MANAV RACHNA UNIVERSITY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF CHECMISTRY

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

B.Sc. (Hons.) Chemistry

BATCH: 2015-2018

	MANAV RACHNA UNIVERSITY									
	DEPARTMENT OF CHEMISTRY									
	B.SC (CHU01)									
	SEMESTER - 1									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
MAH113-T	ESSENTIALS OF MATHEMATICS	MA	HARD	CORE	3	1	0	0	4	4
MAH114-T	FUNDAMENTALS OF MATHEMATICS									
MAH113-P	ESSENTIALS OF MATHEMATICS LAB	MA	HARD	CORE	0	0	2	0	2	1
MAH114-P	FUNDAMENTALS OF MATHEMATICS LAB									
PHH107-T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	4	4
PHH107-P	ESSENTIALS OF PHYSICS LAB				0	0	2	0	2	1
CHH101-T	GREEN CHEMISTRY	CH	HARD	CORE	3	1	0	0	4	4
CHH101-P	GREEN CHEMISTRY LAB				0	0	2	0	2	1
CSH101-T	STRUCTURED PROGRAMMING	CS	HARD	CORE	3	1	0	0	4	4
CSH101-P	STRUCTURED PROGRAMMING LAB				0	0	2	0	2	1
HLS101	BUSINESS ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
CSW151	COMPUTING WORKSHOP	CS	WORKSHOP	CORE	0	0	3	0	3	2
CHS102	ENVIRONMENTAL SCIENCE	CH	SOFT	UNIVERSITY COMPULSORY	1	0	2	0	3	0
FLS103	FRENCH-I	MRCFL	SOFT	UNIVERSITY COMPULS	1	1	0	0	2	0
FLS101	SPANISH-I									
FLS102	GERMAN-I									
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**15**	**5**	**15**	**0**	**35**	**24**
	SEMESTER - 2									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
CHH106-T	PHYSICAL CHEMISTRY-I	CH	HARD	CORE	3	1	0	0	4	4
CHH106-P	PHYSICAL CHEMISTRY-I LAB				0	0	2	0	2	1
CHH107-T	INORGANIC CHEMISTRY-I	CH	HARD	CORE	3	1	0	0	4	4
CHH107-P	INORGANIC CHEMISTRY-I LAB				0	0	2	0	2	1
MAH117-T	ADVANCED MATHEMATICS	MA	HARD	CORE	3	1	0	0	4	4
MAH118-T	FUNDAMENTALS OF MATHEMATICS-II									
MAH117-P	ADVANCED MATHEMATICS LAB				0	0	2	0	2	1
MAH118-P	FUNDAMENTALS OF MATHEMATICS-II LAB									
PHH108-T	MODERN PHYSICS	PH	HARD	CORE	3	1	0	0	4	4
PHH108-P	MODERN PHYSICS LAB				0	0	2	0	2	1
HLS102	COMMUNICATIVE ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
CHW109	CHEMISTRY IN EVERYDAY LIFE	CH	WORKSHOP	CORE	0	0	3	0	3	2
FLS107	FRENCH-II	MRCFL	SOFT	UNIVERSITY COMPULS	1	1	0	0	2	0
FLS105	SPANISH-II									
FLS106	GERMAN-II									
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**14**	**5**	**13**	**0**	**32**	**24**

	SUMMER TRAINING POST 2nd SEMESTER CHO110									3
	SEMESTER - 3									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
CHH211-T	INORGANIC CHEMISTRY-II	CH	HARD	CORE	3	1	0	0	4	4
CHH211-P	INORGANIC CHEMISTRY-II LAB				0	0	2	0	2	1
CHH212-T	PHYSICAL CHEMISTRY-II	CH	HARD	CORE	3	1	0	0	4	4
CHH212-P	PHYSICAL CHEMISTRY-II LAB				0	0	2	0	2	1
CHH213-T	ORGANIC CHEMISTRY-I	CH	HARD	CORE	3	1	0	0	4	4
CHH213-P	ORGANIC CHEMISTRY-I LAB				0	0	2	0	2	1
CHH214-T	ANALYTICAL CHEMISTRY & SPECTROSCOPY	CH	HARD	CORE	3	1	0	0	4	4
CHH214-P	ANALYTICAL CHEMISTRY & SPECTROSCOPY LAB				0	0	2	0	2	1
MCS231 MCS232	MANAGEMENT ELECTIVES: (1)Basics for Economics (2) Introduction to Finance		SOFT	ELECTIVE	1	0	2	0	3	2
EDS288 EDS289 EDS290	HUMANITIES ELECTIVES: (1) Applied Psychology (2) Applied Philosophy (3) Applied Sociology				1	0	2	0	3	2
CHW215	EXTRACTION & SYNTHESIS	CH	WORKSHOP	CORE	0	0	3	0	3	2
FLS211	FRENCH-III	MRCFL	SOFT	UNIVERSITY COMPULS	1	1	0	0	2	0
FLS209	SPANISH-III									
FLS210	GERMAN-III									
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**15**	**5**	**15**	**0**	**35**	**26**
	SEMESTER - 4									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
CHH216-T	INORGANIC CHEMISTRY-III	CH	HARD	CORE	3	1	0	0	4	4
CHH216-P	INORGANIC CHEMISTRY-III LAB				0	0	2	0	2	1
CHH217-T	PHYSICAL CHEMISTRY-III	CH	HARD	CORE	3	1	0	0	4	4
CHH217-P	PHYSICAL CHEMISTRY-III LAB				0	0	2	0	2	1
CHH218-T	ORGANIC CHEMISTRY-II	CH	HARD	CORE	3	1	0	0	4	4
CHH218-P	ORGANIC CHEMISTRY-II LAB				0	0	2	0	2	1
CHH219-T	POLYMER CHEMISTRY	CH	HARD	ELECTIVE	3	1	0	0	4	4
CHH220-T	CLINICAL AND PHARMACEUTICAL CHEMISTRY									
CHH219-P	POLYMER CHEMISTRY LAB	CH	HARD	ELECTIVE	0	0	2	0	2	1
CHH220-P	CLINICAL AND PHARMACEUTICAL CHEMISTRY LAB									
MAS230	QUANTITATIVE APTITUDE		SOFT	CORE	1	0	2	0	3	2
ECS249 CHS234	ENVIRONMENT ETHICS AND SUSTAINABLE DEVELOPMENT: 1. E-Waste: Environmental problem and management 2. Environmental Sustainable Development	CH/ CH	SOFT	ELECTIVE	1	0	2	0	3	2
CHW221	WORKSHOP ON COROSION	CH	WORKSHOP	CORE	0	0	3	0	3	2
FLS215	FRENCH-IV			UNIVERSI						

FLS213	SPANISH-IV	MRCFL	SOFT	TY COMPULS	1	1	0	0	2	0
FLS214	GERMAN-IV									
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**15**	**5**	**15**	**0**	**35**	**26**
	SUMMER TRAINING POST 4TH SEMESTER (CHO222)									
	SEMESTER - 5									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
CHH323-T	INSTRUMENTAL METHOD OF CHEMICAL ANALYSIS	CH	HARD	CORE	3	1	0	0	4	4
CHH323-P	INSTRUMENTAL METHOD OF CHEMICAL ANALYSIS LAB				0	0	2	0	2	1
CHH324-T	ORGANIC CHEMISTRY-III	CH	HARD	CORE	3	1	0	0	4	4
CHH324-P	ORGANIC CHEMISTRY-III LAB				0	0	2	0	2	1
CHH325-T	PHYSICAL CHEMISTRY-IV	CH	HARD	CORE	3	1	0	0	4	4
CHH325-P	PHYSICAL CHEMISTRY-IV LAB				0	0	2	0	2	1
CHH326-T	FOOD CHEMISTRY & TECHNOLOGY	CH	HARD	ELECTIVE	3	1	0	0	4	4
CHH327-T	GREEN TECHNOLOGY									
CHH326-P	FOOD CHEMISTRY & TECHNOLOGY LAB	CH	HARD	ELECTIVE	0	0	2	0	2	1
CHH327-P	GREEN TECHNOLOGY LAB									
CHN328	SEMINARS/ PRESENTATIONS	CH	NTCC	CORE	0	0	0	2	0	2
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**9**	**4**	**8**	**3**	**24**	**22**
	SEMESTER - 6									
SUBJECT CODES	**SUBJECT NAME**	****OFFERING DEPARTMENT**	***COURSE NATURE (Hard/Soft/ Workshop/ NTCC)**	**COURSE TYPE (Core/Elective / University Compulsory)**	**L**	**T**	**P**	**O**	**NO. OF CONTACT HOURS PER WEEK**	**NO. OF CREDITS**
CHH329-T	INDUSTRIAL & APPLIED CHEMISTRY	CH	HARD	CORE	3	1	0	0	4	4
CHH329-P	INDUSTRIAL & APPLIED CHEMISTRY LAB				0	0	2	0	2	1
CHH330-T	CHEMISTRY OF BIOMOLECULES & NATURAL PRODUCTS	CH	HARD	CORE	3	1	0	0	4	4
CHH330-P	CHEMISTRY OF BIOMOLECULES & NATURAL PRODUCTS LAB				0	0	2	0	2	1
CHH331-T	MATERIALS OF INDUSTRIAL IMPORTANCE	CH	HARD	ELECTIVE	3	1	0	0	4	4
CHH332-T	INDUSTRIAL CHEMICAL & ENVIRONMENT									
CHH331-P	MATERIALS OF INDUSTRIAL IMPORTANCE LAB	CH	HARD	ELECTIVE	0	0	2	0	2	1
CHH332-P	INDUSTRIAL CHEMICAL & ENVIRONMENT LAB									
CHN333	PROJECT	CH	NTCC	CORE	0	0	0	5	5	5
PHS331	Computational Modeling Workshop	PH	W/S	Soft	0	0	3	0	3	2
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**9**	**3**	**6**	**5**	**23**	**20**

MANAV RACHNA UNIVERSITY

FACULTY: FACULTY OF APPLIED SCIENCES

PROGRAM: B.SC (H) CHEMISTRY

PROGRAM CODE: CHU01

SYLLABUS: SCHEME A

TOTAL CREDITS FOR SEMESTER I – VI

S.No.	Semester	Credits
1	I	24
2	II	24
3	SUMMER TRAINING (POST 2nd SEM)	3
4	III	26
5	IV	26
6	SUMMER TRAINING (POST 4th SEM)	3
7	V	22
8	VI	20
TOTAL CREDITS		148

SECTION WEIGHTAGE PARAMETERS

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

CHU01- SEMESTER-I

COURSE CODE	COURSE NAME	Course Type Core(Departmental/ Allied)/Elective (Departmental/Open) / University Compulsory	Course Nature Hard/Soft/ Workshop/ NTCC	PERIODS				CREDITS
				L	T	P	O	
CHH101-T	Green Chemistry	Domain Core	Hard	3	1	0	0	4
CHH101-P	Green Chemistry-Lab			0	0	2	0	1
CSW151	Computer workshop	Allied Core	Workshop	0	0	3	0	2
PHH107-T	Essentials of Physics	Allied Core	Hard	3	1	0	0	4
PHH107-P	Essentials of Physics-Lab			0	0	2	0	1
MAH113-T	Essentials of Mathematics	Allied Core	Hard	3	1	0	0	4
MAH113-P	Essentials of Mathematics Lab			0	0	2	0	1
MAH114-T	Fundamentals of Mathematics-I	Allied Core	Hard	3	1	0	0	4
MAH114-P	Fundamentals of Mathematics-I Lab			0	0	2	0	1
CSH101-T	Structured Programming	Allied Core	Hard	3	1	0	0	4
CSH101-P	Structured Programming-Lab			0	0	2	0	1
HLS101	Business English (Humanities)	Allied Core	Soft	1	0	2	0	2
FLS103 FLS101 FLS102	Foreign Languages: FRENCH SPANISH GERMAN	Allied Elective	Audit	1	1	0	0	0
CHS102	Environmental Sciences	Audit Course	Soft	1	0	2	0	0

CHU01-SEMESTER I

MANAV RACHNA UNIVERSITY

DEPARTMENT OF CHEMISTRY

B.Sc. CHEMISTRY (H) Program

Course Title/ Code	**Green Chemistry (CHH101) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**Students are able to demonstrate the necessity and viability of the methods of green chemistry**

GREEN CHEMISTRY-THEORY (CHH101-T)

SECTION-A

INTRODUCTION TO GREEN CHEMISTRY

Definition, history, need and goals of green chemistry, Green Chemistry in sustainable development, Importance of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry.

BASIC PRINCIPLES OF GREEN CHEMISTRY

Twelve Principles in Green Chemistry with their explanations and examples, Prevention of waste/by-products, Atom Economy, Prevention/Minimization of hazardous/toxic products, Designing safer chemicals, Selection of safer solvents and auxiliaries, Design for energy efficiency (use of microwave and ultrasonic radiations), Use of renewable Feedstock's, Avoidance of unnecessary derivatization, Use of catalytic reagents in preference to stoichiometric reagents, Designing biodegradable products, Prevention of chemical accidents (including releases, explosions and fires), Strengthening/Development of green techniques to prevent hazardous substances in chemical process

SECTION-B

GREEN LUBRICANTS & POLYMERS

Introduction to Lubrication (types and mechanism), Properties of lubricants (Viscosity and its determination, flash point & fire point, cloud point & pour point, aniline point, saponification value, acid value and iodine value) Applications of conventional and green lubricants, Introduction & Classification of polymers, Biodegradable and non-biodegradable polymers, Synthesis of Green Polymers, Polymer Composites.

SECTION-C

GREEN SYNTHESIS: COMPARISION WITH CONVENTIONAL SYNTHESIS

Green Solvents and Reaction Conditions: Water as green solvent, Properties of water (Alkalinity, Hardness and Dissolved Oxygen and their determination), Phase diagram of one component system - Water and CO_2, Supercritical fluids, Ionic Liquids (Introduction, properties and Ions Structure), Liquid polymers-PEG, and Renewable Solvents (Alcohols, Esters, Terpenes and 2 Me THF)

Green reagents-Triplet Oxygen, Singlet Oxygen, Ozone, H_2O_2, Dioxirane, Dimethyl carbonate, Polymer supported Reagents

Green Catalysis- Green Catalysts/Biocatalysts, Phase transfer catalysts, Recoverable catalysts, Enzymes- their classes, specificity and selectivity.

