, (1987) Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, Jossey-Bass. ISBN: 978-15-5542- 220-2.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the significance of acquiring 21st-century skills for Physics teaching.
2. Elaborate the need for and importance of assessment and evaluation in the teaching of Physics.

3. Appraise with various assessment strategies for continuous assessment in reference to teaching of Physics.
4. Utilize appropriate tools and techniques for assessment and evaluation in teaching-learning of Physics.
5. Identify recent trends in research related to the teaching and learning and its implications in teaching learning of Physics.
6. Prepare unit test item based on TOSS and develop different types of test items.
7. Construct and administer different type of tests.
8. Plan offline and online activities for testing higher order thinking skills in teaching learning of Physics.
9. Relate ICT integration and elaborate its use in classroom situations,
10. Identify a problem in the context of Physics teaching-learning and find the solution through action research.

EDPC64	MATHEMATICAL AND QUANTITATIVE REASONING	L	T	P	C
		1	0	1	2

Course Objectives:

The Objectives of the course are to:

1. Understand the fundamentals of mathematical and quantitative reasoning and their applications in education and various fields
2. Identify and analyze different data sources related to education, including enrolment ratios, literacy rates, and national sample surveys.
3. Apply statistical tools and techniques for data analysis and interpretation in an educational context
4. Develop skills in data visualization and representation using charts, graphs, and other visual tools for effective communication
5. Explore the significance of learning analytics and apply analytical tools to enhance educational decision-making.

Course Content:

Fundamentals of Mathematical and Quantitative Reasoning

Meaning, nature, and scope of mathematical and quantitative reasoning- Importance of mathematical and quantitative reasoning in various fields- Types of quantitative reasoning and its application in problem-solving- Concept of mathematization and its role in education and society.

Introduction to Data in Education

Understanding data requirements in educational research and decision-making-Sources of data: primary and secondary sources-School enrolment indicators: Gross Enrolment Ratio (GER), Net Enrolment Ratio (NER)- Educational progression: Dropout rate, retention rate, transition rate- Literacy measurements and their significance in policy-making-Indian census: Data collection, interpretation, and application in education- Nationwide sample surveys: NFHS, DLHS, UDISE, and their role in educational research.

Data Analysis and Interpretation in Education

Concept and importance of data interpretation. Representation of data through equations, diagrams, graphs, and tables-Statistical tools for data analysis: Measures of central tendency (mean, median, mode), measures of variability (range, standard deviation, variance)-Application of statistical techniques in the educational context.

Visualization and Representation of Educational Data

Visual and numerical representation of data and its importance in decision-making-Types of data representation: Bar diagrams, histograms, pie charts, line graphs-Comparative analysis of data through visual representation-Case studies on the use of data representation in educational research.

Learning Analytics and Its Application in Education

Concept and significance of learning analytics- Types and levels of learning analytics in education- Application of learning analytics for student performance tracking and

decision-making-Predictive analytics and AI-based tools in educational data analysis-Ethical considerations in data analysis and usage in education.

Suggestive Practicum:

1. Take last 5 years of UDISE data and analyze various indicators related to schools, teachers, and students

Reference Books

1. Creswell, J. W., & Creswell, J. D. (2023). Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.). SAGE Publications.
2. Field, A. (2023). Discovering statistics using IBM SPSS statistics (6th ed.). SAGE Publications.
3. Johnson, R. B., & Christensen, L. (2024). Educational research: Quantitative, qualitative, and mixed approaches (8th ed.). SAGE Publications.
4. Hatcher, L. (2013). Advanced Statistics in Research: Reading, Understanding, and Writing up Data Analysis Results. Shadow Finch Media LLC Publication.
5. Malik, S. C. (2021). Mathematical Analysis. New Age International Pvt. Ltd.

Course Outcomes:

After completing this course, the prospective teachers will be able to,

1. Explain the importance of mathematical and quantitative reasoning in education and policy-making.
2. Utilize data sources such as census reports, UDISE, and sample surveys for educational research and planning.
3. Perform statistical analysis of educational data using measures of central tendency, variability, and data interpretation techniques.
4. Interpret and visually represent data using bar diagrams, histograms, pie charts, and line graphs for effective decision-making.
5. Apply learning analytics tools to analyze student performance and contribute to data-driven educational improvements.

EDPC65	SCHOOL OBSERVATION (FIELD PRACTICE)	L	T	P	C
		0	0	2	2

Course Objectives:

The Objectives of the course are,

1. To know various schooling systems available in the society.
2. To realize the processes, practices, and overall environment of the school.
3. To understand how to establish a rapport with all the stakeholders of the school system.
4. To observe the process of conducting different activities in the school.
5. To study availability and the work of human resources, including members of school management (SMC), school head, teachers, administrative and support staff).
6. To observe the existing infrastructure available in the schools (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting).
7. To observe and document the availability and usage of TLM, including ICT.
8. To study the available physical and digital documents, including UDISE data.
9. To study inter-personal relationships among the stakeholders.
10. To study various assessment processes adopted in different types of schools for holistic development of children.
11. To prepare and present a comprehensive profile of the schools observed (including classroom processes)
12. To study the engagement of parents and other community members in school activities.

Course Content:

School Observational Activity:

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement& Value-Added Courses.

1. Meaning and Nature of school observation process
2. Difference between monitoring and observation
3. Theory and practices of school observation components such as:
    a) Schooling system
    b) Rapport with all the stakeholders
    c) Office management procedures of different types of schools
    d) School environment in all perspectives
    e) Process of conducting curricular activities in the schooling process
    f) Existing infrastructure available in the school
    g) Utility of ICT and TLM facilities

h) Interpersonal relationships among the stakeholders
i) Various assessment processes adopted in different types of schools.
j) Engagement of parents and other community members in school activities.

Suggestive Practicum:

1. Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
2. Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
3. Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
4. Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
5. Study the available opportunities for learning interdisciplinary subjects.
6. Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
7. Study the provision of other student support services- guidance and counseling, NCC, NSS, health and wellness programme.
8. Observe the organization of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
9. Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Differentiate various schooling systems.
2. Explain the processes, practices, and overall environment of the school.
3. Establish a rapport with all the stakeholders of the school system.
4. Conduct different activities in the school.
5. Work of human resources, including members of school management (SMC), school head, teachers, administrative and support staff).
6. Create infrastructure in the schools (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting).
7. Develop and usage of TLM, including ICT.
8. Handle physical and digital documents, including UDISE data.
9. Develop inter-personal relationships among the stakeholders.
10. Analyze various assessment tools adopted in different types of schools for holistic development of children and find out the background.
11. Prepare and present a comprehensive profile of the schools observed (including classroom processes)
12. Explain the engagement of parents and other community members in school activities.

SEMESTER 7

EDPC71	PERSPECTIVES ON SCHOOL LEADERSHIP AND MANAGEMENT	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to:

1. Understand the structure, governance, and socio-political context of schools in India and analyze their impact on school leadership and management.
2. Explore the concept and practice of school leadership, identifying the multiple roles, responsibilities.
3. Examine the role of school leadership in creating schools as learning organizations by fostering shared vision, team learning, and inclusive school cultures
4. Utilize data-driven approaches to enhance school improvement, address equity challenges, and build an inclusive and equitable learning environment
5. Develop strategies for professional and collaborative learning among teachers, parents, and school management committees to improve teaching.

Course Content:

Understanding the Indian School System

School as a normative organization vis-a-vis school as a socio-emotional-cultural space for learning-Diversity of schools in India: their structure, governance, socio-political and cultural context, funding, management, autonomy, and accountability mechanisms-Relationship between school leadership and school diversity issues, challenges, and needs-Engagement with diversity discourses, educational policies, reforms, and practices in developing inclusive schools.

Understanding School Leadership

School leadership: concept as defined and concept as practiced-Being a school leader: exploring the multiple roles, responsibilities, issues, and challenges of school leadership in the Indian context- National and international best practices on school leadership.

Schools as Learning Organizations

Role of school leadership in creating motivating learning spaces and developing an inspiring school ethos- Schools as learning organizations: promoting personal mastery, examining mental models, and developing a shared vision, team learning, and a system's thinking perspective-Development of a shared vision and shaping of school culture.

Data-Driven School Improvement and Equity

Use of data for school improvement focused on students' learning- Addressing equity challenges and building an equitable school culture that promotes excellence for all-Nurturing school belongingness by engaging students, teachers, staff, parents, School Management Committees (SMCs), and the community in the formulation of whole-school development plan- Frameworks: POSDCORB, PERT and XYZ

Professional and Collaborative Learning in Schools

Designing professional and collaborative learning opportunities for self and others, including teachers, parents, and SMC members- Strategies for improving teaching and learning- Role of continuous professional development in school leadership.

Suggestive practicum

1. Case Study on School Leadership
2. Visit different types of schools (government, private, special schools, alternative schools) to understand their leadership structures, governance, and management.
3. Structured Interview with a School Principal or Administrator
4. Examine educational policies such as NEP 2020, RTE Act, and other relevant frameworks to understand their implications for school leadership.

Reference Books:

1. Pajankar, V. D., & Kumar, H. (2012). Indian School Education System: A Holistic View. Kunal Books.
2. Murphy, J. F. (2023). Understanding Communities of School Leadership: Changing Dynamics of Organizations. Springer International Publishing.
3. Roberts, S. M., & Pruitt, E. Z. (2008). Schools as Professional Learning Communities. Corwin Publication.

Course Outcomes (COs):

After the completion of this course, prospective teachers will be able to:

1. Analyze the Indian school system's diversity, governance, and accountability structures to understand their implications.
2. Demonstrate knowledge of school leadership practices by reflecting on national and international best practices and real-life leadership challenges.
3. Design strategies to transform schools into effective learning organizations by fostering collaboration, shared vision, and an inspiring school ethos.
4. Apply data-driven decision-making skills to improve student learning outcomes, address educational inequities, and develop inclusive school cultures.
5. Implement professional learning communities by engaging stakeholders in continuous school development efforts.

EDPC72	SECONDARY STAGE CURRICULUM PLANNING AND DEVELOPMENT	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to:

1. Understand the meaning, significance, and relationship between education and curriculum, along with different types of curricula.
2. Analyze the foundational principles and concerns influencing curriculum development, including socio-cultural, economic, and technological aspects.
3. Explore various curriculum development approaches and theories to create learner-centered, activity-based, and inclusive curricula.
4. Examine curriculum planning and implementation processes, with a focus on converting curriculum into practical learning experiences.
5. Evaluate curriculum effectiveness using appropriate tools and suggest improvements based on research and feedback.

Course Content:

Education and Curriculum – Meaning, Relationship, and Significance

Concept, meaning, and need for curriculum in education- Relationship between education and curriculum-Significance of curriculum in teaching and learning- Types of curricula: subject-centered, activity-centered, environment-centered, and community-centered-Differences and relationships between curriculum, curriculum framework, syllabus, and textbooks.

Foundations and Principles of Curriculum Development

Basic principles of curriculum development- Key concerns in curriculum planning: aims and objectives, nature of disciplines, socio-cultural and economic factors, value transitions, environmental concerns, gender inclusiveness, and technological advancements- Influence of globalization on curriculum development.