Green Synthesis : Adipic acid, Adiponitrile, Ibuprofen, MMA, Sebacic acid and Biodiesel, Quantitative Solid-solid synthesis

SECTION-D

GREEN ENGINEERING & ITS APPLICATIONS

Need and scope of green engineering, Basic principles of green engineering, Elimination of hazardous compounds by green compounds, Eco-friendly materials for computing Case studies of Real World/ Indian Cases: Sony Ericsson: Bromine-and Chlorine-Free Mobile Phones, Bio-based composite resins design for electronic materials: Soy Plastics, US Presidential Green Chemistry Challenge Award Winners.

REFERENCE BOOKS

1. P. T. Anastas, J. C. Warner Green Chemistry: Theory and Practice, 1998. Oxford University Press
2. Concepcion Jimenez Gonzalez, David JC Constable, Green Chemistry and Engineering. 2011 John Wiley & Sons
3. EMO Chiellini and Roberto Solaro Biodegradable Polymers and Plastics. 2002 Kluwer Academic Publishers.
4. Paul T. Anastas, Robert H. Crabtree Green Catalysis. 2009 Wiley-VCH.
5. James H. Clark, Duncan J. Macquarrie Handbook of green chemistry and technology. 2002. John Wiley & Sons
6. Roger A. Sheldon, Isabel Arends, Ulf Hanefeld Green Chemistry and Catalysis. First Edition, 2007 Wiley-VCH.

GREEN CHEMISTRY LAB (CHH101-P)

LAB EXPERIMENTS

1. To determine the alkalinity of given water sample
2. To determine Hardness of water sample
3. To determine the concentration of given $KMnO_4$ solution using a Digital Photocolorimeter
4. To determine flash point and fire point of lubricating oil by Pensky's Marten's apparatus
5. To determine Viscosity of Liquid Compounds
6. To prepare (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin.
7. Preparation of Iron nanoparticles using tea.
8. Synthesis of Green compounds (Biodiesel from vegetable oil).
9. Synthesis of green reagent Tetra butyl ammonium tribromide (TBATB).

Course Title/ Code	ESSENTIALS OF PHYSICS
Course Type	Core (Departmental/Allied)
Course Nature	Hard
L-T-P-O Structure	(3-1-2-0)
Objectives	To apply the concepts of physics to 1) different optical phenomena 2) devices based on these phenomena lasing in gases and solids 3) quantum mechanics and its simple applications.

LEARNING OUTCOMES:

Students will have the ability to:

1) Produce and Analyze the Interference Pattern Due to Division of Amplitude and Wave front.

2) Produce Required Quality Spectrum and analyze it Using Appropriate Diffraction Grating.

3) Measure the Concentration/Purity of Optically Active Materials Using Optical Devices.

4) Explain the Construction, Working and Applications of Lasers and Optical Fibers.

5) Able to solve problem of one dimensional Box using concepts of Quantum Mechanics.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

SECTION-A

INTERFERENCE OF LIGHT

Conditions for Sustained Interference, Coherent Sources, Interference Based on the Division of Wave Front: Young's Double Slit Experiment, Fresnel Bi-Prism and its Applications, Interference Based upon Division of Amplitude: Interference in Thin Films, Newton's Ring and its Applications, Michelson Interferometer and its Applications.

DIFFRACTION OF LIGHT

Fraunhofer Diffraction at Single Slit, Plane Transmission Grating, Dispersive and Resolving Power of a Grating, Rayleigh Criterion

POLARIZATION OF LIGHT

Polarized and Un-Polarized Light, Malus's Law, Double Refraction, Nicol Prism, Quarter and Half Wave Plates, Detection and Production of Different Types of Polarized Light, Polarimetry: Bi-Quartz and Laurent's Half Shade Polarimeters

SECTION-B

ELECTROMAGNETIC THEORY

Electric Flux Density, Gauss's Law and its Applications to a Spherical Symmetry and Uniformly Charged Infinite Plane Sheet, Energy per Unit Volume, Ampere's Law and its Modification for Non-Steady Currents, Maxwell's Equations, Wave Propagation in Free Space, Dielectrics and Conducting Medium, Poynting Theorem and its Significance. (10 L)

SECTION - C

LASER AND FIBER OPTICS

Stimulated Absorption, Spontaneous and Stimulated Emission, Population Inversion, Conditions for Laser Action, Laser Properties and Laser Applications, Types of Laser: He-Ne Laser, Dye Laser, Semiconductor Laser.

***Fiber Optics*:** Introduction, Propagation of Light Through a Fiber, Numerical Aperture, Types of Fiber, Modes of Propagation (Simple Idea), V-Number, Applications of Optical Fibers (10L)

SECTION D

QUANTUM PHYSICS

Introduction to quantum mechanics, Discovery of Planck's constant, Group velocity and phase velocity, Schrodinger wave equations-time dependent and time independent, Physical significance of wave function, Particle in one dimensional box.

LIST OF EXPERIMENTS

1. To determine the wavelength of sodium light by Newton's rings experiment. Describe the interference pattern using polychromatic source of light.
2. To determine the wavelength of sodium light by Fresnel's biprism experiment.
3. To determine the wavelength of various colors of white light with the help of a plane transmission diffraction grating.
4. Determination of dispersive power of the given grating.
5. To determine the refractive index and Cauchy's constants of a prism by using spectrometer.
6. To determine the wavelength of sodium light by Michelson interferometer.
7. To determine the resolving power of a telescope.
8. To determine the pitch of a screw using He-Ne laser
9. To determine the specific rotation of optically active solution solution by using Laurent's half shade polarimeter.
10. To determine the numerical aperture of an optical fiber using laser light.

Suggested Books:

1. Fundamentals of Engineering Physics , M S Khurana, MR Pub, Delhi (**Text Book)**
2. Modern Physics for Engineers I & II, S P Taneja; R Chand Publication **(Text Book)**
3. Engineering Physics, Satya Prakash, Pragati Prakashan.
4. Concepts of Modern Physics , A. Beiser
5. Optics, A. Ghatak

Course Title/ Code	**Essentials of Mathematics (MAH113) T & P**
Course Type	**Allied Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**The students would be able to apply the mathematical concepts of matrices, calculus of single and several variables, vector and integral calculus required for solving the mathematical problems and their applications.**

ESSENTIALS OF MATHEMATICS-THEORY (MAH113-T)

SECTION A

MATRICES AND ITS APPLICATIONS

Elementary transformations, Elementary matrices, inverse using elementary transformations, Rank of a matrix, normal form of a matrix, Linear dependence and independence of vectors, consistency of linear system of equations, Eigen Values and Eigen vectors, properties of Eigen values, Cayley Hamilton theorem, Linear Transformation, Orthogonal transformation, Complex matrices.

SECTION B

DIFFERENTIAL CALCULUS

Successive differentiation, Leibnitz theorem, Mean value theorems: Rolle's theorem, Cauchy's theorem, Lagrange's theorem, Taylor's and Maclaurin's Series, Partial differentiation, Euler's theorem, total differential, Jacobian.

SECTION C

INTEGRAL CALCULUS

Double and Triple Integral, evaluation of double integral over the region, evaluation of double integral by changing the order of integration, evaluation of double & triple integral by changing the variable. Beta and Gamma functions.

SECTION D

VECTOR CALCULUS

Continuity and differentiability of vector functions, Scalar and vector point function, Gradient, Directional Derivative, divergence, curl and their applications. Line integral, surface integral and volume integral, Green's, Stoke's and Gauss divergence theorems and their applications.

Reference Books:

1) Shanti Narayan: *Differential Calculus*, S. Chand & Co.
2) Shanti Narayan: *Integral Calculus*, S. Chand & Co.
3) K. B. Dutta: *Matrix and Linear Algebra*.
4) David Widder: *Advanced Calculus*, Prentice- Hall of India,
5) M.R. Spiegal : Vector analysis & an introduction to tensor analysis, McGraw Hill.

ESSENTIALS OF MATHEMATICS-PRACTICAL (MAH113-P)

LAB EXPERIMENTS

1. Introduction to MATLAB and use of some simple MATLAB commands.
2. Introduction to some of the fundamentals of MATLAB: Variables, operators, expressions and Arrays(including vectors and matrices)
3. Introduction to graphics: Basic Two-Dimensional Graphs, Labels, Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
4. To find the Rank of a matrix, Inverse of a Square matrix and to reduce a matrix into Normal Form.
5. To solve the system of simultaneous linear equations. To find the Eigen values and Eigenvectors of a square matrix.
6. Evaluation of Double integral and its application.
7. Evaluation of Triple integral and its application.
8. To find derivatives of vector functions and gradient of a scalar field (through graph also).
9. To find the directional derivatives, divergence & curl (through graph also) of vector functions.
10. To evaluate line integrals and applications of Green's, Stoke's & Gauss divergence theorems.

Course Title/Code	**Fundamentals of Mathematics-I (MAH114) T & P**
Course Type	**Allied Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**The students would be able to apply the mathematical concepts of matrices, trigonometry, differential and integral calculus required for solving the mathematical problems and their applications.**

FUNDAMENTALS OF MATHEMATICS-I THEORY (MAH114-T)

SECTION A

MATRICES AND ITS APPLICATIONS

Algebra of Matrices, Determinants and their properties, Adjoint and Inverse of a Matrix, Solution of simultaneous linear equations.

SECTION B

TRIGNOMETRY

Trignometric functions, Identities, values of Trignometric functions at 0, 30, 45, 60, 90, 180, 270 and 360 degrees. Operations on Trignometric equations, Graph of Trignometric functions of sum of two angles, Trignometric equations, Graph of Trignometric functions, Introduction to inverse Trignometric functions.

SECTION C

DIFFERENTIATION

Introduction, Differentiation by 1^{st} principle, Geometrical meaning of derivative at a point, Fundamental Rules of Differentiation: Derivative of sum of two functions, product Rule, Quotient Rule , Derivative of function of a function (Chain Rule). Logarithmic differentiation, Derivative of an infinite series.

SECTION-D

INTEGRATION

Primitive or Anti-derivative, Indefinite integrals, Fundamental integration formulas, Geometrical interpretation of indefinite integrals, Integrals of some special form. Integration by Parts. Definite Integrals.

FUNDAMENTALS OF MATHEMATICS-I PRACTICAL (MAH114-P)

LIST OF EXPERIMENTS

1. Introduction to MATLAB and use of some simple MATLAB commands.
2. Introduction to some of the fundamentals of MATLAB: Variables, operators, expressions and Arrays(including vectors and matrices)
3. To create sub arrays and perform element by element operations.
4. To perform arithmetic operations on Matrices, determinant, inverse and solution of equations.
5. Introduction to graphics: Basic Two-Dimensional Graphs along with labels.
6. Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
7. To verify trigonometric identities.
8. To find derivatives of function and verification of basic rules of differentiation.
9. To integrate the functions and geometrical interpretation of integration.
10. To find the definite integral of the function.

Reference Books:

1. Mathematics for class XI-XII- By R D Sharma
2. Mathematics for class XI- XII - NCERT

Course Title/ Code	**Structured Programming (CSH101) T & P**
Course Type	**Allied Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**Students are able to construct a program of moderate complexity from a specification**

STRUCTURED PROGRAMMING-THEORY (CSH101-T)

SECTION A

PROGRAMMING AND UNIX

Students will learn the basics of programming using Scratch; they will learn to use statements, expressions, conditions, selection, iteration, variables, functions, arrays, threads and events. In addition, they will be introduced to basic UNIX commands under Bash.

Introduction to Programming, test driven development

Scratch: Introduction, statements, expressions, conditions, selection, iteration, variables, functions, arrays.

Unix: Basic commands- pwd, ls, cd, rm, cat, less, mkdir, rmdir; permissions, root C language: statements, expressions, conditions, selection iteration, variables, functions, arrays.

SECTION B

APPLYING PROGRAMMING CONSTRUCTS

Students will learn how to write programs that satisfy unit tests. The instructor will build the unit tests, demonstrating how to break a problem down into smaller components. In the labs and homework, students will construct programs that satisfy the unit tests. Students become familiar with the constructs of the C programming language.

Types, constants, and variables, Statements, Expressions, Conditions, Selection, iteration, Functions and recursion.

Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming

One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Null terminated strings as array of characters, Standard library string functions

Introduction to Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions. Students will become familiar with the concepts.

SECTION C

PRACTICAL PROGRAMMING

During the third quarter of the class, students will begin building their own programs by decomposing problems into smaller tasks and writing unit tests that will check to see that the program accurately accomplishes the task using Test Driven Development. They will then write the program that satisfies their own unit tests. Students will learn to apply the constructs of the C programming language to create programs.

Application of Top-down approach of problem solving, Modular programming and functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments.
Students will learn to apply these programming techniques: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions. Students will be able to use these techniques to develop programs

Concept of Files, File opening in various modes and closing of a file, Reading from a file, writing onto a file.

SECTION D

MEMORY MANAGEMENT AND ABSTRACTION

During the final quarter, students will be introduced to dynamic memory allocation and dynamic data structures including: dynamic arrays, linked lists, and stacks. They will consolidate their ability to use the C programming techniques they have learned in the earlier sections.

Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.
Linked list

Reference Books:

1. The C Programming Language, Brian Kernighan and Dennis Ritchie
2. The Unix Programming Environment
3. Pro Git,

Help Pages:

1. Eclipse C/C++ Development Guide

Wikipedia Pages:

1. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
2. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

Tool Web Sites:

1. Eclipse, https://eclipse.org/users/
2. Git, http://git-scm.com/
3. GCC, https://gcc.gnu.org/onlinedocs/gcc-4.9.3/gcc/
4. Make
5. Unix

Web tutorials:

1. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

STRUCTURED PROGRAMMING PRACTICAL (CSH101-P)

LAB EXPERIMENTS:

1. Swap two numbers
2. Fibonacci series, Factorial
3. GCD
4. Sieve of Eratosthenes
5. Square Root
6. Sorting
7. Decimal to binary conversion
8. Linked lists
9. Program to support humans playing chess against each other.
10. Stacks and queues
11. Manipulating files

Course Title/ Code	**Business English (HLS101)**
Course Type	**Allied Core**
Course Nature	**Soft**
L-T-P-O Structure	**(1-0-2-0)**
Objectives	**1. To make the students well-versed in the basics of EnglishLanguage, grammar and communication skills.** **2. To enhance the interactive learning skills** **3. To emphasize on group as well as individual performance of students.** **4. To enhance written as well as oral performance of students** **5. To prepare students as per society and industry need**

BUSINESS ENGLISH THEORY (HLS101)

SECTION A

SCOPE & IMPORTANCE OF BUSINESS ENGLISH

Directly taken from Infosys designed Lesson plans of Business English, the paper attempts to execute the modules over the course of a semester, by end of which students will be well-versed in the basics of English Language grammar and communication skills. The lab-activities that go hand-in-hand with the lessons will help in enhancing the interactive aspect of the paper.