Approaches and Theories of Curriculum Development

Major approaches to curriculum development: learner-centered, activity-centered, constructivist, and knowledge-construction approaches- Theoretical perspectives influencing curriculum design-Interdisciplinary and multidisciplinary curriculum models-Role of different stakeholders in curriculum planning and execution.

Curriculum Planning, Implementation, and Engagement

Curriculum planning as a cyclic process-Converting curriculum into syllabus and operationalizing it into learning experiences-Curriculum engagement activities and learning resource integration-Role of schools at regional, state, and national levels in curriculum implementation-Role of teachers in facilitating curriculum engagement and assessment.

Curriculum Evaluation and Continuous Improvement

Concept and importance of curriculum evaluation- Methods and tools for assessing curriculum effectiveness- Role of teachers in operationalizing and evaluating curriculum resources such as textbooks, teacher handbooks, workbooks, and digital resources- Strategies for curriculum improvement based on feedback and research-Emerging trends in curriculum evaluation.

Suggestive Practicum:

1. Arranging discussion on:
2. Basis of National curriculum frame works (1975, 1988, 2000, and 2005).
3. Document: Learning without burden" by Prof. Yashpal
4. Preparing of Report based on observation of:
5. Facilities and infrastructure to implement the present curriculum.
6. Interviewing teachers to understand their role in:
7. Implementing and assessment of the curriculum.
8. Analysis of the following in the context of principles of developing the Curriculum: Guidelines of NEP, 2020.

- Curriculum of 4 Years B.Ed. Integrated Programme
- Learning without Burden, MHRD, and India.
- Position paper (2006). National Focus Group on 'Curriculum, Syllabus, Textbooks', NCERT.
- NCERT (1988) National Curriculum for Elementary and Secondary Education: A framework.
- NCERT (2000) National Curriculum Framework for school Education.
- NCERT (2005) National Curriculum Framework. NCERT publications.

Reference Books:

1. Olivia, P. (2004). *Developing the curriculum* (6th ed.). Allyn & Bacon, Inc.
2. Giroux, H., et al. (1981). *Curriculum and Instruction: Alternatives in Education*. MC Cutchan Public Corp.
3. Howson, G. (1978). *Developing a New Curriculum*. Heinmann.
4. Schubert, W. (1986).*Curriculum Perspectives, Paradigms and Possibilities*. Macmillan.
5. Hirst, P. (1975). *Knowledge and curriculum*. International Library of the Education, 12. Routledge.

Course Outcomes:

After the completion of this course, the prospective teachers will be able to:

1. Explain the fundamental concepts of curriculum, its significance, and its role in education
2. Critically analyze different principles and factors influencing curriculum development in the context of globalization, inclusivity, and social needs.
3. Apply theoretical perspectives and curriculum models to design effective and meaningful curriculum frameworks.
4. Implement curriculum planning strategies by integrating syllabus content, instructional materials, and engagement activities.
5. Assess and improve curriculum effectiveness by utilizing evaluation techniques and research-based feedback.

EDPC73	SPORTS, NUTRITION, AND FITNESS	L	T	P	C
		2	0	0	2

Course Objectives:

The objectives of the course are to:

1. Demonstrate comprehensive understanding of sports fundamentals, including their meaning, importance, types, and stages of development.
2. Analyze and apply various methods of teaching different types of sports (indoor, outdoor, team, and individual.
3. Evaluate the components of physical fitness (muscular strength, endurance, flexibility, body composition, and cardiovascular endurance).
4. Examine the fundamentals of nutrition, including types, importance, and nutritional requirements for different age groups.
5. Integrate knowledge of sports, physical fitness, and nutrition to develop holistic approaches promoting healthy lifestyles.

Course Content:

Introduction to Sports and its Significance

Meaning and importance of sports in human development-Types of sports: indoor, outdoor, individual, team games-Different stages of sports: primary and secondary-Psychology of sports: mental aspects and preparation-Sports for children with disabilities and inclusion practices-Practical Component: Reflective reading of different sports personalities.

Teaching and Organization of Sports Activities

Methods of teaching different sports disciplines-Organization principles for various sporting activities-Team games: strategies, coaching methods, and collaboration-Individual sports: techniques, skill development, and coaching approaches-Game adaptations for different age groups and abilities-Practical Component: Collection of different types of games (Indoor, Outdoor, Individual, Team) and organizing games for different age groups.

Physical Fitness: Components and Development

Meaning and importance of physical fitness-Key components of physical fitness: Muscular strength and endurance, Flexibility and mobility, Body composition analysis, Cardiovascular endurance-Assessment methods for physical fitness-Practical Component: Organizing fitness programs and exercises at various levels.

Nutrition Fundamentals for Health and Performance

Meaning and types of nutrition-Importance and need for proper nutrition-Methods for teaching nutrition concepts-Nutritional requirements across different age groups-Special nutritional needs for sports personalities versus common individuals-Practical

Component: Collection of different nutritious food items (Charts, Things, Objects, Models).

Integration of Sports, Nutrition, and Fitness

Coordination of health and fitness programs-Relationship between nutrition and physical performance-Developing healthy lifestyles through integrated approaches-Nutrition programs in educational settings (midday meals in schools, hostel diets)-Promoting cooperation through group activities and sports-Practical Component: Programs organized to promote the use of nutritious food.

Reference Books:

1. M.M. Gore. (2017). *Anatomy and Physiology of Yogic Practices.* Motilal Banarasi Dass, New Delhi. ISBN: 978-8178223919.
2. NCTE. (2015). *Yoga Education-Bachelor of Education Programme,* New Delhi.
3. NCERT. (2014). Population Education: Source Material under National Population Education Project (NPEP) New Delhi.
4. NCERT. (2013). *Training and resource materials on Adolescence Education*, NCERT, New Delhi.
5. Jack H. Wilmore, David L. Costill, W. Larry Kenney. (2011). 5th edition. Physiology of Sports and Exercise. Human Kinetics Publication. ISBN: 978-0736094092.
6. Roberts, S. Weinberg & Daniel Gould. (2011). 4th Edition. "Foundation of Sports and Exercise Psychology", Human Kinetics Publication. ISBN: 978-073664675.
7. Deborah A. Wuest, Charles A. Bucher. (2006). 15th edition. "Foundation of Physical Education Exercise Science and Sports", Tata McGraw Hill, Pvt. Ltd., New Delhi. ISBN: 978-0072972801.

Course Outcomes:

After the completion of this course, the prospective teachers will be able to:

1. Categorize different types of sports and adapt them for various age groups and abilities.
2. Design and implement appropriate teaching methods for various sports activities, demonstrating understanding of both individual and team-based approaches.
3. Assess the five key components of physical fitness and create targeted fitness programs that address specific developmental needs.
4. Develop nutritional guidelines and educational materials that promote healthy eating habits tailored to different age groups.
5. Organize and facilitate programs that effectively integrate sports, fitness, and nutrition concepts.

EDPC74	SCHOOL BASED RESEARCH PROJECTS	L	T	P	C
		0	0	2	2

Course Objectives:

The Objectives of the course are,

1. To understand the contextual problems and how to formulate appropriate research design.
2. To know how to prepare the plan of action for undertaking school-based research.
3. To know how to develop and use tools and techniques for the collection of relevant data.
4. To Study the effectiveness of the intervention(s),
5. To gain the school-based research experiences and make reports and presentations.

Course Content:

School Based Research Activity:

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value- Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

1. Learning progress and outcomes in different subjects.
2. School-based assessment.
3. Learners' diversity and inclusion.
4. Participation in arts, games, sports.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Identify contextual problems, formulate appropriate research design and address it.
2. Prepare the plan of action for undertaking school-based research and execute it.
3. Develop the tools and techniques for collecting of relevant data for the school based research.
4. Collect and analyze the data to identify the causes.
5. Develop and implement need-based interventions for addressing the problems.
6. Find the effectiveness of the intervention(s).
7. Reflect and share school-based research experiences through reports and presentations.

EDPC75	INTERNSHIP IN TEACHING	L	T	P	C
		0	0	10	10

Course Objectives:

The Objectives of the course are,

1. To perceive the overall functioning of the school and the different roles played by a teacher in the school.
2. To understand the importance of teacher-student relationships for effective teaching.
3. To know the age-appropriate pedagogic skills and use different pedagogies learnt in real-life classrooms.
4. To know how to create appropriate teaching-learning materials.
5. To know how to develop necessary planning and execution skills to conduct school activities (assembly, celebrations, and cultural programmes).
6. To realize the relationship among school, teacher, parents, and community.
7. To understand the rapport with the stakeholders and their roles in the school system.
8. To know the importance of student's portfolios and comprehensive 360-degree (holistic) progress reports.
9. To understand the importance of maintaining different types of records in the school system.
10. To enhance research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

School Internship Activity:

1. Pedagogies' different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning.
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

Suggestive Practicum:

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    a. Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
    b. Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge

systems and character building.

4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, and Computer), sports, and arts and crafts activities.
7. Participate in student support services- guidance and counselling, NCC, NSS, health and wellness programme.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyze the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyze data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research/case study.
19. Prepare a sample student portfolio,
20. Write a reflective diary daily and prepare a report of each activity.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the overall functioning of the school and the different roles played by a teacher in the school.
2. Experience the importance of teacher-student relationships for effective teaching.
3. Develop age-appropriate pedagogic skills and use different pedagogies learnt in real-life classrooms.
4. Create appropriate teaching-learning materials and develop necessary planning and execution skills to conduct school activities (assembly, celebrations, and cultural programmes).
5. Establish the strong relationship among the school, teacher, parents, and community.
6. Create rapport with the stakeholders and understand their roles in the school system.
7. Create student portfolios and comprehensive 360-degree (holistic) progress reports to know the students performance.
8. Explain why the schools are maintaining different types of records.
9. Conduct action research for the situations/problems faced during their school internship experience and produce the results and do the follow up activities.

SEMESTER 8

EDPC81	PHILOSOPHICAL AND SOCIOLOGICAL PERSPECTIVES OF EDUCATION - II	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. Understand the relationship between education and society, including the role of educational sociology in shaping social structures.
2. Analyze the role of education in facilitating social change, modernization, and national development.
3. Examine the influence of culture and socialization on educational practices, policies, and reforms.
4. Evaluate the significance of values, constitutional provisions, and human rights in education.
5. Explore contemporary pedagogical challenges and innovative approaches to addressing societal issues through education.

Course Content:

Education and Society

Concept and significance of education in society. Relationship between education and society. Educational sociology: meaning, functions, and scope. Education as a social system: conceptual clarity of key terms—society, social behavior, status, institution, ideology, system, sub-system, socialization, stratification, acculturation, enculturation social values and norms, conflict, and modernization. Role of education in individual and group behavior.

Education and Social Change

Meaning and dimensions of social change. Relationship between education and social change. Factors affecting social change: technology, social and educational movements, curricular innovations, value conflict, legal provisions. Role of education in social transformation. Constitution of India and its provisions related to education. Education and modernity.

Education, Culture, and Socialization

Interrelationship between education and culture. Education as a process of socialization. Impact of social welfare and reform movements on education. Legal interventions in child marriage and child labor. Role of educational policies and acts in cultural development. Adult literacy and its significance in social transformation. Influence of technology, equality, and constitutional provisions on education.

Education and Values

Concept, significance, and types of values. Constitutional values and their impact on education. Relationship between human rights and values in education. Role of education in fostering environmental awareness and sustainable practices. Value education and its pedagogical concerns in curriculum design.