GRAMMAR

Introduction to Grammar: Adverbs, Adjectives, Articles, Noun (Compound, Countable, Uncountable) Active -Passive Voice

SECTION B

TENSE and SEMANTICS

Tenses, Subject- Verb Agreement, Introduction to Verbs (Auxiliary and Modals, non-finite), Prepositions, Modifiers, Collocation, Synonym, Antonym, Phrasal Verbs, Idioms and Phrases.

SECTION C

ORAL COMMUNICATION-I

Speech Pattern-1 (Intonation, Word Stress), Speech Pattern-2 (Indianisms, Sentence Stress, Connected Speech), Link Expressions, Question Tags.

SECTION D

TECHNICAL WRITING-I:

ABC of Writing, KISS Concept, Essay Writing, Report Writing, Email Etiquette, Circular Précis Writing, Memos and Notices.

Reference Books:

1. A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt.
2. High School English Grammar and Composition. Wren and Martin: S.Chand and Co.
3. A Textbook of English Phonetics for Indian Students. T.Bala Subhrmaniam: Macmillan
4. English Vocabulary in Use. MaCarthy: Foundation Books, OUP
5. English Grammar, Competition and Correspondence. M.A. Pink and A.C.Thomas: S.Chand and Co.

BUSINESS ENGLISH PRACTICAL (HLS101)

LAB EXERCISES:

1. Exercises based on Grammar
2. Exercises based on Semantics
3. Introduction to Articulation Skills (Conversation: Telephonic and Face-to-Face)
4. Exercise based on Email & Report
5. Business QUIZ &Idioms and Phrases
6. Techniques & Levels of Reading Comprehension
7. Group Discussion
8. Exercise Based on Tense & S-V Agreement
9. Exercise based on Active & Passive Voice
10. Exercise Based on Intonation & Word Stress
11. Circular, Memos and Notice Writing
12. Presentation

Course Title/ Code	**Computing Workshop (CSW151)**
Course Type	**Allied Core**
Course Nature	
L-T-P-O Structure	**W/S (0-0-3-0)**
Objectives	**To make the students well-versed in the basics of English Language, grammar and communication skills. To enhance the interactive learning skills To emphasize on group as well as individual performance of students. To enhance written as well as oral performance of students. To prepare students as per society and industry need**

INTRODUCTION TO COMPUTER SYSTEMS (1P)

Characteristics and Components of a computer system, Memory – Primary & Secondary, Input Devices, Output Devices, Hardware and Software.

OPERATING SYSTEM (6P)

Microsoft Windows - Versions of Windows, Basic Windows elements, Folder and File management, Using essential accessories: Calculator, Notepad, Paint, WordPad. Utility of My Computer, My Documents, Recycle bin, My Network Places, Control Panel, Searching Files

INTRODUCTION TO INTERNET (3P)

Introduction to internet, www, urls, portals, web browsers, ip addresses, searching and downloading content, e-mail, intranet.

WORD PROCESSING (9P)

Creating and handling documents, Editing, Spellcheck, Formatting, Tables, Macros, Mail merge, Page setting, Headers and footers, Printing documents

SPREADSHEET PACKAGE (10P)

Creating and handling workbook and spreadsheet, Editing, Formatting, Cell referencing, Formulae and Functions, Charts and Graphs, Macros, Views, Sorting, Page setting, Headers and footers, Printing worksheets

PRESENTATION PACKAGE (10P)

CREATING AND HANDLING Presentations, Using templates, Views, Handling Master slide - Notes and Handouts, Slide Design and layout, Animations, Transition, Slide Show, Custom Show, Timing, Headers and footers, Printing Presentations and handouts.

Course Title/ Code	**Environmental Sciences (CHS102)**
Course Type	**Audit**
Course Nature	**Soft**
L-T-P-O Structure	**(1-0-2-0)**
Objectives	**1. To make the student identify the areas of environmental degradation** **2. To make the student identify the impact of environmental degradation on the surroundings** **3. To enable student apply the concept of sustainable development in real life** **4. To help the student to correlate his/her field with various aspects of environment**

ENVIRONMENTAL SCIENCES THEORY (CHS102)

SECTION A

SCOPE & IMPORTANCE OF EVS

Definition and Scope of Environmental Sciences, Importance of EVS in Various Branches of Engineering & Sciences

SECTION B

ECOSYSTEM DYNAMICS

***Structure and functions of ecosystem*:** Trophic Level, Food Chain, Food Web, Ecological Pyramids, Energy Flow, Ecological Succession: Basic Concept, Types, Stages

***Types of ecosystems*:** Aquatic Ecosystem (Lake), Terrestrial Ecosystem (Grassland)

Biodiversity: Levels of biodiversity; Hot Spots, Threats, In Situ and Ex Situ Conservation,

***Population and its characteristics*:** Population Growth, Age and Structure Pyramids

SECTION C

POLLUTION PREVENTION AND SUSTAINABILITY

Air pollution: Sources of Air Pollution, Methods of Monitoring and Control of Air Pollution. Effect of Air Pollution on Human Beings, Plants, Animals, Materials and Atmosphere. Photochemical Smog, Ozone Layer Depletion, Green House Effect, Acid Rain.

Water pollution: Sources and Consequences of Water Pollution, Physio-Chemical and Biological Monitoring of Water Quality (TDS, TSS, BOD, COD). Eutrophication.

Soil pollution: Control Measures, Over Usage of Chemical Pesticides, Bio-Magnification

Sustainable development: Definition, Energy Conservation

SECTION D

ENVIRONMENTAL TECHNIQUES & ASSESSMENT

Flame Photometry, Paper Chromatography, Statistical Analysis: Mean, Mode, Median and Standard Deviation. Environmental Impact Analysis (EIA): Aims & Objectives, ISO- 14000 Standards and Certification, National Green Tribunal Act, Environmental Priorities in India and Environmental Regulations for Small and Large Scale Industries. Disaster management: flood and cyclone.

REFERENCE BOOKS:

1. Environmental Chemistry C. Baird and M. Cann W.H. Freeman and Company, New York, 2012.
2. Green Chemistry and engineering: A practical Design Approach C.J-Gonzalez and D.J.C. Constable A John Wiley & Sons, INC., publication, New Jersey, 2011
3. Environmental Chemistry S.E. Manahan CRC Press, 2005
   Perspectives in Environmental Studies Kaushik & Kaushik New age international publishers Ltd.-New Delhi
4. The Green marketing Manifesto John Grant Wiley Pub.

ENVIRONMENTAL SCIENCES PRACTICAL (CHS102)

LAB EXPERIMENTS:

1. To analyse a sample of water for metal ions using flame photometer.
2. To determine the total dissolved oxygen in a given sample of water.
3. To analyse the TDS and TSS in given sample of water.
4. To calculate mean, mode, median and standard deviation of the given data.
5. To separate the components in a mixture using paper chromatography.
6. To determine residual chlorine in water.
7. To determine free CO_2 in given sample of water.
8. To study the efficacy of bio adsorption of Tea waste
9. To study the various acts: wildlife protection act 1972, the water (prevention and control of pollution) act 1974, prevention and control of air pollution act 1981, forest conservation act 1981, environment (protection) act 1986, hazardous waste (management and handling) rules, 1989, bio-medical waste (management and handling) rules, 1998.
10. Case studies of eco-marketing: KFC, Coca Cola, Mc Donald, Tropicana, Nestle, Ceres fruit juice (methodologies for sustainable environment & advantages)

Course Title/ Code	**French-I (FLS103)**
Course Type	**Allied Elective**
Course Nature	**Soft**
L-T-P-O Structure	**(1-1-0-0)**
Objectives	**At the end of the course, students will be able to** **1.Exchange greetings and do introductions using formal and informal expressions** **2. Understand and use interrogative and answer simple questions** **3.Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar Vocabulary** 4. **Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed** 5. **Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed.** **6.Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary** **7.Provide basic information about familiar situations and topics of Interest** **8. Express or/and justify opinions using equivalents of different verbs.** **9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.**

SECTION A

Les Salutations & forms of politeness

Alphabets

Taking leave expressions

SECTION B

Les pronoms sujets

Les verbes ER Self introduction

SECTION C

Les noms

Verbes Avoir, Etre, Aller & Faire Les articles define et indefini

SECTION D

Les moin de l'annee

les jours de la semaine Repondez aux questions.

Course Title/ Code	**Spanish-I (FLS101)**
Course Type	**Allied Elective**
Course Nature	**Soft**
L-T-P-O Structure	**(1-1-0-0)**
Objectives	**At the end of the course, students will be able to** **1. Exchange greetings and do introductions using formal and informal expressions** **2. Understand and use interrogative and answer simple questions** **3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary** **4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed** **5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed** **6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary** **7. Provide basic information about familiar situations and topics of interest** **8. Express or/and justify opinions using equivalents of different verbs** **9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture**

SECTION A

Presentation on Spanish language Greetings and goodbye's, Spanish letter, Introduction of VerboSER

SECTION B

Uses of Verbo SER , Introduction of Nationality, Professions and vocabulary related to professions. Adjectives related to Verbo SER. Counting till number 20.

SECTION C

Introduction of Articles and Indefinite articles Interrogatives
Adjectives to describe things and place and Counting till number 90

SECTION D

Introduction of Verbo ESTAR, Uses of Verbo ESTAR with respect to positioning of objects Prepositions related to the positioning of an object.

Course Title/Code	**German-I (FLS102)**
Course Type	**Allied Elective**
Course Nature	**Soft**
L-T-P-O Structure	**(1-1-0-0)**
Objective	**At the end of the course, students will be able to** **1. Exchange greetings and do introductions using formal and informal expressions** **2. Understand and use interrogative and answer simple questions** **3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary** **4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities) with repetition when needed** **5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed.** **6. Describe themselves, other people, familiar places and objects in short discourge using simple sentences and basic vocabulary** **7. Provide basic information about familiar situations and topics of interest.** **8. Express or/ and justify opinions using equivalents of different verbs.** **9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.**

SECTION A

Salutations/Greetings: Introduction

SECTION B

Introduction: cntd. Alphabets Numbers 1-20

SECTION C

Personal pronouns, Hobbies and professions

SECTION D

Café related vocabulary and dialogues

Revision personal pronouns

Common verbs and their conjugations

CHU01- SEMESTER-II

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/ Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CHH106-T	Physical Chemistry –I	Domain Core	Hard	3	1	0	0	4
CHH106-P	Physical Chemistry–I Lab			0	0	2	0	1
CHH107-T	Inorganic Chemistry-I	Domain Core	Hard	3	1	0	0	4
CHH107-P	Inorganic Chemistry-I Lab			0	0	2	0	1
CHW109	Chemistry in Everyday Life	Domain Core	Workshop	0	0	3	0	2
MAH117-T	Advanced Mathematics	Allied Core	Hard	3	1	0	0	4
MAH117-P	Advanced Mathematics Lab			0	0	2	0	1
MAH118 -T	Fundamentals of Mathematics-II	Allied Core	Hard	3	1	0	0	4
MAH118-P	Fundamentals of Mathematics-II Lab			0	0	2	0	1
PHH108-T	Modern Physics	Allied Core	Hard	3	1	0	0	4
PHH108-P	Modern Physics Lab			0	0	2	0	1
HLS102	Communicative English (Humanities)	Allied Core	Soft	1	0	2	0	2
FLS107	Foreign Languages: FRENCH SPANISH GERMAN	Allied Elective	Audit	1	1	0	0	0
FLS105								
FLS106								

CHU01-SEMESTER II
MANAV RACHNA UNIVERSITY
B.Sc. CHEMISTRY (H) PROGRAM
DEPARTMENT OF CHEMISTRY

Course Title/ Code	**Physical Chemistry-I (CHH106) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To discuss mathematical and empirical relationship of gaseous characteristics with examples to understand gas laws** **2. To describe colligative properties of pure solvents and their solutions.** **3. To discuss structure, symmetry and electrical and magnetic properties of solids.** 4. **To derive and calculate pH of hydrolysis of salts.**

PHYSICAL CHEMISTRY-I THEORY (CHH106-T)

SECTION A

GASEOUS STATE

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.
Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

SECTION B

LIQUID STATE

Physical properties of liquids; vapour pressure, surface tension, interfacial tension, surface active agents, the Parachor and chemical constitution (atomic and structural parachors).
Viscosity of liquids, coefficient of viscosity. Determination of surface tension and viscosity. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

SECTION C

SOLID STATE

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

Defects in crystals. Glasses and liquid crystals.

ELECTRICAL & MAGNETIC PROPERTIES OF ATOMS AND MOLECULES

Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

SECTION D

IONIC EQUILIBRIA:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids.

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Theory of acid–base indicators; selection of indicators and their limitations. Hydrolysis and hydrolysis constants.

REFERENCE BOOKS:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University 12 Press (2014).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Engel, T. & Reid, P. *Physical Chemistry* 3rd Ed. Pearson (2013).
6. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
7. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw-Hill: New York (2003).
8. K. L. Kapoor, A textbook of Physical Chemistry (Volume I), Macmillan

PHYSICAL CHEMISTRY-I PRACTICAL (CHH106-P)

LAB EXPERIMENTS:

1. To determine the relative surface tension of the given liquid with respect to water at room temperature by Stalgmometer.
2. Determine the surface tension of a given liquid by means of stalgmometer using drop weight method.
3. To determine the viscosity of the given Polymer with respect to water at room temperature by

Ostwald's viscometer.

4. To determine the viscosity of the given Polymer with respect to Ethanol by Ostwald's viscometer.
5. To determine the viscosity of the given Glucose and Sucrose solutions by Ostwald's viscometer.
6. To determine the concentration or strength of given HCl solution by titrating against standard NaOH solution using a pH meter.
7. Prepare buffer solutions using acetic acid and sodium acetate in entire compositional range and determine the pH of the given unknown solution by colour matching.
8. To determine the composition of the given mixture consisting of two miscible liquids A and B by viscosity measurements.

Course Title/ Code	**Inorganic Chemistry-I (CHH107) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To introduce concepts and phenomenon related to electronic structure of atom** **2. To compare electronic properties of various elements of s and p Block** **3. To apply the concepts of Chemical bonding in the structure elucidation of various compounds** **4. To elaborate importance of physical and chemical properties of *s* and *p* block elements** **5. To understand concept of electrode potential and its applications.**

INORGANIC CHEMISTRY-I THEORY (CHH107-T)

SECTION A

ATOMIC STRUCTURE

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

SECTION B

PERIODICITY OF ELEMENTS

Introduction of modern and long form of periodic table, Classification of elements as s, p d and f-block elements. Detailed discussion of the following properties of the elements for s and p- block.

(a) Atomic size (atomic, ionic, covalent and metallic radious, van der Waal's radious)
(b) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(c) Electron gain enthalpy, trends of electron gain enthalpy.
(d) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's, electronegativity scales. Sanderson's electron density ratio.
(e) Oxidizing and reducing behavior
(f) Electropositive and Metallic character,
(g) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

SECTION C

CHEMICAL BONDING

(i) lonic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Haber cycle and its application, Solvation energy. (ii) Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding: σ and π bond approach, and bond lengths.

SECTION D

ACIDS AND BASES

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

OXIDATION-REDUCTION

Redox equations, Standard Electrode Potential and its application to inorganic reactions.

REFERENCE BOOKS:

S. No	Author	Title	Publisher
1.	J.D. Lee,	Concise Inorganic Chemistry	ELBS,
2.	Douglas, Mc Daniel, D.H.,	B.E. and Concepts & Models of Inorganic Chemistry	Oxford
3.	H.W. Porterfield	Inorganic Chemistry Second Edition	Academic Press,
4.	Vogel, A.I.	A Textbook of Quantitative Inorganic Analysis,	ELBS
5.	Vogel	Vogel's Text book of Inorganic Qualitative Analysis	ELBS London
6.	Cotton, Wilkinson, G.	F.A. & Advanced Inorganic Chemistry,	Wiley, VCH, 1999
7.	James E. Huheey, Ellen Keiter and Richard Keiter	Inorganic Chemistry: Principles of Structure and Reactivity	Pearson Publication
8.	G.S. Manku	Theoretical Principles of Inorganic Chemistry	Tata McGraw-Hill Education, 1980
9.	Atkin, P. Shriver & Atkins'	Inorganic Chemistry 5th Ed.	Oxford University Press (2010).

INORGANIC CHEMISTRY-I PRACTICAL (CHH107-P)

LAB EXPERIMENTS:

ACIDIMETRY AND ALKALIMETRY

1. To determine the strength of NaOH and of Na_2CO_3 present in a solution and find their percentage composition.
2. To determine the strength of Na_2CO_3 and $NaHCO_3$ in the given mixture and also find their percentage composition.

OXIDATION REDUCTION TITRATIONS

3. To determine the strength of given oxalic acid solution by titrating it against standard $KMnO_4$ solution.
4. To determine the strength in g/l of a given solution of ferrous ammonium sulphate (Mohr's Salt) with standard $KMnO_4$ solution.
5. To estimate Fe(II) and Fe(III) ions in given mixture using standard $KMnO_4$ solution.

COMPLEXOMETRIC TITRATIONS

6. To estimate the amount of Zinc present in a given solution by EDTA method.
7. To estimate the amount of copper present in given solution by EDTA method.
8. To determine the amount of Magnesium in given solution by EDTA method.
9. To determine the amount of Calcium in given solution by EDTA method.

Course Title/ Code	**Advanced Mathematics (MAH117) T & P**
Course Type	**Allied Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**The students would be able to apply the concepts of integral and vector calculus required for solving the mathematical problems and their applications.**

ADVANCED MATHEMATICS THEORY (MAH117-T)

SECTION A

APPLICATIONS OF SINGLE AND MULTIPLE INTEGRALS

Surface Area and Volume of Solids of Revolution. Area Enclosed by Plane Curves, Area of a Curved Surface, Volumes of Solids.

SECTION B

VECTOR DIFFERENTIATION

Scalar and Vector Fields. Ordinary and Partial Derivative of a Vector w.r.t. Coordinates. Del and Laplacian Operators. Space Curves. Unit Tangent Vector and Unit Normal Vector, Vector Identities, Directional Derivatives and Normal Derivative, Gradient of a Scalar Field and its Geometrical Interpretation. Divergence and Curl of a Vector Field.

SECTION C

ORTHOGONAL CURVILINEAR COORDINATES

Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

VECTOR INTEGRATION

Ordinary Integral of Vectors, Line, Surface and Volume Integrals. Flux of a Vector Field, Gauss Divergence Theorem, Green's Theorem and Stokes Theorem.

SECTION D

FOURIER SERIES

Fourier Series, Dirichlet Conditions (Statement only), Kronecker's Method for Computation of Fourier Coefficients, Even and Odd Functions. Orthogonality of Sine and Cosine Functions, Sine and Cosine Series, Applications: Square Wave, Triangular Wave, Output of Full Wave Rectifier and other Simple Functions, Summing of Infinite Series Term-by-Term Differentiation and Integration of a Fourier Series.

REFERENCES BOOKS

1. Schaum's Outline of Vector Analysis, 2nd Edn. By Murray Spiegel, Seymour Lipschutz (McGraw-Hill, 2009)
2. Vector Analysis and Cartesian Tensors, 3ed By D. E. Bourne, P C Kendall (Chapman & Hall, 1992)
3. Schaum's Outline of Theory and Problems of Fourier Analysis By Murray R. Spiegel (McGraw-Hill, 1974)
4. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Limited,1985)
5. Introduction to Mathematical Physics by Charlie Harper. (P.H.I., 1995).

ADVANCED MATHEMATICS PRACTICAL (MAH117-P)

LIST OF EXPERIMENTS:

1. To find Arc length & Area of a given surface(Cartesian & Polar form) by single integration using Matlab.
2. To find Area & Volume of a given surface(Cartesian & Polar form) by double & triple integration using Matlab.
3. To find Beta & Gamma function using Matlab.
4. To find gradient of a scalar field using Matlab.
5. To find directional derivatives, normal vector to the given surface & angle between the surfaces using Matlab.
6. To find divergence & curl of vector field at the given point using Matlab.
7. To evaluate line integrals & surface integrals using Matlab.
8. To verify Green's theorem & Stoke's theorem using Matlab.
9. To verify Gauss-Divergence theorem using Matlab.
10. To find the Fourier series expansion of a given periodic functions and plot the same.

Course Title/ Code	**Fundamental of Mathematics-II (MAH 118) T & P**
Course Type	**Allied Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**The students would be able to apply the mathematical concepts of differential equations, set theory, probability and statistics required for solving the mathematical problems and their applications.**

FUNDAMENTALS OF MATHEMATICS-II THEORY (MAH118-T)

SECTION A

DIFFERENTIAL EQUATIONS

Introduction, definition, Order and degree of a differential equation, Formation of a D.E., Solution of a D.E., D.E. of 1^{st} order and 1^{st} degree and their solution .Linear differential equations, Application of ODE of 1^{st} order and 1^{st} degree.

SECTION B

PERMUTATION & COMBINATION

Introduction to the Set theory, Permutation and Combination.

SECTION C

PROBABILITY THEORY

Introduction, Random experiments, Event, Axiomatic approach to probability. Conditional probability and Baye's theorem.

SECTION D

STATISTICAL TECHNIQUES

Frequency distribution and frequency table, Graphical representation of frequency distribution: Bar diagrams, Pie diagrams, measure of location: arithmetic mean , median ,Mode ,Measure of dispersion: variance and standard deviation, mean deviation ,quartile, percentile. correlation and regression analysis.

TEXT BOOKS:

1. Engineering Mathematics by Dr. B.S.Grewal.
2. Mathematics for class XII by Dr. R. D. Sharma
3. Business Statistics by S.C.Gupta

REFERENCE BOOKS:

1. Ordinary Differential Equations by Shanti Narayan
2. Probability and Mathematical statistics by S.C.Gupta and V.K. Kapoor

FUNDAMENTALS OF MATHEMATICS-II PRACTICAL (MAH118-P)

LAB EXPERIMENTS:

1. To solve ordinary differential equations of 1^{st} order and 1^{st} degree using MATLAB.
2. To solve linear differential equations using MATLAB.
3. To perform basic Set operations using MATLAB.
4. To present the data by tables and by diagrams.
5. To study the frequency distributions by histogram and frequency polygon.
6. To find mean, median, mode, quartiles, deciles and percentiles for the data.
7. To find mean deviation, standard deviation, coefficient of mean deviation and coefficient of variation. Comparison of various measures of dispersion.
8. Bivariate data scatter diagram and to find coefficient of correlation.
9. To find rank correlation.
10. To find regression coefficients and lines of regression.

Course Title/ Code	**MODERN PHYSICS(PHH108)**
Course Type:	**Core (Departmental/Allied)**
Course Nature:	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To study the relativistic effects** **2. To study and analyze different types of spectra** **3. To study nuclear models and detectors** **.**

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

LEARNING OUTCOMES:

Students will have the Ability to:

1) Apply concept of Length Contraction, Time Dilatation, Velocity addition, Energy mass conversion, variation of mass with velocity.

2) Calculate wavelength of different series of hydrogen atom and explain fine structure of the spectrum.

3) Explain much electron system.

4) Explain nuclear properties and detection of nuclear radiation.

SECTION – A

Inertial and Non inertial frame of references, Michelson-Morley Experiment (Qualitative), Einstein's Postulates of Special Theory of Relativity, Lorentz Transformations, Length Contraction, Time dilation, velocity Addition Theorem, Variation of mass with velocity, Mass – Energy Equivalence Relation (10L)

SECTION – B

Bohr's Model of Hydrogen Atom, Spectral Series, Schrodinger Equation in Spherical Polar Coordinates, Hydrogen Atom (Qualitatively), Quantum Numbers and Selection Rules (Qualitative). Stern-Gerlach Experiment, Spin as An Intrinsic Quantum Number, Fine Structure. (12L)

SECTION C

Magnetic Moment of the Electron, Lande g-Factor, Vector Model – Space Quantization, Zeeman Effect, Pauli Exclusion Principle, Shell Structure. Hund's Rule, Spectroscopic Terms of Many Electron Atoms in the Ground State Diatomic Molecules–Rotational and Vibrational Energy Levels, Basic Ideas About Molecular Spectra, Raman Effect and Its Application to Molecular Spectroscopy (Qualitatively). (12 L)

SECTION D

STRUCTURE OF NUCLEI

Basic Properties of Nuclei: Mass, Radii, Charge, Angular Momentum, Spin, Magnetic Moment (μ), Stability and Binding Energy.

NUCLEAR MODELS

Liquid Drop Model, Mass formula, Shell Model, Meson Theory of Nuclear Forces

DETECTORS OF NUCLEAR RADIATIONS

Interaction of Energetic particles with matter, Ionization chamber, GM Counter, Cloud Chambers, Wilson Cloud Chamber, Bubble Chamber, Scintillation Detectors, Semiconductor Detectors (Qualitative Discussion Only) (12L)

LIST OF EXPERIMENTS

1. Verification of Stefan's Law and Wien's displacement law by constructing Black Body Spectrum
2. Measurement of sodium doublet using Michelson Interferometer
3. Construction of Wave Packet by superposition of waves
4. Hydrogen spectra using Transmission Grating
5. Measurement of e/m of an electron
6. Measurement of Charge of an electron using Millikan Oil Drop method.
7. Measurement of energy Band Gap of intrinsic semiconductor by Four Probe Method
8. Measurement of Hall Effect.
9. Thermionic emission of electron
10. Energy band measurement for semiconductor diode/ diode laser.
11. To determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.
12. To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode.
13. To determine the value of Planck's constant by using a Photoelectric Cell.
14. To determine the value of Planck's constant by using LEDs of at least 4 Different Wavelengths.

SUGGESTED BOOKS

1. Concepts of modern Physics A Beiser, S Mahajan & S R Chaudhary (Text Book)
2. Modern Physics-R A Serway, C J Moses & C A Moyer
3. Atomic and Molecular Spectra: Laser-R Kumar (Text Book)
4. Fundamentals of Molecular Spectroscopy-C N Banwell & E M Mccash
5. Introduction to Molecular Spectra – H E White

Course Title/ Code	**Communicative English (HLS102)**
Course Type	**Allied Core**
Course Nature	**Soft**
L-T-P-O Structure	**(1-0-2-0)**
Objectives	**1. To equip the students with effective communication skills.** **2. To deal extensively with the requirements of Industry.** **3. To equip students with the nuances of technical writing.** **4. To bridge the gap between college and work-place** **5. To understand the genres of English Literature**

COMMUNICATIVE ENGLISH THEORY (HLS102)

SCOPE & IMPORTANCE OF COMMUNICATIVE ENGLISH

This course aims to take off from the threshold of the previous paper dealt in Semester I. Dealing extensively with requirements of Industry, the paper aspires to equip students with the nuances of technical writing, excellent communication flair and presentation skills. Eventually, the agenda is to bridge the gap between college and work-place.

SECTION A

LEXIS and SYNTAX: Homonym, Homophones, Words often confused, Foreign Words, Sentence, Kinds of Sentence, Parts of Sentence, The Phrase, The Clause, Synthesis of Simple Sentence, Spotting the Errors (Articles, Pronoun, Preposition, Adjective, Verb)

SECTION B

ORAL COMMUNICATION-II: Importance of Speech Sounds, IPA Symbols (Vowels and Consonants), Phonetic Transcription, Phoneme and Syllables

SECTION C

TECHNICAL WRITING-II: Business Letters, Job Application and CV Writing, Paraphrasing, Punctuation, Situation Writing, Paragraph Writing, Developing Outlines.