Pedagogical and Contemporary Issues in Education

Pedagogical challenges in addressing social issues through education. Strategies to incorporate social change, cultural diversity, and values in educational settings. Education in the context of globalization. Emerging trends and concerns in education: equity, accessibility, and technological advancements. Educational policies and their implications on inclusive education and social justice

Suggestive Practicum:

1. Critical/Reflective study of contemporary aims of education and their social determinants.
2. Observation and critical study on how textbooks determine every activity of teacher and learner in the school.
3. A critique of textbook culture in school.
4. Observing the process of knowledge construction by children in structured and unstructured environments to appreciate their learning processes and nature.
5. A critical analysis of Constitution of India in the context of process of Education in India / Educational Policies / Educational Commissions)
6. Critically observing nearby society/ locality in groups of 4-5 students and sharing observations related to cultural/ social influences on educational practice.
7. Analyzing social purpose of NEP, 2020.

Reference Books:

1. Agarwal, S. (2022). *Philosophical Foundations of Education*. Mahaveer Publications.
2. Dhawan, M. L. (2005). *Philosophy of Education*. Gyan Publishing House.
3. Jyoti Khemka. (2018). *Perspective of Education*. Invincible Publishers.
4. Khan, W. A. (2011). *Philosophical Foundation of Education*. Sports Publication, Delhi.
5. Pathak, R. P. (2018). *The Educational Thinkers of East and West*. Kanishka Publishers Distributors.
6. Saxena, N. R. S., & Dutt, N. K. (2019). *Philosophy and Social Foundation of Education*. Anu Books.
7. Suman Lata, & Khatri, H. L. (2016). *Socio-Philosophical Perspectives of Education*. Paragon International Publishers.
8. Taneja, V. R., & Taneja, S. (2021). *Educational Thinkers*. Atlantic.

Course Outcomes:

After the completion of this course, the prospective teachers will be able to:

1. Explain the interrelationship between education, society, and social behavior.
2. Critically assess the impact of educational reforms, policies, and legal interventions on social change and development.
3. Apply sociological perspectives to understand cultural influences on education and socialization.
4. Demonstrate awareness of values and human rights in the context of education and implement value-based teaching practices.
5. Develop strategies to address contemporary pedagogical and educational challenges using innovative and inclusive approaches.

EDPC82	EDUCATION POLICY ANALYSIS	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to,

1. Understand the meaning, significance, and foundational principles of educational policy planning and analysis
2. Critically analyze key educational policies in India, assessing their goals, frameworks, and impact on national education.
3. Examine the mechanisms and strategies for policy implementation and the role of various stakeholders in execution.
4. Identify major challenges and barriers in the implementation of education policies and suggest potential solutions.
5. Explore global perspectives on education policy-making and compare international policy frameworks with Indian policies.

Course Content:

Understanding Educational Policy and Planning

Meaning and significance of education policy-Purpose and dimensions of educational policy at local and global levels- Philosophical and sociological perspectives in educational policy planning- Historical development of educational policies in India-Basic steps involved in policy planning-Constitutional provisions related to education policy- Fundamental principles for analyzing an educational policy.

Educational Policies in India, Post-Independence Era

Critical analysis of educational policies in India: 1968, 1986 (Modified in 1992), 2020-Need, significance, goals, and frameworks of each policy- Content and issues raised in policies-Constitutional provisions and their implications on education- Special focus areas in each policy-Modifications and revisions in policies over time- Implementation strategies adopted in different policies.

Implementation of Educational Policies

Meaning, need, and significance of policy implementation- Mechanism of policy implementation- Strategies for effective execution of an educational policy-Programme of Action (POA): concept, importance, and steps- Role of different stakeholders in policy implementation: legislature, judiciary, political bodies, voluntary organizations, non-governmental organizations (NGOs), and public pressure groups.

Challenges and Issues in Policy Implementation

Major challenges in implementing educational policies- Political and economic factors affecting education policy implementation- Socio-cultural barriers to policy execution-

Issues of equity, accessibility, and quality in education policies- Role of governance, leadership, and teacher participation in the success of educational policies-Case studies on policy implementation failures and successes.

Global Perspectives on Educational Policy

Comparative analysis of educational policies in developed and developing nations-International education policies and their impact on national education systems-Role of global organizations in shaping educational policies (UNESCO, UNICEF, OECD, World Bank)-Best practices in policy-making from global perspectives- Emerging trends in education policy formulation and implementation.

Suggestive Practicum:

1. Reviewing and presenting report on NEP, 2020 in reference to Policy Implementation.
2. To present a critical review of the Programme of Action (1987).
3. Preparing a list of challenges to implement the present new National Education Policy, 2020 in our States.
4. Preparing a list of Measures to be taken or taken to implement National Education Policy, 2020 in our State.

Reference Books:

1. Srivastava, A. K. (2011). Educational Administration: Policy, Planning and Survey. Kunal Books Publication.
2. Bhattacharjee, S., & Mondal, P. Educational Acts and Polices in India. Lambert Academic Publishing.
3. Johnston, J. (2022). Our Educational Policy in India. Legare Street Press.
4. Wiseman, A. W., & Kumar, P. (2021). Building Teacher Quality in India. Emerald Publishing Ltd.
5. Tilak, J. B. G. (2019). Education and Development in India: Critical Issues in Public Policy and Development

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to:

1. Explain the philosophical, sociological, and constitutional foundations of educational policy-making.
2. Evaluate and critique post-independence educational policies in India and their implications.
3. Demonstrate an understanding of policy implementation mechanisms and stakeholder involvement in execution.
4. Analyze challenges in policy implementation and propose strategies for overcoming them.
5. Compare and contrast Indian education policies with global best practices and emerging trends.

EDPC83	YOGA, AND UNDERSTANDING SELF	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are,

1. To know the importance of Yoga and how it helps an individual in understanding self.
2. To understand the importance of practicing Yoga Asana.
3. To understand the postures available basic Yoga Asanas/Kriyas.
4. To understand the principles of yoga and meditation.
5. To understand the self through yoga.

Course Content:

Philosophical and Historical Perspectives of Yoga

Philosophy and Historical Perspective of Yoga: Concept and Meaning of Yoga, Philosophy of Yoga - Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period) – Importance of Yoga for healthy living, Yoga and its relevance in the modern times, Traditions in Yoga.

Schools of Yoga

Schools of Yoga: Different streams\schools of Yoga (Gnana, Bhakthi, Karma) – Construction of Yoga Practice for all round development - Principals of Yoga: Ahimsa, Satya, Asteya, Brachmacharya, Aparigraha, Shoucha, Santhosha, Tapas, swadyaya and IsvaraParidhana.

Modern Principles of Yoga

Modern Principles of Yoga: Modern Principles: Human Body is a holistic entity, Individuals and their need are Dhāraṇa & Dhyāna, etc, meditation and reflective practices, and the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind is crucial to healing.

Meditation

Meditation: meaning, and its Importance- Benefits: Psychological, Physiological and Spiritual – Techniques of Meditation: Mantra meditation, Trataka, Vipasana, and Zen techniques - Types and Process - Pranayama: its importance, and types and process.

Yoga for Understanding Self

Yoga as a Way of life for Peace, Harmony, Health love and happiness – Yoga train our body, our mind, and our intellect – Eight Fold Path of Yoga – Yoga in Indian philosophy for understanding Self.

Suggestive Practicum:

1. Practice of Basic Yoga Asanas/Kriyas.

Reference Books:

1. NCERT. (2015). Yoga: A Healthy Way of Living, Upper Primary Stage, NewDelhi. (This material is also available on www.aeparc.org.www.ncert.nic.in)
2. NCERT. (2015). Yoga: A Healthy Way of Living, Secondary Stage, NewDelhi.(This material is also available on www.aeparc.org.www.ncert.nic.in)
3. Gharote M.L.(2004). Applied Yoga. Kaivalyadhama Publication. ISBN:978-8189485030.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the importance of Yoga and how it helps an individual in understanding self.
2. Explore and disseminate the importance of practicing Yoga Asana.
3. Practice and demonstrate the postures available basic Yoga Asanas/Kriyas.
4. Describe the principles of yoga and meditation.
5. Doing yoga for understanding the self.

EDPC84	CITIZENSHIP EDUCATION, SUSTAINABILITY, AND ENVIRONMENTAL EDUCATION	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are to,

1. Understand the core concepts and aims of citizenship education including the role of cultural paradigms such as Vasudhaiva Kutumbakam.
2. Analyze the philosophical and cultural dimensions that shape citizenship education.
3. Comprehend the concept of sustainability and its multidimensional aspects.
4. Develop strategies for integrating education for sustainable development into school and community practices.
5. Evaluate environmental issues and formulate innovative approaches to deliver effective environmental education.

Course Content:

Foundations of Citizenship Education and Global Citizenship

Concepts of citizenship and citizenship education, including aims and approaches- Introduction to global citizenship and global citizenship education, emphasizing the objectives and methodologies- Exploration of the concept of Vasudhaiva Kutumbakam and its significance in developing a holistic perspective toward both local and global communities.

Philosophical and Cultural Dimensions of Citizenship

In-depth examination of citizenship education from philosophical and cultural perspectives-Analysis of how values, traditions, and social ideals influence citizenship-Discussion of Vasudhaiva Kutumbakam as a cultural paradigm that fosters unity and collective responsibility in diverse communities.

Understanding Sustainability and Sustainable Development Goals

Definition and scope of sustainability across human activities- Exploration of the three dimensions of sustainable development – economic, social, and environmental-Detailed study of Sustainable Development Goals (SDGs) and strategies for sustainable management of natural resources.

Education for Sustainable Development and Community Engagement

Approaches to integrating education for sustainable development into school curricula- Examination of school and community-based activities that promote sustainability- Strategies for engaging learners in practices that contribute to economic, social, and environmental sustainability.

Environmental Education: Issues, Strategies, and Technological Innovations

Overview of key environmental issues including climate change, environmental degradation, and pollution- Discussion on initiatives for waste management, conservation of biological diversity, forest and wildlife conservation, and sustainable living-Approaches to delivering environmental education using mass media, technology, and the collaborative efforts of governmental and non-governmental organizations, alongside school and community-based activities.

Suggestive Practicum

1. Write a report on the roles of governmental and non-governmental organizations in promoting Environmental Education.

Reference Books:

1. Chong Shimray. (2016). Teaching Environmental Education: Trends and Practices in India. Sage Publications.
2. NCERT. (2017). Towards A Green School: Resource Book on Education for Sustainable Development for Elementary Schools. NCERT.
3. NCERT. (2010). Ways to Peace, A Resource Book for Teachers.
4. NCERT. (2006). Position Paper on Habitat and Learning. NCERT.
5. NCERT. (2006). Position paper on Education for Peace. NCERT.
6. NCERT. (2005). National Curriculum Framework. NCERT.

Course Outcomes :

After completing this course, students will be able to:

1. Explain and differentiate between traditional citizenship education and global citizenship education, citing their aims and practical approaches.
2. Apply philosophical and cultural insights to promote inclusive educational practices that embrace the concept of Vasudhaiva Kutumbakam.
3. Critically assess sustainability challenges and articulate the significance of the Sustainable Development Goals in contemporary society.
4. Design and implement educational activities and projects that advance sustainable development through school- and community-based initiatives.
5. Develop and propose strategic solutions for mitigating environmental issues by leveraging media, technology, and collaborative efforts.