SECTION D

Literature: *Goodbye Party for Miss. Pushpa T S* - Nissim Ezekiel
Why Scientists and Engineers Need Literature- Troy Camplin
The Time Machine - H. G.Wells

REFERENCE BOOKS

1. High School English Grammar and Composition. Wren and Martin: S.Chand and Co.
2. A Textbook of English Phonetics for Indian Students. T.Bala Subhrmaniam: Macmillan
3. English Vocabulary in Use. MaCarthy: Foundation Books, OUP
4. English Grammar, Competition and Correspondenc. M.A. Pink and A.C.Thomas: S.Chand and Co.
5. Reading Between the Line: Students Book. MacRae: Foundation Books. CUP, New Delhi

COMMUNICATIVE ENGLISH PRACTICAL (HLS102)

LAB ACTIVITIES:

1. Exercise on Lexis.
2. Exercise on Syntax
3. Exercise on Spotting the Errors
4. One- Man Task
5. Role-Play Activities
6. Mock-Interview
7. Paragraph Writing
8. Situation Writing
9. Slogan Writing
10. Phonetic Transcription
11. Synthesizing Sentences
12. Presentation (Book Review/ Movie Review)

Course Title/ Code	**Chemistry in Everyday Life (CHW109)**
Course Type	**Domain Core**
Course Nature	**W/S**
L-T-P-O Structure	**(0-0-3-0)**
Objectives	**To make the students aware of the importance of Chemistry in daily life**

LIST OF EXPERIMENTS IN WORKSHOP

1. Determination of acid content in lubricating oil.
2. Determination of Saponification Number of oil.
3. Osazone formation: Preparation of Phenyl –glucosazone and recrystallization.
4. Preparation of methyl orange-An Azodye.
5. Detection of Adulteration in Milk and Milk Products
6. Detection of Adulteration in Spices.
7. Detection of Adulteration in Food.

CSU01- SEMESTER-III

COURSE CODE	COURSE NAME	Course Type Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Course Nature Hard/Soft/ Workshop/ NTCC	PERIODS				CREDITS
				L	T	P	O	
CHH211-T	Inorganic Chemistry-II	Domain Core	Hard	3	1	0	0	4
CHH211-P	Inorganic Chemistry-II Lab			0	0	2	0	1
CHH212-T	Physical Chemistry-II	Domain Core	Hard	3	1	0	0	4
CHH212-P	Physical Chemistry-II Lab			0	0	2	0	1
CHH213-T	Organic Chemistry-I	Domain Core	Hard	3	1	0	0	4
CHH213-P	Organic Chemistry-I Lab			0	0	2	0	1
CHH214-T	Analytical Chemistry & Spectroscopy	Domain Core	Hard	3	1	0	0	4
CHH214-P	Analytical Chemistry & Spectroscopy Lab			0	0	2	0	1
CHW215	Extraction & Synthesis	Domain Core	W/S	0	0	3	0	2
	Management Electives	Allied Elective	Soft	1	0	2	0	2
	Humanities Elective	Allied Elective	Soft	1	0	2	0	2
	Foreign Languages:	Allied Elective	Audit	1	1	0	0	0
FLS211	FRENCH							
FLS209	SPANISH							
FLS210	GERMAN							

CHU01-SEMESTER III
MANAV RACHNA UNIVERSITY
B.SC. CHEMISTRY (H) PROGRAM
DEPARTMENT OF CHEMISTRY
INORGANIC CHEMISTRY-II THEORY (CHH211-T)

Course Title/ Code	**Inorganic Chemistry-II (CHH211) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To compare chemical properties of s and p block elements** **a. To understand general principles of metallurgy** **2. To recognize and compare applications of inorganic polymers** **a. To perform synthesis of inorganic compounds** **b. To find out concentration of transition elements by titrations.**

SECTION A

GENERAL PRINCIPLES OF METALLURGY

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

SECTION B

CHEMISTRY OF *s* AND *p* BLOCK ELEMENTS

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial.

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

SECTION C

NOBLE GASES

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2, XeF4and XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).

Rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2 and XeF4, XeF6; XeO3.

SECTION D

CHEMICAL BONDING-II

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

(iii) Metallic Bond: Qualitative idea of valence bond and band theories.

(iv) Weak Chemical forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetic of dissolution process.

REFERENCE BOOKS:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).
8. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis*
9. G.S. Manku, Theoretical Principles of Inorganic Chemistry, Tata McGraw-Hill Education, 1980

INORGANIC CHEMISTRY-II PRACTICAL (CHH211-P)

LAB EXPERIMENTS:

OXIDATION REDUCTION TITRATIONS

1. To determine strength of given ferrous ammonium sulphate solution by titrating it against $K_2Cr_2O_7$ solution and using potassium ferricyanide as an external indicator.
2. To determine strength of given ferrous ammonium sulphate solution by titrating it against $K_2Cr_2O_7$ solution and using N-phenyl anthranilic acid as an internal indicator. Standardize $K_2Cr_2O_7$ by using N/30 ferrous ammonium sulphate.
3. To determine strength of given $K_2Cr_2O_7$ solution by titrating it against ferrous ammonium sulphate solution and using N-phenyl anthranilic acid as an internal indicator.

IODINE TITRATIONS

4. To determine strength of given copper sulphate solution by using approx. N/30 sodium thiosulphate solution.
5. To determine strength of given $K_2Cr_2O_7$ solution by using approx. N/30 sodium thiosulphate solution.
6. To determine strength of given $KMnO_4$ solution by using approx. N/20 sodium thiosulphate solution.

GRAVIMETRIC ANALYSIS

7. To estimate Barium as barium sulphate in barium chloride solution.
8. To estimate zinc as zinc oxide from zinc chloride/zinc sulphate solution.
9. To estimate copper as cupric oxide in a solution of copper sulphate.

Course Title/ Code	**Physical Chemistry-II (CHH212) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To develop in depth understanding of thermodynamic laws and their application.** **2. To derive relationship between various equilibrium constants** **3. To derive relation between colligative properties** **4. To understand phase equilibrium and draw phase diagram for one, two and three component system** **5. To find out concentration of transition elements by titrations.**

PHYSICAL CHEMISTRY-II THEORY (CHH212-T)

SECTION A

CHEMICAL THERMODYNAMICS

Intensive and extensive variables; state and path functions; isolated, closed and open systems;

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

SECTION B

CHEMICAL EQUILIBRIUM

Chemical equilibria in ideal gases, concept of fugacity. Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium. Temperature, pressure and concentration dependence of equilibrium constant; Van't Hoff reaction isochore, Van't Hoff reaction isotherm. thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le-Chatetier's principle and its applications Clapeyron equation and Clausius – Clapeyron equation its applications.

SECTION C

SOLUTIONS AND COLLIGATIVE PROPERTIES

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Behavior of real gases: Deviations from ideal gas behavior, compressibility factor *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. vander Waals equation of state, its derivation and application in explaining real gas behaviour, Isotherms of real gases and their comparison with van der Waals isotherms, critical state, relation between critical constants and van der Waals constants.

SECTION D

PHASE EQUILIBRIA

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.

Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, Nernst distribution law: its derivation and applications.

REFERENCE BOOKS:

1. Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed*.,* Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
4. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).

6. Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
7. Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006).
8. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
9. Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001)

PHYSICAL CHEMISTRY-II PRACTICAL (CHH212-P)

LAB EXPERIMENTS:

1. To determine the solubility of a salt (KCl) in water at room temperature.
2. To determine the solubility of an organic acid (Oxalic Acid) in water at room temperature.
3. To determine the solubility product of calcium hydroxide using common ion effect of sodium hydroxide or any other strong alkali.
4. To determine the rate constant and order of reaction of the hydrolysis of an ester (methyl acetate) catalyzed by an acid (dilute HCl).
5. To determine the rate constant of hydrolysis (saponification) of ethyl acetate with NaOH and to show that reaction is second order.
6. To study of kinetics of dissolution of magnesium metal in dil. HCl.
7. To study of kinetics of decomposition of sodium thiosulphate by a mineral acid.

Course Title/ Code	**Organic Chemistry-I (CHH213) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To understand nomenclature, hybridization and electronic displacement.** **2. To draw conformational, geometrical and optical isomers.** **3. To outline chemistry of alkane, alkene, alkynes and aromatichydrocarbons.** **4. To purify organic compounds by crystallization.** **5. To determine melting and boiling points of organic compounds and solvents.** **6. To separate mixture of organic compounds by using paper chromatography.**

ORGANIC CHEMISTRY-I THEORY (CHH213-T)

SECTION A

BASICS OF ORGANIC CHEMISTRY

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements*:* Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

SECTION B

ISOMERISM AND STEREOCHEMISTRY

Conformational isomerism: Conformers, dihedral angle, torsional strain. Fischer Projection, Newmann and Sawhorse Projection, Conformational analysis of ethane and n-butane, conformers of cyclohexane (Chair, boat and skew boat forms), axial-equatorial positions and their interconversions, conformers of mono and disubstituted cyclohexanes, 1,2 and 1,3 interactions.

Geometrical isomerism: Cis-trans, syn-anti and E-Z notations, methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration, cyclisation and heat of hydrogenation. Examples of geometrical isomerism and mono, di-substituted cyclohexanes.

Optical Isomerism*:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

SECTION C

ALIPHATIC HYDROCARBONS

Alkanes: Synthesis and chemical reactivity of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Alkenes: general methods of synthesis of alkenes, Electrophilic additions their mechanisms Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Alkynes: General methods of synthesis*,* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

SECTION D

AROMATIC HYDROCARBONS

Aromatic Hydrocarbons: Aromaticity, Structure of benzene, general mechanism of electrophilic substitution, reactions of benzene, synthesis of aromatic compounds using nitration, halogenation, Friedel-Craft's reactions. Directing effects of the groups.

REFERENCE BOOKS:

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
5. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
8. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).

ORGANIC CHEMISTRY-I PRACTICAL (CHH213-P)

LAB EXPERIMENTS:

1. Purification of organic compounds by crystallization using Water as a solvent
2. Purification of organic compounds by crystallization using Alcohol-Water as a solvent
3. Determination of the melting points of organic compounds.
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
5. Determination of boiling point of liquid compound (Benzene)
6. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
7. Separation of a mixture of two sugars by ascending paper chromatography.
8. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)
9. To extract Aniline from Aniline-water mixture

Course Title/Code	**Analytical Chemistry and Spectroscopy (CHH214) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To calculate concentration terms and their inter-conversion** **2. To understand basic principles of UV-Vis spectroscopy and analyze spectra** **3. To recognize and compare applications of inorganic polymers** **4. To perform synthesis of inorganic compounds** **5. To find out concentration of transition elements by titrations.**

ANALYTICAL CHEMISTRY AND SPECTROSCOPY THEORY (CHH214-T)

SECTION A

SCOPE AND INTRODUCTION TO ANALYTICAL CHEMISTRY

Qualitative and Quantitative analysis, Classification of analytical methods, Classical and Instrumental methods. Sampling, Accuracy and Precision concepts, Selection of a sampling method for analysis, Applications of analytical methods in various fields: Organic, Pharmaceuticals, Electronic and Environmental.

Chemical calculations of Expressing concentration of solutions –Normality, Molality, Molarity, Formality, inter-conversion between molality and molarityMole fraction, Weight ratio, Volume ratio, Weight to volume ratio, ppb, ppm, millimoles, milliequivalents.

SECTION B

SPECTROSCOPY

Intoduction: Gerneral principles, introduction to absorption and emission spectroscopy, Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the born-oppenheimer approximation.

UV-Vis Spectroscopy*:* Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), relative positions of λmax considering conjugative effect, steric effect, solvent effect, red shift
(bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

Applications of UV-Vis spectroscopy for identification of simple organic molecules.

SECTION C

SEPARATION TECHNIQUES

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.
Role of computers in instrumental methods of analysis.

SECTION D

PHYSICOCHEMICAL METHODS OF ANALYSIS

Thermal methods of analysis: Theory of thermogravimetry Analysis (TGA), Theory of Differential thermal analysis (DTA), Theory of Differential Scanning Calorimetry (DSC), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

REFERENCE BOOKS:

1. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
4. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.
8. Singh, J.; Ali, S.M.& Singh, J. *Natural Product Chemistry*, Prajati Prakashan (2010).
9. Kemp, W. *Organic Spectroscopy*, Palgrave.
10. Pavia, D. L. *et al. Introduction to Spectroscopy* 5th Ed. Cengage Learning India Ed. (2015).

ANALYTICAL CHEMISTRY AND SPECTROSCOPY PRACTICAL (CHH214-P)

LAB EXPERIMENTS:

1. Determination of the amount of oxalic acid & Sulphuric Acid in the given solution titrimetrically.
2. Determination of % composition of $BaSO_4$ and NH_4Cl in the given mixture gravimetrically.
3. Determination of R_f value of amino acids by Thin Layer Chromatography and Identification of given Amino Acid.
4. Separation of dyes in a given mixture by Thin Layer Chromatography.
5. Determination of Strength of Acetic Acid and Hydrochloric Acid in a given Mixture by Conductometric Titration using Strong Base NaOH.
6. To determine the λ_{max} of solution of $KMnO_4$ using a Spectrophotometer and apply it to find out the concentration of given unknown solution.