EDPC85	POST INTERNSHIP (REVIEW AND ANALYSIS)	L	T	P	C
		2	0	0	2

Course Objectives:

The Objectives of the course are,

1. To have comprehensive understanding of the school ecosystem.
2. To understand their learning from internship with the peers and teacher educators.
3. To enjoy the school internship sharing learning experiences one each activity undertaken.
4. To do action research and case study of the students.
5. To take the classes with pre-planned lesson plans.

Post-Internship Activity:

1. Presentation of reflective journal summary
2. My Learning Journey: by each student-teacher
3. Gallery walks (Exhibition): TLMs, display of participation in school activities (photos/stories) and other artifacts created during the internship by student teachers.
4. Sharing of best practices (PPTs, Videos.)
5. Survey and collect the local stories and rhymes from the parents and community (in the context of the foundational stage)
6. Holding a training workshop for the parents and community and encouraging them to act as volunteers.
7. Awareness and advocacy programme in FLN for parents and community: Roleplay with parents and community on conducting specific FLN activities.
8. Organizing a parents/community mela/fair on home made TLM for FS children

Suggestive Practicum:

1. Reflective Journal.
2. Lesson Plans and TLMs.
3. Observation records (Teacher Educator, Mentor, School heads, Teachers, Parents).
4. Assessment records and Student Portfolio.
5. Action research report/case study.
6. Comprehensive internship report.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Explain the importance of reflective journal through their experiences.
2. Elaborate how the lesson plans and TLMs are supported their teaching and their self confidence.
3. Justify that how the observation activity assist their teaching process.
4. Representing the importance of action research and case study to identify the solution and solve and know the students background respectively.
5. Be confidence in teaching as well as researching.

EDPC86	CREATING TEACHING LEARNING MATERIAL/WORK EXPERIENCE (EDUCATIONAL TOY MAKING, LOCAL/TRADITIONAL VOCATION, ETC.)	L	T	P	C
		0	0	2	2

Course Objectives:
The objectives of the course are,

1. To assess the need for Teaching Learning Materials and prepare innovative TLM.
2. To develop an understanding of the importance of work experience and competencies of a local crafts person, artisans and entrepreneurs.
3. To understand the different types of learners such as Kinesthetic, Visual and Auditory learners.
4. To know the need of students based on the individual differences.
5. To know that how the learning occurs in different stages.

Activities:
1. Understanding how students learn at different stages.
2. Knowledge of toys and other TLMs from different parts of the countries.
3. Knowledge of relevant TLMs for specific groups of children-CWSN, kinesthetic learners, visual learners, auditory learners addressing individual differences.

Suggestive Practicum:

1. Orientation workshop on work experience and development of learning resources.
2. Field visit for interaction with local artisans, crafts people, and entrepreneurs.
3. Observe Traditional work practices and their integration into Local Technologies and Ideas.
4. Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process
5. Development of at least two low-cost learning resources as per the local contexts (foundational/preparatory/middle/secondary) and presentation/exhibition.
6. Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the material used, the process of its development and its use during classroom transaction.

Course Outcomes:

After completion of the course, the prospective teachers will be able to,

1. Prepare innovate TLM based on the students need.
2. Prepare indigenous low cost TLM including the toys.
3. Develop learning resources based on the teaching experienced.
4. Identify the local technologies and ideas relevant to the subject concept and adopt their teaching process.
5. Classify the students based on the learning styles and adopt appropriated teaching methods.

ELECTIVES OF
FOUNDATIONS OF EDUCATION (FE)

EDPE81	ADOLESCENCE EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the intellectual, emotional, social, and physiological aspects of adolescence.
2. Analyze the significance and challenges of adolescence education in the Indian context.
3. Examine the relationship between life skills and adolescence education, including sexual and reproductive health.
4. Evaluate the historical development, goals, and role of teachers in Adolescence Education Programme (AEP) in India.
5. Assess pedagogical issues and effective strategies for teaching adolescence education.

Course Content:

Adolescence and Adolescence Education

Understanding Adolescence: Intellectual, Emotional, Social, and Physiological Aspects of Adolescence - Issues and Challenges During Adolescence - Myths and Realities - Adolescence Education: Concept, Nature, and Significance in the Indian Context - Aims and Objectives of Adolescence Education - Role of School, Family, Media, and Community as Social Agencies in Adolescence Education - Challenges of Adolescence Education.

Life Skills and Adolescence Education

Concept, Nature, and Significance of Life Skills for Adolescence Education - Relationship between Life Skills and Adolescence Education - Core Life Skills and Their Significance - Understanding Sexual and Reproductive Health - STIs and HIV/AIDS: Causes, Prevention, Cure, and Coping Skills.

Adolescence Education Programme in India (AEP)

Historical Development of Adolescence Education Programme in India - Goals and Significance of Adolescence Education Programme in India - Role of Teachers in Adolescence Education (AEP) - Challenges to Educational Programmes in India - Myths and Misconceptions.

Pedagogical Issues in Adolescence Education

Meaning, Goals, and Significance - Challenges of Teaching Adolescence Education: Understanding Student Behavior, Dealing with Personal Self-Constraints, Socio-Cultural Issues, Classroom Issues and Challenges, Material Production, and Methodology - Preparation of Teachers - Approaches to Adolescence Education: Case Studies and Critical Incidents, Brainstorming, Role-Playing, Gaming, Value

Clarifications, Question Box, Discussions and Debates, Puppet Shows, Role Reversal, Video Shows.

Strategies for Effective Adolescence Education

Designing and Implementing Adolescence Education in Schools - Role of Teachers in Adolescence Development - Integrating Life Skills into the Curriculum - Community-Based Approaches for Adolescence Education - Collaboration Between Schools, Families, and Social Institutions - Evaluating the Impact of Adolescence Education Initiatives - Overcoming Barriers to Effective Adolescence Education.

Suggestive Practicum:

1. Study of Case studies and Critical Incidents. a) Field visit/s
2. Review and analysis of the work done by Government and Non-Government.
3. Study of Organizations (NGO) at national and international level.
4. A research study or detailed case study: Adolescents' behavior in different socioeconomic settings, a study on child abuse victims, adolescents in drug rehabilitation centers, adolescents residing in the precincts of industrial areas and factory establishments, adolescents in the educational regions showing either higher or lower drop-out rate, adolescents belonging to communities in which social evils affecting them are manifested like child marriages, conducting Adolescence Education sessions in School.

Reference Books:

1. Girish Bala Choudhary. (2014). *Adolescence Education, PHI Learning, ISBN: 9788120349803.*
2. Ismail Thamarasseri. (2016). *Adolescence Education. Dominant publishers & Distributors (p) Ltd. ISBN: 978-9384161835.*
3. *Panel Gullybaba C.M. (2010). Adolescence and Family Education, Gullybaba Publishing House Pvt. Ltd. ISBN: 9789381638903.*
4. *D. B. Rao. (2010). Adolescence Education, Discovery Publishing Pvt.Ltd. ISBN: 978- 8171414321.*
5. *Nagarajan N. (2010). Adolescence and Family Life Education, Shipra Publications. ISBN: 978- 8175415270.*
6. *Savin-Williams Ritch C. (2012). Adolescence: An Ethological Perspective, Springer-Verlag New York Inc. ISBN: 9781461386841*

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to:

1. Demonstrate knowledge of the fundamental aspects and challenges of adolescence.
2. Apply life skills education in addressing issues related to adolescence
3. Evaluate the effectiveness of Adolescence Education Programme (AEP) in India.
4. Develop strategies to enhance adolescence education through pedagogical innovations.

EDPE82	EDUCATION FOR MENTAL HEALTH	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the fundamental concepts, determinants, and significance of mental health and mental hygiene
2. Identify various mental disorders, their characteristics, causes, and debunk common myths related to mental health.
3. Analyze different types of stress, their impact on mental health, and explore effective stress management techniques
4. Examine the significance, dimensions, and historical development of mental health education programs at local and global levels
5. Evaluate pedagogical challenges in mental health and develop strategies for effective guidance, counselling, and intervention programs.

Course Content:

Understanding Mental Health

Meaning and Determinants of Mental Health - Mental Health vs. Mental Hygiene - Mental Disorders: Characteristics and Types - Causes of Poor Mental Health - Myths vs. Facts about Mental Health - Legal Perspectives of Mental Health in India - Concept of a Healthy Personality.

Stress, Stress Management, and Adjustment

Stress: Meaning, Nature, and Symptoms - Types of Stress: Acute, Chronic, Eustress, and Distress - Social and Psychological Perspectives of Stress - Remedial Measures for Stress Management - Stress Management and Adjustment: Meaning and Significance - Role of Parents, Peer Groups, and Teachers in Stress Prevention and Mental Health Promotion.

Mental Health Education Programme

Meaning and Significance of Mental Health Education Programs - Dimensions of Mental Health Education Programme in India - Historical Development of Mental Health Education Programmes in India - Local and Global Perspectives of Mental Health Education Programmes - Organizations at Local and International Levels - Characteristics of a Good Mental Health Education Programme - Role of Educational Institutions in Promoting Mental Well-being.

Challenges to Pedagogical Issues in Mental Health

Home vs. School: Diverse School and Home Contexts - Lifestyles of Teachers and Parents - Stereotypical Roles and Their Impact on Mental Health - Mental Health Concerns of Teachers and Parents - Material Availability and Production Challenges in Mental Health Education.

Guidance and Counselling in Mental Health

Concept, Need, and Techniques of Guidance and Counselling - Teacher as a Counsellor - Designing and Evaluating Mental Health Programmes - Role of Teachers, Parents, and Peer Groups in Counselling - Strategies for Effective Implementation of Mental Health Initiatives in Schools and Colleges.

Suggestive Practicum:

1. Visiting of Mental hospital and preparing list of four cases admitted in Hospital.
2. Preparation of two case histories on causes of abnormal behavior.
3. Critical analysis of laws and Public Health Policies.
4. Critical analysis of National Educational Policy, 2020 in the context of Health of children at school.
5. Critical analysis of Legal perspectives Mental Health Education in India.
6. Preparing comprehensive report on Mental Health Education Programme in India.

Reference Books:

1. Aggarwal, J. C. (2009). *Health and physical education*. Shipra Publications.
2. Aakash. (2015). *Mental hygiene by S.S. Chauhan second hand book*. Visionias.
3. Auerbach, S. E., & Gramling, S. (1997). *Stress management: Psychological foundations*. Pearson.
4. Chauhan, S. S. (2001). *Mental hygiene a science of adjustment*. Allied Publishers.
5. Crow, L. D. (2011). *Mental health and hygiene*. The Readers Paradise.
6. Gupta, S., & Khanna, P. (2018). *Approaches to stress management in modern era*. Anu Books.
7. Hermans, M. H. M. (2019). *Education about mental health and illness*. Springer.
8. National Committee for Mental Hygiene. (2021). *Hand book of the mental hygiene movement and exhibit*. Legare Street Press.
9. Ranganathan, N. (2012). *Education for mental health*. Shipra Prakashan.
10. Upadhyay, A. (2022). *Mental health problems*. Notion Press

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to:

1. Demonstrate knowledge of mental health, mental hygiene, and factors influencing mental well-being
2. Recognize different types of mental disorders, their symptoms, causes, and correct misconceptions about mental health.
3. Apply stress management techniques to enhance personal and professional well-being.
4. Assess and contribute to the development of mental health education programs at various levels.
5. Implement effective guidance and counselling strategies to address mental health concerns in educational and social settings.

EDPE83	EDUCATION FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the fundamental concepts, relationship, goals, and significance of Education for Sustainable Development (ESD).
2. Analyze the Sustainable Development Goals (SDGs) and their role in social transformation, peace, and human rights.
3. Examine the significance of SDG-4 in ensuring quality education and its alignment with NEP 2020
4. Evaluate the role of politics and policies in sustainable development and their impact on global sustainability.
5. Develop critical perspectives on decolonizing knowledge and democratizing science and technology for sustainable development.

Course Content:

Education and Sustainable Development

Meaning, Relationship, Goals, and Significance - Characteristics of Education for Sustainable Development (ESD) - Historical Perspective of Education for Sustainable Development - Philosophical, Sociological, and Psychological Perspectives - Role of Education in Sustainable Development - Decolonizing Knowledge for Sustainable Development - Challenges of Education for Sustainable Developmen.t

Sustainable Development Goals (SDGs)

Meaning, Nature, and Significance of SDGs - UNESCO Agenda on Sustainable Development Goals - SDGs and Social Transformation as a Universal Commitment - Education as a Human Right to Achieve Sustainable Development - Sustainable Development and Peace - Role of Educational Institutions - Challenges in Achieving SDGs.

SDG Goal-4: Quality Education for All

Meaning, Nature, and Significance - National Education Policy (NEP) 2020 on SDG-4 - Sustainable Lifestyle - Gender Equality - Promotion of Peace and Non-Violence - Global Citizenship - Good Mental Health and Well-being - Justice in Society - Pedagogical Issues for SDG-4.

Sustainable Development: Politics and Policies

Understanding the Policy-Making Process - Policy Analysis - Democratizing Science and Technology - Globalization and the Environment: Capitalism, Ecology, and Power - Perspectives, Methods, and Skills - Innovation for Sustainability - Key Issues from an International Perspective - Critical Issues Involved in Sustainability.

Implementation and Future Challenges in Sustainable Development

Strategic Implementation of Sustainable Development Goals - Education Reforms for Sustainability - Role of Stakeholders in Sustainable Development - Ethical Considerations and Sustainability - Future Challenges and Opportunities in Achieving Sustainable Development.

Suggestive Practicum:

1. To present critical review on NEP, 2020 in the context of SDGs.
2. Critical study of Delors Commission Report, 1996: Learning: The Treasure within with reference to SDGs.
3. To review and present a critical report on legal perspective on SDGs.
4. To prepare Toolkit for Educations for Sustainable Development.
5. To organize discussions/ seminars of Teachers of all streams to present their views on SDGs and to present Action Plan for this. 6. To prepare and present a short Video/film to promote SDGs

Reference Books:

1. *Ahlawat, A. (2019). Sustainable development goals. Notion Press.*
2. *Bamber, P. (2019). Teacher education for sustainable development and global citizenship. Routledge.*
3. *Devaki, N. (2019). Education for sustainable development. Shanlax Publications.*
4. *Goel, S., & Sharma, N. (2020). Education for sustainable development (ESD). Universal Academic Books Publishers & Distributors.*
5. *Ossewaarde, M. J. (2018). Introduction to sustainable development. SAGE Publications Pvt. Ltd.*
6. *Padmanabhan, J. (2021). Education for sustainable development. Atlantic Publishers and Distributors Pvt Ltd.*
7. *Paswan, R. (2022). An illustrated guide to sustainable development & goals. Notion Press.*
8. *Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). An introduction to sustainable development. Taylor & Francis Books India Pvt. Ltd.*
9. *Roy, S. (2011). Encyclopaedia of sustainable development. ABD Publishers.*

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to:

1. Demonstrate knowledge of Education for Sustainable Development, its characteristics, and challenges.
2. Critically assess the impact of Sustainable Development Goals (SDGs) on social transformation and global peace.
3. Apply pedagogical strategies to integrate SDG-4 principles into educational practices.
4. Analyze policy-making processes and their influence on sustainability at national and international levels.
5. Formulate strategies to address key issues in sustainability, including decolonizing knowledge and innovation for sustainability.

EDPE84	EMERGING TECHNOLOGIES IN EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to:

1. Understand the relationship between education and technology and distinguish between Technology of Education and Technology in Education.
2. Analyze the significance, principles, and historical development of technology in education.
3. Evaluate the role of Information and Communication Technology (ICT) in education.
4. Apply technology-integrated pedagogical approaches for teaching, learning, and assessment, including support for children with special needs.
5. Develop instructional design strategies and e-content using multimedia tools and Open Educational Resources (OER)

Course Content:

Education and Technology

Relationship between Education and Technology - Conceptual Clarity of Technology of Education and Technology in Education - Meaning, Nature, and Significance of Technology in Education - Historical Development of Use of Technology in Education - Principles of Using Technology in Education - Emerging Trends in Technology in Education.

Information and Communication Technology (ICT)

Meaning, Nature, and Types - Fundamentals of Information and Communication Technology - ICT Tools and Applications - Hardware and Software: Meaning, Difference, and Types - System Software and Application Software - ICT Application and Multiple Intelligence - Social, Economic, and Ethical Issues Associated with the Use of ICT.

Technology in Education and Pedagogy

Approaches of Integration of Technology in Teaching and Learning - Subject-Specific ICT Tools for Creating and Facilitating Learning - Subject-Specific Online Resources and Their Uses in Lesson Planning - Technology Integrated Learning Experiences and Creating Learning Environments - Use of Technology for Children with Special Needs: Tools and Processes; Universal Design for Learning - Massive Open Online Courses (MOOC): Concept and Use - ICT for Assessment and Management

Online and Offline Software Applications

Application Software: Meaning and Types - Word Processing, Spreadsheet, Presentation: Features and Educational Applications - Drawing Tools: Diagrams,

Concept Maps, Timelines, Flow Charts - Educational Applications of These Tools - Web 2.0 Technology and Tools: Meaning, Characteristics, and Types - Social Networking and Social Bookmarking: Educational Applications - Blog and Microblog: Reflective Journaling and Other Educational Applications - Wiki, YouTube, TED, Skype: Collaborative Authoring and Projects - Instant Messaging and Its Educational Applications - Online Forums/Discussion Groups and Chats: Educational Applications - Social Media Sharing: Video, Presentations, Audio (Podcasts), Graphics, and Text - Web 2.0 Tools for Creating, Sharing, Collaborating, and Networking

Instructional Design and E-Content

Instructional Design: Concept, Principles, Models, and Stages - E-Learning Courseware (E-Content) Design - Identifying and Organizing Course Content: Need Analysis (Learner, Content, and Task), Learning Objectives, and Course Sequence - Designing Instructional Media, Evaluation, and Delivery Strategies - Creating Interactive Content: Storyboard, Courseware Outline, Interactivity, and Interface - Courseware Delivery and Evaluation - Multimedia Tools: Audio Editing, Video Editing, Screen Casting, Graphic Editing, Basics of Animation, and Creating Interactive Media - Reusable Learning Objects (RLO): Meaning, Types, and Characteristics, RLO Repositories, Metadata, and Standards - E-Content Authoring Tools: Open Source and Proprietary Alternatives - Open Educational Resources (OER): Meaning and Importance, Various OER Initiatives, Creative Common Licensing

Suggestive Practicum:

1. Creating an account in wikispace/ wikipedia/ mediawiki and adding/editing content.
2. Developing an educational blog in www.blogger.com, www.wordpress.com.
3. A critical study of some ***e-learning*** course.
4. Developing a multimedia e-content for a topic.
5. Field visits to the EDUSAT center and take part in teleconferencing.
6. Planning and creating digital rubrics for any topic
7. Organizing web conferencing using Skype/Yahoo/ Messenger/ Google+.
8. Interview of computer hardware engineer/ICT specialist regarding Hardware planning, evaluation, maintenance, and up gradation
9. Review of NEP, National ICT policy and curriculum in the context of Technology in Education.
10. Enrolling and completing some MOOC courses of interest.
11. Developing technology integrated unit/lesson plans and trying them out in schools.

Reference Books:

1. *Aggarwal, J. C. (2016). Essentials of educational technology. Vikas Publishing House.*
2. *Lata, S., & Khatri, H. L. (2016). Educational technology. Shipra Publications.*
3. *Mangal, S. K. (2009). Essentials of educational technology. Prentice Hall India Learning Private Limited.*

4. *Mohanty, J. (2016). Modern trends in educational technology. Neelkamal Publications Pvt. Ltd.*
5. *Mukhopadhyay, M. (2022). Educational technology for teachers. Shipra Publications.*
6. *Prakash, S., & Shukla, S. (2019). Information communication and educational technology. Agrawal Publication.*
7. *Rajasekar, S., & Vanaja, M. (2014). Educational technology & computer education. Neelkamal Publications Pvt. Ltd.*
8. *Ramakrishna, A., & Mrunalini, T. (2016). Information & communication technology (ICT) in education. Neelkamal Publications Pvt. Ltd.*
9. *Sharma, S. (2016). Communication and educational technology. Elsevier India.*
10. *Watson, D., & Brown, G. (2021). Cambridge IGCSE information and communication technology. Hodder Education.*

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to:

1. Demonstrate an understanding of the key concepts and significance of technology in education.
2. Assess the impact of ICT tools and applications in diverse educational contexts.
3. Utilize subject-specific ICT tools and online resources to enhance teaching and learning
4. Apply knowledge of software applications, Web 2.0 tools, and social media for educational purposes
5. Design and evaluate instructional materials, e-learning content, and multimedia resources for effective teaching and learning.

EDPE85	GENDER EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to,

1. Understand the meaning, relationship, and significance of gender in education.
2. Analyze key gender-related concepts and their impact on education and society.
3. Examine the social and cultural perspectives of gender identity and roles in learning
4. Evaluate issues related to gender, sexuality, and sexual violence in educational settings
5. Develop strategies for creating gender-sensitive pedagogical practices and classroom environments.