Course Title/ Code	**Extraction and Synthesis (CHW215)**
Course Type	**Domain Core**
Course Nature	**W/S**
L-T-P-O Structure	**(0-0-3-0)**
Objectives	**To impart the students hands-on exposure to extraction and chemical Synthesis of various functional materials.**

List of Experiments in workshop:

1. To synthesize inorganic compound of daily use (Ferrous ammonium sulphate, Potash alum)
2. Synthesis of organic compounds (oxalic acid, picric acid)
3. Extraction of rose water and Rosen dye (natural pink dye) from petals of rose.
4. Extraction of phytochemicals from fruit peels.
5. To determine the moisture, volatile, fixed carbon and ash content in a given coal sample by proximate analysis.
6. Preparation of Aniline/formaldehyde resin.
7. Synthesis of Soap.
8. Preparation of pharmaceutical drugs (Aspirin formation)

CHU01- SEMESTER-IV

COURSE CODE	COURSE NAME	Course Type Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Course Nature Hard/ Soft/ Workshop /NTCC	PERIODS L	T	P	O	CREDITS
CHH216-T	Inorganic Chemistry-III	Domain Core	Hard	3	1	0	0	4
CHH216-P	Inorganic Chemistry-III Lab			0	0	2	0	1
CHH217-T	Physical Chemistry-III	Domain Core	Hard	3	1	0	0	4
CHH217-P	Physical Chemistry-III Lab			0	0	2	0	1
CHH218-T	Organic Chemistry-II	Domain Core	Hard	3	1	0	0	4
CHH218-P	Organic Chemistry-II Lab			0	0	2	0	1
MAS230	Quantitative Aptitude	Allied Core	Soft	1	0	2	0	2
CHH219-T	Polymer Chemistry	Domain Elective	Hard	3	1	0	0	4
CHH219-P	Polymer Chemistry Lab			0	0	2	0	1
CHH220-T	Clinical & Pharmaceutical Chemistry	Domain Elective	Hard	3	1	0	0	4
CHH220-P	Clinical & Pharmaceutical Chemistry Lab			0	0	2	0	1
CHS203	Environmental Ethics and Sustainable development 1.e-waste: Environ-mental Problems & Management	Domain Elective	Soft	1	0	2	0	2
CHW221	Corrosion Workshop	Domain Core	W/S	0	0	3	0	2
	Foreign Languages FRENCH SPANISH GERMAN	Allied Elective	Audit	1	1	0	0	0

CHU01-SEMESTER IV

MANAV RACHNA UNIVERSITY

B.SC. CHEMISTRY (H) PROGRAM

DEPARTMENT OF CHEMISTRY

Course Title/ Code	**Inorganic Chemistry-III (CHH216) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To compare chemical properties of transition elements** **2. To perform synthesis of organometallic compounds** **3. To study the properties of coordination compounds** **4. To study the electronic structure and chemical properties of lanthanides and actinides.**

INORGANIC CHEMISTRY-III THEORY (CHH216-T)

SECTION A

TRANSITION ELEMENTS (D-BLOCK ELEMENTS)

Introduction, General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. metallic character, and complex formation, properties (size of atom and ions, density, MPand BP, reactivity, ionization energy, colour), chemical reactions.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

SECTION B

LANTHANIDES AND ACTINIDE SERIES (F-BLOCK ELEMENTS)

Lanthanides: Introduction, electronic structure, oxidation state, abundance of number of isotopes, extraction, uses. Chemical properties, variable oxidation states, separation of lanthanide series.

Actinides: Introduction, electronic structure, oxidation state, abundance of number of isotopes, extraction, uses. Chemical properties, variable oxidation states, latter actinide elements.

SECTION C

COORDINATION COMPOUNDS

Double salts and co-ordination compounds. Werner's theory, Valance bond theory (inner and outer orbital complexes), effective atomic numbers. Crystal field theory, CFSE in weak and strong fields, Effect of crystal field splitting, Jahn teller effect, pairing energies.

Molecular orbital theory; Complex arrangements, chelate, magnetism, Qualitative aspect of Ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

SECTION D

ORGANOMETALLIC COMPOUNDS

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. Behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

REFERECE BOOKS:

1. Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected topics in inorganic Chemistry, S.Chand
4. Robert H. Crabtree, The Organometallic Chemistry of transition Metals, Wiley
5. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
6. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999.
7. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
8. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.
9. D. N. Bajpayee, O.P. Pandey, S. Giri, Practical Chemistry, S. Chand

INORGANIC CHEMISTRY-III PRACTICAL (CHH216-P)

LAB EXPERIMENTS:

GRAVIMETRIC ANALYSIS

1. To estimate iron as Ferric oxide in a solution of ferrous sulphate or ferrous ammonium sulphate.
2. To estimate Aluminium or aluminium oxide in potash alum or ammonium aluminium sulphate.
3. To estimate lead as lead sulphate in lead chloride/nitrate/acetate.

INORGANIC SYNTHESIS

4. Synthesis of Sodium Ferrioxalate $Na_3[Fe(C_2O_4)_3].9H_2O$
5. Synthesis of Nickel Dimethylglyoxime Complex $[Ni\ (DMG)_2]$
6. Synthesis of Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4$
7. Synthesis of Cuprous Chloride Cu_2Cl_2
8. Synthesis of Chrome Alum $K_2SO_4Cr_2(SO_4)_3.24H_2O$

Course Title/ Code	**Physical chemistry-III (CHH217) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To impart in-depth knowledge of Chemical Kinetics** **2. To familiarize the students with surface Chemistry and catalysis** **3. To impart the students in-depth knowledge of Electrochemical Reactions**

PHYSICAL CHEMISTRY-III THEORY (CHH217-T)

SECTION A

CHEMICAL KINETICS

Order and molecularity of a chemical reaction, kinetic laws of first and second order reactions, analysis of kinetic data for the determination of the rate constant and order, effect of temperature on reaction rates (Arrheninus equation), activation energy, collision theory of rates of bimolecular reactions. Experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Systems of Variable Composition: Partial molar quantities, Gibbs- Duhem equation.

SECTION B

SURFACE AND COLLOIDS CHEMISTRY

Physical adsorption, chemisorption, nature of adsorbed state. Adsorption- Langmuir and Freundlich isotherms. Multi layer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels. Applications of colloids.

CATALYSIS

Types of catalysts, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis and mechanism.

SECTION C

ELECTROCHEMISTRY-I

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect,. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

SECTION D

ELECTROCHEMISTRY–II

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Applicationof EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

REFERENCE BOOKS:

1. Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed.*,* Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
6. Zundhal, S.S*. Chemistry concepts and applications* Cengage India (2011).

7. Ball, D. W. *Physical Chemistry* Cengage India (2012).
8. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
9. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).
10. Metz, C. R. *Physical Chemistry 2nd Ed.,* Tata McGraw-Hill (2009).
11. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
12. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
13. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
14. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R.Chand & Co.: New Delhi (2011).
15. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
16. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

PHYSICAL CHEMISTRY-III PRACTICAL (CHH217-P)

LAB EXPERIMENTS:

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
2. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: simple eutectic system.
3. Distribution of acetic/ benzoic acid between water and cyclohexane.
4. Study the equilibrium of following reaction by the distribution method:
   $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
5. Study the kinetics of acid hydrolysis of methyl acetate with hydrochloric acid 1. Initial rate method: Iodide-persulphate reaction.
6. Study the kinetics of Saponification of ethyl acetate.
7. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.
8. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Course Title/Code	**Organic Chemistry-II (CHH218) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To familiarize the students about Halogenated Hydrocarbons, alcohols, phenols, ethers and epoxides** **2. To make the students understand the chemistry of polynuclear Hydrocarbons** **3. To educate the students about carbonyl compounds**

ORGANIC CHEMISTRY II-THEORY (CHH218-T)

SECTION A

CHEMISTRY OF HALOGENATED HYDROCARBONS

Alkyl halides: Methods of preparation, nucleophilic substitution reactions, mechanisms with stereochemical aspects and effect of solvent, etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation including preparation from diazonium salts, nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/ benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

SECTION B

ALCOHOLS, PHENOLS, ETHERS and EPOXIDES

Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvael-Blanc Reduction, Preparation and properties of glycols; Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties, Acidity and factors effecting it, Ring substitution reactions, Reimer Tiemann and Kolbe's Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

***Ethers and Epoxides*:** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4.

SECTION C

POLYNUCLEAR HYDROCARBONS

Polynuclear hydrocarbon or fused ring hydrocarbons: nomenclature

***Napthalene Anthracene*:** structure, synthesis, properties (physical and chemical: sufonation, acylation, nitration, halogenation, reduction, oxidation) and uses(naphthol, naphthylamines)

Anthracene: structure, synthesis, properties (physical and chemical: sufonation, nitration, halogenation, reduction, oxidation) and uses (Anthraquinone, Alizarine).

Phenanthrene: structure, synthesis, properties (physical and chemical: nitration, acylation) and uses.

SECTION D

CARBONYL COMPOUNDS

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives wittig mechanism; Mechanisms of aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villinger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolf-Kishner, LiAlH4, NaBH4, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds; Michael addition.

Active methylene compounds; Keto-enol tautamerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

REFERENCE BOOKS:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009).
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012).
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
4. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
7. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

ORGANIC CHEMISTRY II-PRACTICAL (CHH218-P)

LAB EXPERIMENTS:

1. Detection of elements
2. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
3. Identification of functional groups in the given unknown organic compound
4. Identification of functional groups in the given mixture
5. Benzoylation of Aniline by Schotten Baumann reaction
6. Oxidation of isopropanol by iodoform reaction
7. Nitration of phenol
8. Hydrolysis of amides

Course Title/ Code	**Polymer Chemistry (CHH219) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To make the students aware of the emergence of Polymers** **2. To make the students understand the classification of Polymeric materials** **3. To make the students understand the thermal, mechanical, electrical properties of polymers** **4. To make the students analyse the microstructure of polymeric materials**

POLYMER CHEMISTRY THEORY (CHH219-T)

SECTION A

INTRODUCTION AND HISTORY OF POLYMERIC MATERIALS

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

FUNCTIONALITY AND ITS IMPORTANCE

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

SECTION B

KINETICS OF POLYMERIZATION

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

CRYSTALLIZATION AND CRYSTALLINITY

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

SECTION C

NATURE AND STRUCTURE OF POLYMERS

Structure Property relationships. Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Factors affecting glass transition temperature (Tg).

POLYMER SOLUTION

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

SECTION D

PROPERTIES OF POLYMERS (PHYSICAL, THERMAL, FLOW & MECHANICAL PROPERTIES):

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers.

REFERENCE BOOKS:

1. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
3. F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. R.W. Lenz: *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.
6. M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
7. H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003).
8. F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984).
9. J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003).
10. P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002).
11. L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. JohnWiley & Sons (2005).
12. M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
13. Seymour**/** Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

POLYMER CHEMISTRY PRACTICAL (CHH219-P)

LAB EXPERIMENTS:

1. Purification of monomer (Acrylamide)
2. Preparation of nylon 66 and nylon 6
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparations of novalac resin
6. Determination of molecular weight of polymers by viscometry
7. Determination of the viscosity-average molecular weight of poly(vinyl alcohol).
8. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

Course Title/ Code	**Clinical and Pharmaceutical Chemistry (CHH220) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**After going through the course the student is expected to learn about** **1. The disinfectants and antiseptics.** **2. The important drugs and the mode of actions.** **3. Enzymes & Body fluids**

CLINICAL AND PHARMACEUTICAL CHEMISTRY THEORY (CHH220-T)

SECTION A

CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS

Definition of health. Ryde of WHO. Sterilization of surgical instruments. Disinfectants, antiseptics, sanitation. Biochemical analysis of urine, serum and fecal matter. Treatment for specific poisons-acids, alkalis, arsenic and mercury compounds. Different types of chemical poisons in society

SECTION B

DRUGS & PHARMACEUTICALS

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

SECTION C

ENZYMES

Classification, specificity. Coenzymes, Cofactor, ATP, Mechanism of enzyme action and Immobilisation of enzymes.

SECTION D

BODY FLUID

Blood volume, blood groups, coagulation of blood. Plasma lipo protiens. Blood pressure. Arteriosclerosis, diseases afecting red cells: Hyperchromic and hypochromic anaemia. Blood tranfusion. Blood sugar and diabetes.

REFERENCE BOOKS

1. O.Le Roy, Natural and synthetic organic medicinal compounds, Ealemi., 1976.
2. B.L. Oser, Hawk's physiological chemistry, 14th edition, Tata-McGraw – Hill Publishing Co.Ltd, 1965
3. O. Kleiner and J. Martin, Bio-Chemistry, Prentice-Hall of India(P) Ltd, New Delhi, 1974.

CLINICAL AND PHARMACEUTICAL CHEMISTRY PRACTICAL (CHH220-P)

LAB EXPERIMENTS:

1. Preparation Of following inorganic pharmaceuticals and identification tests
   - i. Aluminium hydroxide
   - ii. Barium sulphate
   - iii. Calcium carbonate
   - iv. Ferrous sulphate
   - v. Potassium citrate
   - vi. Boric acid

2. Identification of proteins and amino acids (Casein, albumin, gelatin)
3. Identification of carbohydrates
4. To check neutralizing capacity of aluminium hydroxide gel
5. Preparation of cold cream
6. Preparation of simple ointment
7. Preparation of calamine lotion
8. Preparation of Bentonite and glycerine paste
9. Preparation of olive oil emulsion

Course Title/ Code	**Quantitative Aptitude (MAS230)**
Course Type	**Core**
Course Nature	**Soft**
L-T-P-O Structure	**(1-0-2-0)**
Objectives	**The students would be able to apply the concepts of Quantitative techniques and their applications.**

SECTION A

H.C.F. & L.C.M. of Numbers, Square Roots & Cube Roots Average, Problems on Ages, Percentage , Profit & Loss

SECTION B

Ratio & Proportion, Numbers, Time & work. , Time & Distance, Problems on Trains

SECTION C

Simple Interest, Compound Interest, Area, Volume & Surface Areas, Races & Games of Skill

SECTION D

Calendar, Clocks, Permutations & Combinations, Probability

REFERENCES

1. Quantitative Aptitude –R.S. Aggarwal

PRACTICE WORKSHEETS

1. (a)To solve the problems of H.C.F. & L.C.M. of Numbers.

   (b) To solve the problems of Square Roots & Cube Roots.

2. (a) To solve the problems of Average
   (b) To solve the Problems on Ages
3. To solve the problems of Percentage, Profit & Loss
4. To solve the problems of Ratio & Proportion, Numbers
5. To solve the problems of Time & work.
6. To solve the problems of Time & Distance, Problems on Trains
7. To solve the problems of Simple Interest and Compound Interest
8. To solve the problems of Area, Volume & Surface Areas
9. To solve the problems of Races & Games of Skill
10. To solve the problems of Calendar and Clocks.
11. To solve the problems of Permutations & Combinations and Probability.