Course Content:

Gender and Education

Meaning, Relationship, and Significance of Studying Gender in Education - Conceptual Clarity of Related Terms: Gender, Gender Perspective, Sexuality, Patriarchy, Masculinity, Feminist, Gender Bias, Transgender, Gender Stereotyping, and Empowerment - Gender as the Basis in School Education - Constitutional Provisions with Special Reference to Equity and Equality, Rights of Girls - Education and Women's Empowerment - Shifting from Women's Studies to Gender Studies

Learning Gender Roles

Social and Cultural Perspectives of Gender Identity: Role of Family and School, Media, and Other Formal and Informal Organizations/Agencies - Socialization and Learning Gender Roles - Gender Stereotyping and Role Models - Preventive Measures: Role of School and Home

Gender, Sexuality, Sexual Violence, and Abuse

Development of Sexuality and Its Impact on Children with Reference to Gender, Body Image, and Role Models - Sexual Violence in Formal and Informal Institutions - Child Sexual Abuse from Pre-primary to Secondary Stage - Providing Accurate Information on Child Sexual Abuse - Helping and Identifying Signs of Sexual Abuse in Children - Providing Dos and Don'ts About Sexual Abuse - Legal Perspective: Laws for Safety and Security of Girls and Women, Implementation of the POCSO Act

Pedagogical Issues

Analyzing Classroom Practices - Creating Gender-Friendly Classrooms and School Environment - Analyzing Curriculum from a Gender Perspective: Learning Outcomes, Textual Material, Teaching-Learning Processes, Language Used, Teaching Aids, Assessment Strategies - ICT Pedagogy for Gender-Sensitive School Curriculum - Challenges for Pedagogical Issues

Strategies for Gender Equity in Education

Developing Gender-Sensitive Policies in Schools and Educational Institutions - Role of Teachers, Administrators, and Policy Makers in Gender-Inclusive Education - Integrating Gender Perspectives in Teacher Training and Professional Development - Advocacy and Awareness for Gender Equity in Education - Overcoming Challenges in Gender-Sensitive Educational Practices

Suggestive Practicum:

1. Preparing a Report on National Educational Policies, (1986/1992 and2020) in the context of gender issues in Education.
2. Preparation of projects on:
   - Analysis of textual materials from the gender perspective for identifying gender bias and gender stereotype in textual materials.
   - Recommendations of commissions and policies on education to empower girls/women.
   - Mahila Samakhya Programme.
   - Women Role Models in various fields with emphasis on women in unconventional roles.
   - Video clipping on portrayal of women.
   - Folklores reflecting socialization process.
   - How students perceive sexuality and their own body images.
3. Field visits to schools to observe the schooling processes from a gender perspective.
4. Preparing Analytical Report on portrayal of men and women in print and electronic media.

Reference Books:

1. Agarwalla, S. (2020). Gender and education. Mahaveer Publications.
2. Geribo, T. B. (2012). Gender and education. Grin Verlag.
3. Jandhyala, K., & Ramachandran, V. (2019). Gender and education. The Orient Blackswan.
4. Khan, M. A., & Lakshmi, B. G. (2021). Gender, school, society and inclusion in education. Neelkamal Publications.
5. Lindsey, L. L. (2011). Gender roles: A sociological perspective. Prentice Hall India Learning Private Limited.
6. Lindsey, L. L. (2014). Gender roles: A sociological perspective. Pearson.
7. Manjrekar, N. (2020). Gender and education in India. Aakar Books, Delhi.
8. Mehta, R. (2023). Gender and education. Bluerose Publishers Pvt. Ltd.
9. Rana, K. K. (2021). Gender school and society. Pasricha Publications.

Course Outcomes (COs):

After completing this course, students will be able to:

1. Demonstrate an understanding of gender-related concepts and their relevance in education.
2. Assess the role of socialization, family, school, and media in shaping gender identities and stereotypes.
3. Identify and address issues of sexual violence, child sexual abuse, and legal frameworks for gender safety.
4. Apply gender-sensitive pedagogical strategies in curriculum development and classroom practices.
5. Critically analyze challenges in implementing gender equity and inclusion in educational institutions.

EDPE86	GUIDANCE AND COUNSELING	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to,

1. Understand the meaning, need, nature, and scope of guidance and counseling
2. Examine historical perspectives and developments in the field of guidance in India.
3. Analyze different counselling approaches, techniques, and their application in various settings.
4. Evaluate psychological testing methods, personality assessments, and appraisal techniques.
5. Address ethical issues, challenges, and limitations in organizing guidance and counselling programs.

Course Content:

Guidance

Meaning, Need, Nature, and Scope of Guidance - Brief Historical Background of the Guidance Movement in India - Individual and Group Guidance - Basic Assumptions and Principles of Guidance - Understanding the Needs of Individuals and Groups in the Context of Guidance - Essential Information for Effective Guidance - Vocational Guidance and Role of Teachers

Counselling

Meaning, Importance, Areas, and Types of Counselling - Approaches to Counselling: Directive, Non-directive, and Eclectic - Behaviourally and Cognitively Oriented Counselling - Process of Counselling: Initiating Counselling, Preparation, and Intake Procedures - Establishing Rapport, Termination of and Response to Initial Interview - Establishing Structure: Attending Behaviour, Observation, Non-verbal Behaviour, Listening, Verbal Patterning, and Communication Responses - Silence, Use of Questions, Transference and Countertransference - Respect in Counselling Relationships - Involuntary Clients, Client Expectations - Role of Family and Community

Tools and Techniques to Collect Data

Psychological Testing and Diagnosis: Need and Nature - Test Use and Interpretation - Appraisal Techniques - Counselling Interview: Essential Aspects, Basic Procedures, Problems, and Their Handling - Personality Assessment: Historical Perspective - Material Administration, Scoring, Interpretation, and Evaluation of Frequently Used Personality Inventories/Questionnaires and Projective Tests - Personal Orientation Tests and Rating Scales: Type A Behaviour, Locus of Control, Attitude Scale, STAI, and Other Clinical Rating Scales - Case Study: Need and Importance.

Issues Related to Guidance and Counselling

Factors Affecting Guidance and Counselling - Ethical Issues in Guidance and Counselling - Limitations of Diagnosis with Special Reference to Counselling - Challenges in Organizing Guidance and Counselling Programmes in Schools - Counselling and Guidance for Persons with Learning Disabilities, Visual and Hearing Impairment - Challenges Related to Counselling Services in Schools.

Strategies for Effective Guidance and Counselling

Designing and Implementing Guidance and Counselling Programs in Schools - Role of Teachers as Counsellors - Enhancing Counselling Services for Students with Special Needs - Collaboration Between Schools, Families, and Communities for Effective Counselling - Evaluating the Impact of Guidance and Counselling Interventions - Overcoming Barriers to Effective Guidance and Counselling.

Suggestive Practicum:

1. Prepare a case study on students with learning difficulties.
2. Prepare a report on challenges of organizing guidance and counselling programmes in school.

Reference Books:

1. *Barki, B. G., & Mukhopadhyay, B. (1989). Guidance and counselling: A manual. Stosius Inc/Advent Books Division.*
2. *Bhola, P. (2017). Guidance and counselling. Lakshmi Narain Agarwal.*
3. *Mishra, S. K. (2018). Guidance and counseling. Gyan Geeta Prakashan.*
4. *Ramaswamy, B. (2017). Fundamentals of guidance and counselling. Kanishka Publishers.*
5. *Reddy, G. L., & Thankachan, T. C. (2016). Guidance and counselling. Neelkamal Publication.*
6. *Reddy, K. S., & Ravindernath. (2017). Guidance and counseling. Neelkamal Publication.*
7. *Sharma, A., & Biswas, R. (2021). Guidance & counselling. Aaheli Publishers.*
8. *Tiwari, R. (2009). Guidance and counselling. New Central Book Agency Pvt Ltd.*

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to,

1. Demonstrate knowledge of the principles, assumptions, and scope of guidance and counseling
2. Assess individual and group guidance needs and apply appropriate strategies in educational settings.
3. Utilize various counselling techniques and approaches for effective intervention
4. Interpret psychological tests and appraisal tools for effective guidance and counselling.
5. Critically analyze issues and challenges related to guidance and counselling services in schools.

EDPE87	PEACE EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are,

1. Understand the meaning, need, dimensions, and goals of Peace Education
2. Examine historical, philosophical, sociological, and psychological perspectives of Peace Education.
3. Analyze the role of various individuals, institutions, and agencies in peace-building.
4. Evaluate different approaches, frameworks, and pedagogical issues related to Peace Education.
5. Address challenges in implementing Peace Education and conflict resolution strategies.

Course Content:

Peace Education: Nature and Significance

Peace and Peace Education - Meaning, Need, Dimensions, and Goals of Peace Education - Historical Development of Peace Education - Philosophical, Sociological, and Psychological Perspectives of Peace Education - Types of Peace: Positive, Negative, Inner, Social, and With Nature - Conflict Resolution and Peace Education - Relationship Between Development and Peace-building - Learning from Experiences to Explore the Scope of Peace Education - Challenges to Peace Education

Towards the Global Culture of Peace

Process of Peace-building - Culture of Peace vs. Culture of War - Approaches to Peace Education - Conflict Analysis and Resolution - Role of Social and Religious Foundations in Peace-building - Role of Local and International Agencies in the Peace-building Process - Contribution of Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo, and Dalai Lama to Global Peace-building

Thoughts on Peace and Harmony

Ancient Indian Views on Peace - Role of the United Nations in Global Peace Education - Constitutional Provisions for Peace and Harmony - Study of Thinkers in Context of Global Peace and Harmony: J. Krishnamurti, Sri Aurobindo, Rabindranath Tagore, Mahatma Gandhi, Maria Montessori, Bertrand Russell, and Dalai Lama

Pedagogical Issues for Peace Education

Assessing Curriculum Policy for Social and Civic Reconstruction - Comparative and Historical Perspectives on School Knowledge and Peace - Socio-Historical Processes in Curriculum Change - Teachers' Perceptions of the Effects of Young People's War Experiences and Pandemics - Critical Analysis of School Curricula in Light of the Peace-building Process - Challenges of Pedagogical Issues in Peace Education

Strategies for Effective Peace Education

Designing and Implementing Peace Education Programs in Schools - Role of Teachers in Peace-building - Integrating Peace Education in the Curriculum - Community-Based Approaches for Peace Education - Collaboration Between Schools, Families, and Social Institutions - Evaluating the Impact of Peace Education Initiatives - Overcoming Barriers to Effective Peace Education

Suggestive Practicum:

1. Critical analysis of Educational Policies, Curriculum and Text Material for Peace-building Process.
2. Reflection on Human Rights, with special reference to Constitution of India, as a process of Social-cohesion and Peace.
3. Analyzing the Role of UNESCO in the context of Peace at Global level.
4. Collection of statements, shloka or sukti (Good Sayings) from ancient Indian literature related to inner and Social Peace.
5. Study of Yoga-Darshana as a process of Peace and Harmony.

Reference Books:

1. *Arulsamy, S. (2016). Peace and value education. Neelkamal Publication.*
2. *Arya, S. (2017). Peace education. K S K Publishers & Distributors.*
3. *Bringhamani, M. (2015). Peace and value education. Discovery Publishing House.*
4. *Dhal, P. K. (2019). Peace education. Shipra Publications.*
5. *Goswami, M. K. (2021). Value and peace education. Ashok Book Stall.*
6. *Kumar, T. S. (2017). Values and peace education. 24by7Publishing.*
7. *Selvi, A. V., & Charles, K. (1978). Peace and value education. Neelkamal Publication.*

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to,

1. Demonstrate knowledge of the principles, scope, and significance of Peace Education.
2. Assess the relationship between development and peace building at local and global levels.
3. Utilize various peace education approaches for conflict resolution and social harmony.
4. Analyze the contributions of thinkers and organizations toward global peace and harmony.
5. Critically evaluate school curricula and pedagogical issues in the light of Peace Education.