Course Title/ Code	**e-waste: Environmental Problems and Management (CHS203)**
Course Type	**Domain Elective**
Course Nature	**Soft**
L-T-P-O Structure	**(1-0-2-0)**
Objectives	**1. To create awareness about environmental impacts of e-waste.** **2. To identify various components of e-waste** **3. To make the student aware about international regulation and guidelines for e-waste management** **4. To help the engineering student to know about establishment of e- waste recycling technologies**

e-WASTE: ENVIRONMENTAL PROBLEMS AND MANAGEMENT THEORY (CHS203)

SECTION A

INTRODUCTION

e-Waste, Discard rate of e- waste, Indian and global scenario of e-Waste, dynamics of e-waste generation, Environmental and Health implication, Need for the Guidelines for Environmentally Sound Management, Green ICT Standards

CLASSIFICATION OF E-WASTE

Composition of e-Waste, Components of e-Waste, Possible hazardous substances present in e-waste, Basis for Defining e-waste, Proposed reduction of the Hazardous Substances (RoHS) in the Electronic & electrical Equipments, Extended Producer Responsibility (EPR).

SECTION B

REGULATORY REGIME FOR E-WASTE

The Hazardous Wastes (Management and Handling) Rules 2003, The Municipal Solid Wastes (Management and Handling) Rules 2000, e- waste management Rules 2011, Regulatory compliance including roles and responsibility of different stakeholders

GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT FOR E-WASTE

E-waste Composition and Recycle Potential, Assessment of Hazardousness of e-waste, Recycling, Reuse and Recovery Options, Treatment & Disposal Options, e-waste Recycling/Treatment technologies in India

SECTION C

ENVIRONMENTALLY SOUND TREATMENT TECHNOLOGY FOR E-WASTE

Environmentally sound e-waste treatment technologies, Environmental Impacts of the 1st, 2nd and 3rd level e-waste treatment system, Technologies Currently Used in India, Best Available Technology, Available Operating Facilities.

SECTION D

GUIDELINES FOR ESTABLISHMENT OF INTEGRATED E-WASTE RECYCLING & TREATMENT FACILITY

Facility Operation Requirements, Procedures for Setting-up & Management of integrated e-waste. Facility, Procedures for compliance with the existing regulations and Guidelines, Case studies and unique initiatives from around the world

REFERENCE BOOKS:

S.No.	Book	Author	Publisher
1.	Electronic Waste Management	R E Hester, R M Harrison	RSC
2.	E-waste: Implications, regulations, and Management in India and current global best practices	Rakesh Johri	TERI PRESS

e-WASTE : ENVIRONMENTAL PROBLEMS AND MANAGEMENT PRACTICAL (CHS203)

LAB EXPERIMENTS:

1. To identify the hazardous materials present in printed circuit boards
2. Segregation of hazardous materials of printed circuit boards
3. Recovery of copper metal from edge trims of printed circuit boards.
4. Separate tin metal from lead-tin solder.
5. Recovery of copper oxide from waste water sludge
6. Extraction of copper from basic in etching solution

Course Title/ Code	**Workshop on Corrosion (CHW221)**
Course Type	**Domain Core**
Course Nature	**W/S**
L-T-P-O Structure	**(0-0-3-0)**
Objectives	**1. To make the student understand the effects of corrosion and their corrective and preventive measures** **2. To synthesize corrosion inhibitors**

CORROSION WORKSHOP

1. Synthesis of Corrosion inhibitor (organic and polymeric)
2. Calculation of organic corrosion inhibitors having different group on parent structure
3. Calculation of corrosion parameters after gravimetric analysis
4. Determine effect of time and temperature on corrosion
5. Determine effect of concentration of aggressive media
6. Demonstrate sacrificial anodic protection on mild steel and zinc couple in acidic media.
7. Determination of Inhibition efficiency corrosion rate and adsorption isotherm of different inhibitor having different inhibitor concentration.
8. Determine the effect of groups on corrosion inhibition property.
9. Determine Thermodynamic behavior of various inhibitors.
10. Effect of time on rate and efficiency of corrosion and inhibition.

CHU01- SEMESTER-V

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CHH323-T	Instrumental methods of Chemical analysis	Domain Core	Hard	3	1	0	0	4
CHH323-P	Instrumental methods of Chemical analysis Lab			0	0	2	0	1
CHH324-T	Organic Chemistry- III	Domain Core	Hard	3	1	0	0	4
CHH324-P	Organic Chemistry-III Lab			0	0	2	0	1
CHH325-T	Physical Chemistry- IV	Domain Core	Hard	3	1	0	0	4
CHH325-P	Physical Chemistry-IV Lab			0	0	2	0	1
CHH326-T	Food Chemistry & Technology	Domain Elective	Hard	3	1	0	0	4
CHH326-P	Food Chemistry & Technology Lab			0	0	2	0	1
CHH327-T	Green Technology	Domain Elective	Hard	3	1	0	0	4
CHH327-P	Green Technology Lab			0	0	2	0	1
CHN328	Seminars	Domain Core	NTCC	0	0	0	2	2

CHU01-SEMESTER V

MANAV RACHNA UNIVERSITY

B.SC. CHEMISTRY (H) PROGRAM

DEPARTMENT OF CHEMISTRY

Course Title/ Code	**Instrumental Methods of Chemical Analysis (CHH323) T & P**
Course Type	**Domain Core**
Course Nature	**W/S**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To impart knowledge on various spectroscopic techniques like UV-Vis and IR** **2. To make the student understand various chromatographic techniques of separation**

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS THEORY (CHH323-T)

SECTION A

INTRODUCTION TO SPECTROSCOPIC METHODS OF ANALYSIS: QUALITATIVE AND QUANTITATIVE ANALYSIS

Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

INFRARED SPECTROSCOPY

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

SECTION B

ADVANCED SPESCTROSCOPY

Emission, absorption, fluorescence and photoaccoustic Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

SECTION C

SEPARATION TECHNIQUES

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Mass spectroscopy*:* Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

SECTION D

ELEMENTAL ANALYSIS

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

REFERENCE BOOKS:

1. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
2. Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th ed, IBH Book House, New Delhi.
3. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
4. Kakkar, R. *Atomic and Molecular Spectroscopy: Concepts and Applications.* Cambridge University Press, 2015.
5. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
6. Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw- Hill: New Delhi (2006).
7. Smith, B.C. *Infrared Spectral Interpretations: A Systematic Approach.* CRC Press, 1998.
8. Moore, W.J., *Physical Chemistry* Orient Blackswan, 1999.
9. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
10. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmon

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS PRACTICAL (CHH323-P)

LAB EXPERIMENTS:

1. Determination of the isoelectric pH of a protein.
2. Titration curve of an amino acid.
3. Determination of a Mixture of Cobalt and Nickel by UV/Vis spectroscopy
4. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water) by UV-Vis spectroscopy
5. IR Absorption Spectra (Study of Aldehydes and Ketones)
6. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption spectroscopy
7. Potentiometric Titration of a Chloride-Iodide Mixture
8. Detection of pollutants or illegal dumping
9. Fibre analysis

Course Title/ Code	Organic Chemistry-III (CHH324) T & P
Course Type	Domain Core
Course Nature	Hard
L-T-P-O structure	(3-1-2-0)
Objectives	1. To give an exposure to synthesis of carboxylic acids and their derivatives 2. To familiarize the students with the synthesis and properties of nitrogen and sulphur containing compounds 3. To guide the students about heterocyclic chemistry

ORGANIC CHEMISTRY-III THEORY (CHH324-T)

SECTION A

CARBOXYLIC ACIDS AND THEIR DERIVATIVES

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxyl acids and unsaturated acids: succinic/ phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

SECTION B

NITROGEN CONTAINING FUNCTIONAL GROUPS

Preparation and important reactions of nitro and compounds, nitriles and isonitriles. Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.

SECTION C

SULPHUR CONTAINING COMPOUNDS

Preparation and properties of thiols or mercatans (physical and chemical properties), thioethers or sulphides: method of preparation, propreties (reactions with alkyl halide, halogens, hydrolysis, oxidation etc.) mustard gas: preparation and properties. Aromatic sulphonic acids: nomenclature, method of preparation, physical properties, chemical properties (reaction of –OH of SO_3H group and reaction in which $–SO_3H$ group replaced. Uses of suphonic acids (benzenesulphonic acid, benzene suphonyl chloride, Toluenesulphonic acid, Chloramine –T, sulphanilic acid, sulfanilamide: preparation and properties)

SECTION D

HETEROCYCLIC COMPOUNDS

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine.

REFERENCE BOOKS:

1. R.T. Morrison & R. N. Boyd, Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
2. I.L. Finar, Organic Chemistry Volume 1 Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
3. I.L. Finar, Organic Chemistry Volume 2 Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
4. V. K. Ahluwalia, Heterocyclic Chemistry, Alpha Science International, Ltd.

ORGANIC CHEMISTRY-III PRACTICAL (CHH324-P)

LAB EXPERIMENTS

DETECTION OF ORGANIC COMPOUNDS AND DERIVATIZATION

1. Systematic Qualitative organic analysis of organic compounds possessing monofunctional groups (amide, nitro, amines, hydrocarbons, halo hydrocarbons)
2. Differentiation between a reducing and non reducing sugar
3. To determine the concentration of glycine solution by formylation method
4. Study of titration curve of glycine
5. To determine the iodine value of an oil/ fat
6. Derivatization of organic compounds possessing monofunctional groups (Alcohols, Phenols, Carbonyl, carboxylic acids, amide, nitro, amnines, hydrocarbons, halo hydrocarbons).

Course Title/ Code	**Physical Chemistry-IV (CHH325) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To give an in-depth exposure of Quantum Chemistry** **2. To familiarize the students with various spectroscopic techniques like IR, Raman, NMR and ESR.**

PHYSICAL CHEMISTRY-IV THEORY (CHH325-T)

SECTION A

QUANTUM CHEMISTRY-I

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution.

SECTION B

QUANTUM CHEMISTRY-II

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom). Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding andantibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

SECTION C

MOLECULAR SPECTROSCOPY-I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

SECTION D

MOLECULAR SPECTROSCOPY-II

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. Nuclear Magnetic Resonance ***(NMR) spectroscopy:*** Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

REFERENCE BOOKS:

1. Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001). House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
3. Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).
4. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).
5. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
6. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
7. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;*
8. W.H. Freeman & Co.: New York (2003).

PHYSICAL CHEMISTRY-IV PRACTICAL (CHH325-P)

LAB EXPERIMENTS:

1. Study the 200-500 nm absorption spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values.
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
4. Verify Lambert-Beer's law and determine the concentration of $KMnO_4$/ $K_2Cr_2O_7$. in a solution of unknown concentration.
5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium.
7. Determine the amount of iron present in a sample using 1,10-phenathroline.
8. Determine the dissociation constant of an indicator (phenolphthalein).
9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
10. Analysis of the given vibration-rotation spectrum of HCl(g)

Course Title/Code	**Food Chemistry and Technology (CHH326) T & P**
Course Type	**Elective**
Course Nature	**Hard**
L-T-P-O Structure	**(0-0-3-0)**
Objectives	**1. To provide Students the basic knowledge in Food Chemistry and modern trends in the industry.** **2. To provide the practical training to the students in the food analysis**

FOOD CHEMISTRY AND TECHNOLOGY THEORY (CHH326-T)

SECTION-A

INTRODUCTION

Food: source, functions of food – food groups – food guide – basic five food groups,usage of the food guide – food in relation to health – objectives of cooking.Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment. Use of chlorination, ozone, and UV light disinfection. Specification of drinking water. Water borne diseases – microbiological examination. Sources and detection. Milk: Composition and effectiveness as a diet. Fat content in milk, whole and skimmed. Effect of cooking and heat processing of milk – pasteurization. Preservation of milk. Deep freeze preservation, dairy products – cheese, butter, ghee and kova. Spray drying technique – milk powder, infant food preparation. Lactose intolerance Milk substitutes – vegetable milk. Toned milk. Self study Different mode of cooking, and objectives of cooking.

SECTION-B

CONSTITUENTS OF FOODS

Proteins: amino acids – peptides – proteins, modification of food products through heat processing.Effect of cooking – steaming or cooking under pressure of legumes. Detoxication. Analysis of proteins – principles in the determination of moisture content, ash content, nitrogen content – Kjeldahl's method.Separation of amino acids by paper chromatography, separation of proteins by electro phoresis. Enzymes: Nomenclature, classification – Apo, holo and coenzymes. Enzymes used in food processing.Enzymic browning – mode of action, secondary reaction of o-quinones, prevention of enzymic browning – thermal inactivation, pH, antioxidants Non-enzymic browning-Maillard reaction, prevention of non-enzymic browning. Measurement of enzyme activity- principles, estimation of the activity of catalase in Chow-chow and radish (Titrimetry) – principles. Carbohydrates: Classification, structure and reactions of monosaccharides, glucose, fructose, structure of sucrose, maltose, lactose and starch.Artificial sweetening agents.

SECTION C

FOODS AND FOOD ADDITIVES

Food additives: Artificial sweeteners – saccharin, cyclomate, asparatame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking..Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents.Baking powder –Yeast. Taste enhancers – MSG-vinegar Modern food: Mushroom cultivation and types, spirulina composition. Snack foods. Production of bread, bun and biscuits. Raw materials, methods and machinery required. Candy manufacturing. Caramellisation. Fast foods. Instant foods. Dehydrated foods. Oleoresin of spices. Condiments. Beverages: Soft drinks, soda, fruit juices and alcoholic beverages (Types and content of alcohol).Examples, Carbonation. Addiction to alcohol. Cirrhosis of liver. Socialproblems.Composition of soft drinks.Excessive use leading to urinary bladder stones. Preservation of tetrapak. Nitrogen preservation and packing of fruit juices. Coconut water.

SECTION D

NUTRITION AND BALANCED DIET NUTRITION

Calorific value of food stuff – RQ of food (Respiratory quotient of food) – basal metabolic rate – factors influencing BMR, specific dynamic action (SDA) of food. Thermogenic effect – energy requirements of individuals – diet and its components – the protein requirements – biological value of proteins, supplementary value of proteins. Diseases associated with protein malnutrition. Nutritional value of carbohydrates. – Fibers in the diet, dietary sugars – nutritional aspects of lipids.

REFERENCE BOOKS

1. Swaminathan M. Advanced Text Book on Food and Nutrition , volume I and II Printing and Publishing CO., Ltd., Bangalore. 1993.
2. Swaminathan M. Text Book on Food chemistry, Printing and Publishing CO., Ltd., Bangalore. 1993.
3. Norman N. Potter , Food science, CBS publishers and distributors, New Delhi. 1994.
4. Lillian Hoagoland Meyer, Food Chemistry, CBS publishers and distributors, New Delhi.1994.
5. Owen R Fennema, Food Chemistry, Marcel Decker Inc., New York. 1996.
6. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.
7. Siva Sankar B., Food Processing and Preservation. Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
8. Ramakrishnan S., Prasannam K.G and Rajan R –Principles. Text book of medical biochemistry. Orient Longman Ltd. III ed. 2001.
9. Shakuntala Manay N. and Shadaksharaswamy M. FOODS: Facts and Principles. New Age International Pvt. Ltd. Publishers, II ed. 2002.

FOOD CHEMISTRY AND TECHNOLOGY PRACTICAL (CHH326-P)

LAB EXPERIMENTS:

1. Estimation of Nitrogen (protein) by Kjeldhal method.
2. Estimation of iodine value, acid value and RM value of an edible oil. 03. Estimation of food colours (by colorimetric method).
4. Estimation of available carbondioxide in baking powder.
5. Isolation of caesein and lactose from milk.
6. Preparation of oleoresin of ginger and the essential oil.
7. Steam distillation of mint.
8. Estimation of glycine.
9. Isolation of natural food colours – Soxhelet extraction of chlorophyll.
10. Flavour analysis – GC/ HPLC demonstration.

Course Title/Code	**Green Technology (CHH327) T & P**
Course Type	**Elective**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To introduce importance of green technology and processes in industry** **2. To demonstrate green analytical techniques in qualitative and quantitative analysis** **3. To focus upon benefits of green catalyst for fast, economical and non hazardous synthesis** **4. To introduce various technologies for energy and fuel saving** **5. To focus upon importance of nano-particles in various engineering processes**

GREEN TECHNOLOGY THEORY (CHH327-T)

SECTION-A

GREEN INDUSTRIAL CHEMISTRY

Alternatives to Volatile Organic Compounds (VOCs) and Halogenated Organic Compounds (HOCs), Dupont's Technology for Polyester Regeneration, Green Bleaching Agents for Paper Manufacturing: TAML (Tetraamido-macrocyclic ligand), Design for energy efficiency, Design for degradation, zeolites and zeotypes, Super critical solvents, Non VOCs, Solvent less synthesis

GREEN ANALYTICAL TECHNIQUES

Spectroscopy: UV-Visible, Infra-red Chromatography: Thin Layer, Column, Ion Exchange solid phase micro-extraction (SPME), liquid-liquid microextraction (MLLE), Ultrasonic extraction, supercritical fluid extraction (SFE), Vacuum distillation of green organic compounds, Flame Photometer

SECTION-B

GREEN ENGINEERING CATALYSTS

Metal and supported metal catalysis, solid acid catalysis, solid base catalysis, catalyst design through artificial intelligence and computer modeling, supported enzyme catalysis, adsorption and reaction at supported metal catalysts, Physicochemical aspects of preparation of carbon supported noble metal catalysis, Catalysis for auto-exhaust pollution abatement

SECTION-C

GREEN PRODUCTION DESIGN FOR SUSTAINABLE DEVELOPMENT

Clean Technology Pool: Intensive Processing, Life cycle assessment, Alternative Route, ISO 14000, Micro-reactors, Eco labeling, Renewable feed stock, Telescoping synthesis (One-pot synthesis: Synthesis without workup), Alternative Energy Savers, environmental load of product, DeNox and De Sox technologies

SECTION-D

NANOMATERIAL BASED GREEN TECHNOLOGY

Theory of nanoparticle catalysis and electro catalysis, single crystal surfaces as model platinum-based fuel cell electro catalysts, nonmaterial as precursors of catalysts, preparation, characterization and properties of bimetallic nanoparticles, Ceramic/Metal Nano-composites for electronic applications, Nano-tubes, polymer nano-composites, nanao-fillers, metal sensors.

Real World Cases-Green Chemistry Challenge Awards

REFERENCE BOOKS:

1. Anastas, P.T., Williamson T.C., Green Chemistry frontiers in benign chemical synthesis and processes (oxford university press, New York, 1998)
2. Allen, D.T. and D.R. Shonnard, Green engineering: Environmentally conscious Design of chemical Processes, Prentice Hall PTR: Upper saddle river, NJ 2001
3. Martin Carter and Ursula Tischner: Sustainable Solutions: Developing products and services for the future, Green leaf publishing
4. Fabio Giudice, Guido La Rosa, Antonio Risitano, 'Product Design for the environment: A life cycle approach', CRC Press
5. Tundo, P. and P.T. Paul anastas, Eds., Green Chemistry: Challenging perspectives: oxford university press: oxford, U.K., 2000

GREEN TECHNOLOGY PRACTICAL (CHH327-P)

1. Find out concentration of organic pollutant in industrial waste water by UV-Vis Spectroscopy.
2. Estimation of alkali metals and alkaline earth metals in water samples by Flame Photometer.
3. Separating amino acids using paper Chromatography.
4. Separation of compounds using column chromatography technique.
5. To separate a mixture of two miscible liquids with different boiling points.
6. To purify a compound by separating it from a non-volatile or less volatile material.
7. Ultrasonic assisted green synthesis of heterocyclic compounds.
8. Biodiesel: Trans esterification of Soy and Corn Oils: Green Light for the Future.
9. Compare the energy efficiencies and environmental friendliness of bio-fuels and fossil fuels.
10. Analysis between ADC Green (Alternative Daily Cover) and Wood Waste Using the Processes of Post-Hydrolysis vs. Enzymatic Hydrolysis and K-lignin in Order to Produce Cellulosic Ethanol.
11. Saccharification of Cellulose Using Acid and Cellulase Enzymes to Produce Cellulosic Ethanol, a Sustainable Fuel.

CHU01- SEMESTER-VI

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CHH329-T	Industrial & Applied Chemistry	Domain Core	Hard	3	1	0	0	4
CHH329-P	Industrial & Applied Chemistry Lab			0	0	2	0	1
CHH330-T	Chemistry of Biomolecules & Natural Products	Domain Core	Hard	3	1	0	0	4
CHH330-P	Chemistry of Biomolecules & Natural Products Lab			0	0	2	0	1
CHH331-T	Materials of Industrial Importance	Domain Elective	Hard	3	1	0	0	4
CHH331-P	Materials of Industrial Importance Lab			0	0	2	0	1
CHH332-T	Industrial Chemicals & Environment	Domain Elective	Hard	3	1	0	0	4
CHH332-P	Industrial Chemicals & Environment Lab			0	0	2	0	1
CHN333	Project	Domain Core	NTCC	0	0	0	5	5
PHS331	Computational Modeling Workshop	Other departmental W/S	W/S	0	0	3	0	2

CHU01-SEMESTER VI
MANAV RACHNA UNIVERSITY
B.SC. CHEMISTRY (H) PROGRAM
DEPARTMENT OF CHEMISTRY

Course Title/ Code	**Industrial & Applied Chemistry (CHH329) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To impart knowledge of industrial fuels, petrochemicals and petroleum** **2. To impart the knowledge of pesticides, insecticides and fungicides for protection of agricultural produce** **3. To make the students understand the chemistry of cosmetics, perfumes and industrial dyes**

INDUSTRIAL & APPLIED CHEMISTRY THEORY (CHH329-T)

SECTION A

INDUSTRIAL FUELS

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

SECTION B

PETROLEUM AND PETROCHEMICAL INDUSTRY

Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants*:* Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

SECTION C

CHEMISTRY AND AGRICULTURE

Fertilizers: Discussion on ammonium nitrate, urea, superphosphate, triple superphosphate, diammonium phosphate, potassium nitrate, uses of mixed fertilizers, micronutrients and their role.

Pesticides: Classification of pesticides with examples.

Insecticides: stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC(gammexane: conformation of gamma isomer) pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenel (and its Na salt) (structures excluded)

Herbicides*:* 2,4-D and 2,4,5-T

Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula. NPK

fertilizers, triple superphosphate, different types of pesticides, insecticides

SECTION D

CHEMISTRY OF COSMETICS & PERFUMES

Preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Dyes: Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples

REFERENCE BOOKS:

1. Cremlyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.
2. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
3. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
4. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).
5. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).

INDUSTRIAL & APPLIED CHEMISTRY PRACTICAL (CHH329-P)

LAB EXPERIMENTS:

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.
7. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
8. Preparation of simple organophosphates, phosphonates and thiophosphates .

Course Title/ Code	**Chemistry of Biomolecules & Natural Products (CHH330) T & P**
Course Type	**Domain Core**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. Introduction to chemistry of natural products like alkaloids, terpenoids, etc.,** **2. Understanding of the methods of isolation, purification and structural elucidation of natural products.** **3. Introduction to synthesis of important natural products.** **4. Appreciation of bio-activity of natural products.**

CHEMISTRY OF BIOMOLECULES & NATURAL PRODUCTS THEORY (CHH330-T)

SECTION A

NUCLEIC ACIDS

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

Importance of nucleic acids in living system, Watson and crick model for DNA. Different types of DNA and RNA.

SECTION B

AMINO ACIDS, PEPTIDES AND PROTEINS

Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, p*K*a values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis

SECTION-C

CARBOHYDRATES

Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose.

SECTION-D

DYES

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein**;**

NATURAL DYES

Occurrence, colour and constitution, Classification, isolation, purification and properties. structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

REFERENCE BOOKS:

1. O. P. Agarwal*, Chemistry of Natural Products, Vol-1*, Goel Publishing House, 1997.
2. I. L. Finar*, Organic Chemistry, Vol-2*, 5th edition, Pearson education, London, 1975.
3. D. L. Nelson & M. M. Cox, Lehninger's Principles of Biochemistry 7th Edition, W. H. Freeman

CHEMISTRY OF BIO-MOLECULES & NATURAL PRODUCTS PRACTICAL (CHH330-P)

LAB EXPERIMENTS:

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Course Title/ Code	**Materials of Industrial Importance (CHH331) T & P**
Course Type	**Elective**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To study varied types of glass and ceramics materials and their applications** **2. To study the synthesis, properties and uses of various fertilizers** **3. To understand the types and application of various coating materials, batteries and alloys**

MATERIALS OF INDUSTRIAL IMPORTANCE THEORY (CHH331-T)

SECTION A

SILICATE INDUSTRIES

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

SECTION B

FERTILIZERS

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

SURFACE COATINGS

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

SECTION C

BATTERIES

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

ALLOYS

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

SECTION D

CATALYSIS

General principles and properties of catalysts, homogenous catalysis (catalytic steps andexamples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

CHEMICAL EXPLOSIVES

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

REFERENCE BOOKS:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).
8. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
9. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
10. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
11. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
12. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
13. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

MATERIALS OF INDUSTRIAL IMPORTANCE PRACTICAL (CHH331-P)

LAB EXPERIMENTS:

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Course Title/ Code	**Industrial Chemicals & Environment (CHH332) T & P**
Course Type	**Elective**
Course Nature	**Hard**
L-T-P-O Structure	**(3-1-2-0)**
Objectives	**1. To make the students aware of the inorganic industrial gases and chemicals** **2. To familiarize the students with the metallurgical techniques** **3. To study about the environment and its segments**

INDUSTRIAL CHEMICALS & ENVIRONMENT THEORY (CHH332-T)

SECTION A

INDUSTRIAL GASES AND INORGANIC CHEMICALS

Industrial Gases: Large scale production uses storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals*:* Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

SECTION B

INDUSTRIAL METALLURGY

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

ENERGY & ENVIRONMENT

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

SECTION C

ENVIRONMENT AND ITS SEGMENTS

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere.

Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

SECTION D

WATER POLLUTION

Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

WATER PURIFICATION METHODS

Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

REFERENCE BOOKS:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
8. G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
9. A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

INDUSTRIAL CHEMICALS & ENVIRONMENT PRACTICAL (CHH332-P)

LAB EXPERIMENTS:

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid

Computational Modeling Workshop (PHS331)

(For the students of BSc 6th Sem who have not taken elective soft course from Engineering & Science departments other than chemistry during the BSc course)

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied) /Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
(PHS331)	Computational Modelling Workshop	Core (Departmental)	Workshop	0	0	3	0	2

Course Title/ Code	Computational Modeling Workshop (PHS331)
Course Type:	Core (Departmental/Allied)
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)

	Sections	Weightage
Syllabus	A	20%
	B	20%
	C	30%
	D	30%
	TOTAL	100%

Objectives	• To develop familiarity with the physical concepts and facility with the mathematical methods of Computational chemistry • To cultivate skills at formulating and solving Chemistry problems by computer simulation • To provide a firm foundation to students in a very fundamental subject of computational chemistry • The course focuses on learning the principles of computational chemistry and computer-based molecular design. Both molecular mechanical and quantum mechanical models are covered. Students will learn a variety of commonly used techniques, such as geometry optimization, location of transition states, conformational analysis, and prediction of various molecular and spectroscopic properties

Learning Outcomes:

Students will have the Ability to:

1. explore the application of computational chemistry.
2. demonstrate practical importance of the course.
3. students will be able to use advanced computational chemistry techniques to predict the structural, optical, vibrational and electronic properties of molecules.

Computational Modelling Workshop

(PHS331)

(B.Sc-Chemistry)

Section A

Basic of computational chemistry

Introduction to computational lab, introduction to basic linux commands, installation and running commands, molecular structure designing, introduction to electronic structure calculations. Preparation of molecules input in a graphical package, preparation of inputs, Molecular mechanics calculations, energy minimization, conformational analysis

Section B

Molecular Simulations

Calculation of structural properties of different molecules (Amino acids, DNA/RNA nucleobases, polycyclic aromatic hydrocarbons, Dyes and Drugs) by semiempirical methods.

Section C

Advanced computational chemistry

Wave mechanics, Schrodinger equations and wave function, Introduction to basis-set, The Hartree equation, introduction to Density functional theory

Section D

Calculation by Density functional theory

Calculation of structural, vibrational and optical properties of different molecules by Density functional theory, alalysis of output.