EDPE88	SPORTS AND FITNESS EDUCATION	L	T	P	C
		4	0	0	4

Course Objectives:

The Objectives of the course are to,

1. Understand the evolution and importance of health and physical education in the educational framework
2. Develop comprehensive knowledge of health education principles and their practical applications
3. Master the fundamentals of games, fitness, and physical activities
4. Analyze and implement relevant policies and programs in health and physical education
5. Evaluate and assess health and physical education outcomes in educational settings

Course Content:

Evolution and Foundation of Health and Physical Education
Definition and scope-Global and local perspectives-Aims and objectives-Historical Development-Evolution in school curriculum-Integration with Indian education system-Cross-curricular relationships-Contemporary Status-Primary to secondary education globally-Ayurvedic and yogic perspectives-Legal framework in India.

Health Education Fundamentals
Dimensions of health-Determinants in Indian context-Current challenges- Physical and Psychological Aspects-Body systems and functions-Psycho-social concerns-Special needs considerations-Health Management-Common health issues-Prevention and cure-Immunization protocols-Nutrition and dietary requirements.

Games and Physical Fitness
Athletic activities-Lead-up games and relays-Rhythmic activities-Gymnastics-Fitness Development-Posture improvement-Relaxation techniques-Fitness assessment-Sports and Recreation-Fundamental skills-Indigenous activities-Self-defence-Sports awards and scholarships.

Policies and Programs
School health programs-Family health services-Blood bank operations-Media role in health awareness-Safety and Emergency Response-Safety protocols-First aid principles-Emergency procedures - Legal Framework: POCSO Act 2012-PWD 2016-Child Protection Schemes

Assessment and Implementation
School health services-Global health initiatives-Health-promoting schools-Yoga Integration: Historical background-Classifications and schools-Therapeutic applications-Performance Assessment-Health performance testing-Sports evaluation methods-Progress reporting-Documentation procedures.

Suggestive Practicum:

1. Recognizing important indicators of health and wellbeing of children and mental health.
2. Undertaking a survey, understanding local food related matters, and understanding the importance of the right to food.
3. Analyzing NEP, 2020 with reference to Games Oriented Education.
4. Planning activities for development of physical fitness.
5. Organization of games and sports tournaments
6. Learning and performing basic yogic activities, asanas, and pranayama, Kriyas and Meditation. Celebration of yoga day, yoga week.
7. Arranging reflective Dialogues on Serials and related videos.
8. Preparation of inventories on myths on exercises and different types of food.
9. Preparation of First Aid kit.
10. A critical review of YOGA-SUTRA

Reference Books:

1. Aggarwal, J. C. (2016). *Health and physical education*. Vikas Publishing House.
2. Auerbach, S. E., & Gramling, S. (1997). *Stress management: Psychological foundations*. Pearson.
3. Bucher, C. A. (2017). *Foundations of physical education, exercise science, and sport*. McGraw-Hill Education.
4. Park, K. (2023). *Park's textbook of preventive and social medicine*. M/s Banarsidas Bhanot Publishers.
5. Swami Satyananda Saraswati. (2007). *Asana pranayama mudra bandha*. Bihar School of Yoga.

Course Outcomes (COs):

After the completion of this course, the prospective teachers will be able to,

1. Demonstrate understanding of health and physical education concepts and their historical development
2. Apply health education principles to address various physical and psychological needs
3. Design and implement effective physical fitness and sports programs
4. Execute health and safety protocols while conducting physical education activities
5. Assess and evaluate student performance in health and physical education

CURRICULUM

(INTER-DISCIPLINARY COURSES)

ODD SEMESTER - Offered to Other Departments - PHAL11

Physics I

3-0-1 (4 credits)

Course Objectives

The course aims to

1. Analyze the motion of a single particle under the influence of a force.
2. Understand the concept of special theory of relativity
3. Explain the laws of electricity and magnetism.
4. Understand basic concepts in quantum mechanics and the basics of atomic and molecular physics.
5. Learn the experimental aspects on the properties of materials and modern physics.

Course Content

Mechanics

Review of Newton's laws and motion of a particle in one dimension. Position, velocity and acceleration in Cartesian and polar coordinates. Work, energy and, Conservative forces. Central forces. Gravitational force and potential. Kepler's laws of planetary motion. Motion of Satellites - Introduction to special theory of relativity.

Electricity and Magnetism

Coulomb's law - Gauss's law – proof of Gauss's law- Electrostatic field in the matter: dielectric polarization, polarizability and susceptibility - types of polarization – internal field and Claussius-Mosotti equation. Magnetostatics: Lorentz force -Steady current and equation of continuity - Biot-Savart law – Ampere's law –Magnetostatic field in matter: torques and forces on magnetic dipoles-Magnetization-Faraday's law of induction.

Quantum mechanics

Waves behaving as particles; Photoelectric effect- Black body radiation and Planck's hypothesis. Particles behaving as waves; de Broglie hypothesis, matter waves, diffraction of electron waves. Heisenberg Uncertainty principle.Wave function - Position and momentum operators. One dimensional Schrödinger equation. Particle in a box. Potential well. Potential barrier and tunneling (qualitative discussion).

Atomic and Molecular Physics

Hydrogen atom energy – Spectral series – The Bohr atom – Origin of line spectra - Correspondence principle – Rutherford scattering formula – The molecular bond – the hydrogen molecule – rotational energy levels – vibrational energy levels – Electronic spectra.

List of Experiments

1. Determination of Young's modulus - non-uniform bending.
2. Find the velocity of ultrasonic waves in a solid.
3. Determine the coefficient of viscosity of water by capillary flow method.
4. Surface tension of a liquid and interfacial surface tension using the method of drops.
5. Study the Photoelectric effect: photo current versus intensity and wavelength of light.

Course Outcomes

After completion of the course, the students would

1. Learn about the motion of a single particle under the influence of a force.
2. Know the concept of special theory of relativity
3. Understand the laws of electricity and magnetism and derive its consequences.
4. Acquire knowledge of concepts in quantum mechanics and their applications in atomic physics.
5. Appreciate the experimental aspects on the properties of materials and modern physics.

Textbooks

1. A. Beiser, S. Mahajan, S. R. Choudhury, Concepts of Modern Physics, 7th Edn., McGraw-Hill (2017).
2. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).

References

1. P. A. Tipler and R. A. Llewellyn, Modern Physics, W. H. Freeman and Co. (2008).
2. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill (1986).
3. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson (2005).
4. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Wiley (2013).
5. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018).

EVEN SEMESTER - Offered to Other Departments - PHAL21

Physics II

3-0-1 (4 credits)

Course Objectives

The course aims to

1. Expose on the essential aspects of crystallography.
2. Distinguish different types of waves and demonstrate with examples.
3. Understand basic phenomena in optics and concepts such as interference and diffraction.
4. Assimilate knowledge in electromagnetic waves.
5. Experimental skills in basic physics concepts.

Course Content

Crystallography

Crystalline and amorphous solids – lattice and unit cell – Reciprocal lattice - seven crystal system and Bravais lattices – symmetry operation – Miller indices – atomic radius – coordination number – packing factor calculation for sc, bcc, fcc – Bragg's law of X-ray diffraction.

Waves

Simple harmonic motion; examples and solution to the simple harmonic oscillator. Classification of damped oscillators. Driven oscillator. Wave equation; solutions of wave equation. Energy and power transmitted in a wave. Sound waves and their speed. Introduction of the plane waves of electromagnetism. Poynting vector and intensity of light.

Optics

Interference and coherent sources. Two sources-interference of light. Intensity in an interference pattern. Interference in thin films. Michelson interferometer. Fresnel and Fraunhofer diffraction. Diffraction from a single slit. Diffraction from multiple slits. Diffraction grating.

Electromagnetic waves

Maxwell equations – Electromagnetic energy and Poynting vector – radiation pressure electromagnetic wave equation in a vacuum – propagation of EM waves in non-conducting media – waves in conducting media.

List of Experiments

1. Determine the dispersive power of a prism
2. Determine the wavelength of laser using a diffraction grating

3. Find the radius of curvature of lens-Newton's Rings
4. Determine the numerical aperture of an optical fiber
5. Find the specific rotation of a liquid – Half Shade Polarimeter

Course Outcomes

After completion of the course, the students would

1. Know the basic concepts of crystallography.
2. Appreciate different types of wave motion.
3. Understand concepts such as interference and diffraction under various scenarios.
4. Acquire knowledge of optics and electromagnetic waves.
5. Appreciate the experimental aspects of interference, diffraction and polarization.

Textbooks

1. A. R. West, Solid State Chemistry and its Applications, Wiley (2014).
2. H. D. Young and R. A. Freedman, University Physics, Pearson (2020).

References

1. C. Kittel, Introduction to Solid State Physics, Wiley (2019).
2. M.N. Avadhanulu and P.G.Kshirsagar, A textbook of Engineering Physics, S. Chand and Company, New Delhi (2009).
3. Ajoy Ghatak, Optics, McGraw Hill (2008).
4. D. J. Griffiths, Introduction to Electrodynamics, Cambridge Univ. Press (2017).
5. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Wiley (2013).
6. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018).

CHAL31	Fundamental Aspects in Chemistry	L	T	P	C
		3	0	1	4

PRE-REQUISITE: NIL

COURSE LEARNING OBJECTIVES

Upon completion of the course, the student will be able to –

1. Understand basic concepts of atomic structure and bonding in simple molecules.
2. Understand basic concepts of thermodynamics.
3. Understand the basic concepts of aromaticity and stereochemistry of organic molecules.
4. Distinguish between different organic reaction mechanisms.
5. Estimate of acid/base strengths using titrimetric methods.

COURSE CONTENT

Structure and bonding: Atomic structure and periodic table – Schrödinger equation of H-atom - Introduction to bonding – Transitions between main types of bonding - Inert pair effect – Ionic bonding – AX and AX_2 type- Lattice energy- covalent bonding- LCAO method - VSEPR Theory –Metallic bond - Basics of MO Theory – General Properties of Elements.

Aromaticity and Stereochemistry: Aromaticity and principles- concepts and Concept of optical activity, specific rotation, enantiomeric excess, and racemic mixtures. Chiral centre identification. Fischer/Newmann projection and inter translations, Stereoisomerism: cis/trans, E/Z, R/S, D/L, erythro/threo/meso. Enantiomers and Diastereomers. Optical isomers of Glucose. Conformational analysis of ethane and butane.

Organic reaction mechanisms: Types of organic reactions (Addition/Substitution/Elimination) with examples and their nomenclature. Electrophilicity and Nucleophilicity. Concepts of Inductive effect, Resonance, and Aromaticity. Introduction to important functional groups: Alkane /Alkene /Alkyne /Alcohol /Aldehyde /Ketone /Carboxylic Acid /Ester /Ether /Amine /Amide.

Acid base and redox reactions: Concepts of acid-base: Brønsted-Lowry, Lewis. pH and pK_a. Strengths of organic/inorganic acids/bases and their dependence on atomic/molecular structure. HSAB principle. Solvent effect. Buffer mechanism. Henderson-Hasselbach equation. Ion-electron method. Concept of molarity/molality/formality/Eq. wt./wt%/ppm. Acid-base, redox, and iodometric titration. Indicators.

Thermodynamics: Maxwell's velocity distribution of an ideal gas. Equipartition theorem. $1^{st}/2^{nd}/3^{rd}/0^{th}$ laws of thermodynamics. Statistical concept of entropy. Concept of chemical equilibrium. Relationships between K_p – K_c and K_{eq} – ΔG. LeChatelier's principle. Born-Haber cycle and Hess's law. Phase Rule - Phase diagram of single, two-componentsystems.

Laboratory Component

1. Semi-micro analysis & Analysis of mixtures
   i. Cations: NH_4^+, Pb^{2+}, Cu^{2+}, Fe^{3+}, Fe^{2+}, Al^{3+}, Co^{2+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}
   ii. Anions: CO_3^{2-}, NO_2^-, SO_3^{2-}, Cl^-, Br^-, I^-, CH_3COO^-, NO_3^-, $C_2O_4^{2-}$, S^{2-}, PO_4^{3-}, SO_4^2
2. Estimation of carbonate, non-carbonate, and total hardness in the given water sample using EDTA.
3. Estimation of Dissolved Oxygen
4. Determination of the percentage of Fe(II) in the given steel sample using $KMnO_4$

REFERENCE BOOKS

1. Prakash. S., Madan. R. D., Tuli. G. D., & Basu. S. K. (2022) Advanced Inorganic Chemistry: Vol. I (Library Edition), S. Chand Publishing.
2. Puri. B. R., Sharma. L. R., & Pathania. M. S., (2022) Principles of Physical Chemistry, 48th Edition, Vishal Publishing Co.
3. Morrison R.T, Boyd, R.N, Bhattacharjee, S. K, Organic Chemistry, 7th Ed. Dorling Kindersley (India) Pvt. Ltd, (Pearson Education) 2011
4. Allied Practical Manual (2024). Department of Chemistry. National Institute of Technology Tiruchirappalli. (Private circulation).
5. V. Ramanujam, *Inorganic Semi-micro Qualitative Analysis*, 3rd Edition, National Publishing Company, l990.

COURSE OUTCOMES

Upon completing the course, the student will be able to –

CO1	Understand the basic concepts of atomic structure and bonding in simple molecules
CO2	Understand the basic concepts of thermodynamics.
CO3	Understand the basic concepts of aromaticity and stereochemistry of organic molecules.
CO4	Estimate of acid/base strengths using titrimetric methods.

CHAL41	Concepts in Chemistry	L	T	P	C
		3	0	1	4

PRE-REQUISITE: CHAL31: Fundamentals Aspects in Chemistry

COURSE LEARNING OBJECTIVES

Upon completion of the course, the student will be able to –

1. explain the concepts in coordination chemistry and apply them to infer the properties of complexes.
2. solve the problems on reaction rates using principles of chemical kinetics.
3. outline the principles and applications of electrochemistry.
4. explain about macromoleces and applications of industrially relevant polymers
5. summarize principles of photochemistry and photophysics.

COURSE CONTENT

Coordination Chemistry: Werner's theory- central metal atom- types of ligands - nomenclature and isomerism of coordination compounds- effective atomic number- VBT - prediction of structure and calculation of spin only magnetic moment-crystal field theory of octahedral, tetrahedral and square planar complexes- effects of crystal field splitting- chelates- important biological complexes- haemoglobin, chlorophyll, cis-platin (representative structure and functions).

Chemical Kinetics: Concept of rate, order, and molecularity of a reaction. Rate equations (0^{th} , 1^{st} , 2^{nd}, and n^{th} order). Determination of half-life. Activation energy: Arrhenius equation. Multi-step reactions: opposing, consecutive, parallel. Rate-determining step. Enzyme catalysis: Michaelis-Menten equation. Basic concepts of transition state theory.

Electrochemistry: Arrhenius theory, Ostwald dilution law. electrolytic conductance and transference – laws of electrolysis – conductance – ionic mobiliy – kohlrauschs law – applications of conductance measurements – galvanic cells – Nernst equation – Electrochemical series – EMF and equilibrium constant of cell reactions – applications of EMF measurements – Basics of Corrosion- Fuel cells and applications.

Macromolecules: Polymerization reaction and mechanism- type of polymers – Tacticity – Degree of polymerization - determination of molecular mass of polymers - Synthesis and applications of industrially relevant polymers - Structure and classification of Nucleic acids/Lipids/Carbohydrates/Amino acids. Structure of DNA, proteins, and cell membrane. Isoelectric point and electrophoresis.

Photochemistry: Difference between photochemical reactions and dark reactions, Laws of photochemistry Beer - Lambert's Law - derivation and applications, Einstein law of photochemical equivalence - quantum yield - kinetics of hydrogen-chlorine reaction, hydrogen-bromine reaction and decomposition of HI. Photophysical processes- Jablonski diagram, chemiluminescence.

Laboratory Component:

1. Estimation of Phenol
2. Estimation of Aniline
3. Kinetics of acid catalyzed hydrolysis of an ester.
4. Phenol – Water system
5. Conductometric Titration
6. pH metric titration

REFERENCE BOOKS

1. Prakash. S., Madan. R. D., Tuli. G. D., & Basu. S. K. (1994) Advanced Inorganic Chemistry: Vol. II, S. Chand Publishing.
2. Puri. B. R., Sharma. L. R., & Pathania. M. S., (2022) Principles of Physical Chemistry, 48th Edition, Vishal Publishing Co.
3. Allied Practical Manual (2024). Department of Chemistry. National Institute of Technology Tiruchirappalli. (Private circulation).
4. Venkateswaran.V., Veeraswamy, R., & Kulandaivelu, A. R. (1997). *Basic Principles of Practical Chemistry*, (2nd Ed.). New Delhi, Sultan Chand and Sons.
5. Ganapragasm, N. S., & Ramamurthy, G. (2007). Organic Chemistry Lab Manual, (2nd Ed.). S. Vishwanathan Printers and Publishers (P) Ltd.

COURSE OUTCOMES

Upon completing the course, the student will be able to –

CO1	explain the concepts in coordination chemistry and apply them to infer the properties of complexes. summarize principles of photochemistry and photophysics.
CO2	solve the problem son reaction rates using principles of chemical kinetics.
CO3	outline the principles and applications of electrochemistry.
CO4	explain about macromoleces and applications of industrially relevant polymers

Course Code	MAAL 11
Title of the Course	BASIC ANALYSIS AND ANALYTICAL GEOMETRY
Prerequisite	NIL
Credits (L-T-P)	4 (3L + 1T + 0P)
Course Type	Inter-disciplinary Course 1

Course Learning Objectives: Objective of the course is to

1. solve algebraic solutions of cubic and reciprocal equations.
2. apply various tests for determining convergence and divergence of an infinite series.
3. introduce the theory of analytic functions and techniques to evaluate integrals of complex functions.
4. present the theory behind eigenvalues and eigenvectors.
5. analyze the geometric properties and relationships of lines and planes.

Course Content

General properties of polynomial equations - Descartes' rule of signs - relation between the roots and the coefficients of equations - symmetric functions of the roots - sum of the powers of the roots of an equation - Transformation of equations - solution of reciprocal equations -solution of cubic equations-Cardon's method.

Introduction to sequences. Infinite series-convergence tests for positive term series – comparison, integral test, root test, ratio test, Raabe's tests, logarithmic test. Alternating series – Leibnitz's rule – absolute and conditional Convergence.

Analytic functions – Cauchy – Riemann equations – properties of analytic functions – Cauchy's integral theorem, Cauchy's integral formula and for derivatives– Taylor's and Laurent's expansions (without proof) – singularities – residues – Cauchy's residue theorem.

Eigenvalues and eigenvectors of a matrix – properties of eigenvalues –– Cayley-Hamilton Theorem- diagonalization of matrix.

Straight line: direction ratios and direction cosines - angle between two lines - distance of a point from a line - co-planarity of two lines - shortest distance between two skew lines. Plane: equation of a plane passing through the intersection of two planes - angle between two planes - bisectors of angles between two intersecting planes. Orthogonal projection of a point on aplane.

Reference Books:

1. Leonard E. Dickson, *First course in the theory of equations*, Holistence publications, Turkey, 2024.
2. Gilbert Strang, *Introduction to Linear Algebra*, 6th Edition, Wellesley-Cambridge Press, U.S., 2023.
3. James Ward Brown and Ruel V. Churchill, *Complex variables and Applications*, 9th Edition, McGraw Hill Education (India) Private Limited, 2021.
4. Abraham Adrian Albert, *Solid analytical geometry*, Dover Publications, New York,2016.
5. P.R.Vittal, *Analytical geometry 2D and 3D*, Pearson Education India, 2013.
6. Walter Rudin, *Principles of Mathematical Analysis,* 3rd Edition, McGraw Hill Education (India) Private Limited, 2023.

Course Learning Outcomes: On completion of the course, the students will be able to:

1. find the convergence of infinite series by applying various test.
2. find eigenvalue and eigenvectors of a matrix. Also, diagonalize matrices using eigenvalues and eigenvectors.
3. discuss analyticity of complex functions and find integral of complex function using Cauchy's integral theorem.
4. utilize the relationships between coefficients and roots in solving equations and find roots of cubic polynomial equations.
5. determine the intersection and angle between line and plane.

Course Code	MAAL12
Title of the Course	CALCULUS AND DIFFERENTIAL EQUATIONS
Prerequisite	NIL
Credits (L-T-P)	4 (3L + 1T + 0P)
Course Type	Inter-disciplinary Course 2

Course Learning Objectives: Objective of the course is to

1. discuss extrema of function of several variables.
2. understand partial differentiation and multiple integration of multivariable functions.
3. introduce differential operators for vector valued function and techniques for computing line integrals, surface integrals, and volume integrals.
4. introduce the classification and solution methods for different types of differential equations.
5. discuss power series solution for differential equations.

Course Content

Functions of several variables – partial derivatives and transformation of variables – Jacobian and its properties- Taylor series-maxima and minima of function of several variables.

Double integral – changing the order of Integration – change of variables from Cartesian to polar coordinates – area using double integral in Cartesian and polar coordinates – triple integral – change of variables from Cartesian to spherical and cylindrical coordinates – volume using double and triple integrals.

Gradient, divergence and curl – directional derivative – tangent plane and normal to surfaces – solenoidal and irrotational fields. Line, surface and volume integrals – Green's theorem, Stokes' theorem and Gauss divergence theorem.

Higher order linear differential equations with constant coefficients: second order linear differential equations with variable coefficients. Method of variation of parameters, CauchyEuler equation.

Power series solutions- Legendre polynomials, Bessel functions and its properties.

Reference Books:

1. Maurice D. Weir, Joel Hass , Christopher Heil, Przemyslaw Bogacki , *Calculus*, 15thEdition, Pearson Education, India, 2024.
2. Tom M. Apostol, *Calculus, Volume I*, 2nd Edition, Wiley India Pvt Ltd, 2022.
3. Tom M. Apostol, *Calculus, Volume II*, 2nd Edition, Wiley India Pvt Ltd, 2022.
4. William E. Boyce, Richard C. DiPrima, Douglas B. Meade, *Elementary Differential Equations and Boundary Value Problems*, Wiley India Pvt Ltd, 2021.

Course Learning Outcomes: On completion of the course, the students will be able to:

1. write Taylor's series and discuss maxima and minima of function of several variables.
2. evaluate multiple integral and its applications in finding area, volume.
3. compute the dot product of vectors, lengths of vectors, and angles between vectors.
4. use Green's, Gauss divergence and Stoke's theorems to solve problems.
5. solve second order differential equations of some standard type.

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