B.Sc. CHEMISTRY SYLLABUS 2023-24

COURSE STRUCTURE

Pandit Deendayal Energy University

School of Energy Technology

Semester - I

B.Sc. CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
1	University Physics – I	BSP101	core	3	3-0-0
2	University Physics – I Lab	BSP101P	core	1	0-0-2
3	Chemistry – I	16BSC101	core	3	3-0-0
4	Chemistry – I Lab	16BSC101P	core	1	0-0-2
5	Calculus and Analytical Geometry –I (For A Group)	BSM101	core	3	3-0-0
6	General Mathematics (For B Group)	BSM102	core		
7	Foreign Language	A111	core	3	3-0-0
8	English Communication	A101	Core	2 1 2	3-0-0
	Elective Subject (**Any Two**)				
8	Computer Science	A104	Elective	3	3-0-0
9	Linear Algebra	BSM101E	Elective	3	3-0-0
10	Leadership	A106	Elective	3	3-0-0
11	Understanding Theatrical Arts	A107	Elective	3	3-0-0
				23	25

Semester - II

B.Sc. CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
1	University Physics – II	16BSP201	core	3	3-0-0
2	University Physics – II Lab	16BSP201P	core	1	0-0-2
3	Chemistry - II	16BSC201	core	3	3-0-0
4	Chemistry Lab-II	16BSC201P	core	1	0-0-2
5	Calculus and Analytical Geometry –II For A Group	16BSM201T	core	3	3-0-0
	General Mathematics For B Group	16BSM202T	core		
6	Elements of Environment Studies	16BSP203	core	3	3-0-0
7	Foreign Language II	16A219-221	core	3	3-0-0
	Elective Subject (Any One)				
8	Mechanics	16BSP202E	Elective	3	3-0-0
9	Introduction to Bio Chemistry	16BSC203E	Elective	3	3-0-0
10	Theory of equations	16BSM203E	Elective	3	3-0-0
	Elective Subject (Any One)				
11	Fundamental of Programming and data structure	16A215	Elective	3	3-0-1
12	Musical styles	16A209	Elective	3	3-0-0
13	Overview of Indian art	16A217	Elective	3	3-0-0
				23	25

Semester - III					
B.Sc. CHEMISTRY (Hons.)					
Sr. No.	**Paper Title**	**Course Code**	**Core/ Elective**	**Credit**	**L-T-P**
Compulsory Subjects					
	Chemistry Major				
1	Ordinary Differential Equations (For Gr A) / Basic Mathematics-III (For Gr B)		Core	4	4-0-0
2	Thermodynamics	17BSC301	Core	4	4-0-0
3	Chemistry - III	17BSC302	Core	4	4-0-0
	Chemistry - III Lab	17BSC302P	Core	1	0-0-2
8	Physics Subsidiary -Introduction to Modern Physics	17BSP304T	Core	4	4-0-0
	Elective Subject (Any Two) common for Physics, Chemistry & Maths				
1	**Any one from following group**				
	Physics Elective-I (Introduction to Geo-Informatics)	17BSP305T	Elective	3	3-0-0
	Physics Elective-II (Introduction to Astrophysics)	22BSP201T	Elective	3	3-0-0
	Chemistry Elective-I (Introduction to bio organic chemistry and chemical biology)	17BSC305	Elective	3	3-0-0
	Maths Elective-I (Number Theory)	BSMXXX	Elective	3	3-0-0
2	**Any one from Following group**				
	Films and Society	20A330	Elective	3	3-0-0
	Workplace Communication	17A309	Elective	3	3-0-0
	Environmental Psychology	20A329	Elective	3	3-0-0
	Atmospheric Sciences	17A311	Elective	3	3-0-0
	Indian Government and Politics	17A312	Elective	3	3-0-0
	Basics of Accounting	17A317	Elective	3	3-0-0
	Introduction to Human Resource Management	17A318	Elective	3	3-0-0
	Introduction to Law and Governance	17A320	Elective	3	3-0-0
				23	24

Semester - IV					
B.Sc. CHEMISTRY (Hons.)					
Sr. No.	**Paper Title**	**Course Code**	**Core/ Elective**	**Credit**	**L-T-P**
Compulsory Subjects					
	Chemistry Major				
1	Fundamentals of Organic Chemistry	17BSC401	Core	4	4-0-0
2	Polymers	17BSC402	Core	4	4-0-0
3	Materials Chemistry	17BSC403	Core	4	4-0-0
4	Analytical Chemistry Lab - I	17BSC401P	Core	1	0-0-2
5	Physics (Subsidiary)	17BSP404	Core	4	4-0-0
	Elective Subject (Any Two) common for Physics, Chemistry & Maths				
	Any one from following group				

1	Physics Elective-2	17BSP405E	Elective	3	3-0-0
2	Chemistry Elective-2 (Environmental Chemistry)	17BSC405E	Elective	3	3-0-0
3	Applications of Advanced Calculus	17BSM405E	Elective	3	3-0-0
	Any one from Following group				
1	Statistics	A408	Elective	3	3-0-0
2	Rural Development in India	A409	Elective	3	3-0-0
3	Cognitive Psychology	A410	Elective	3	3-0-0
4	Educational Psychology	A411	Elective	3	3-0-0
5	Soft Skills	A412	Elective	3	3-0-0
6	Advanced Atmospheric Science	A414	Elective	3	3-0-0
7	Principles of Financial Management	A420	Elective	3	3-0-0
				23	24

Semester - V

B.Sc. CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
	Chemistry Major				
7	Chemical Kinetics and Catalysis	18BSC501	Core	4	4-0-0
8	Liquid State and Ionic Equilibria	18BSC502	Core	4	4-0-0
9	Oxygen containing functional groups	18BSC503	Core	4	4-0-0
10	Coordination Chemistry	18BSC504	Core	4	4-0-0
11	Inorganic Chemistry Lab-1	18BSC501P	Core	1	0-0-2
12	Organic Chemistry Lab-1	18BSC502P	Core	1	0-0-2
13	**Elective (anyone)**				
	Green Chemistry	18BSC505	Elective	3	3-0-0
	Fundamentals of Biotechnology	18BSC506	Elective	3	3-0-0
	Open Elective (from Basket, under discussion)		Elective	3	3-0-1
				21	23

Semester - VI

B.Sc. CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
	Chemistry Major				
1	Spectroscopy & Photochemistry	18BSC601	Core	4	4-0-0
2	Heterocyclic & Stereochemistry	18BSC602	Core	4	4-0-0
3	Electrochemistry	18BSC603	Core	4	4-0-0
4	Group Chemistry & Organometallic Chemistry	18BSC604	Core	4	4-0-0
5	Physical Chemistry Lab - I	18BSC601P	Core	1	0-0-2
6	Organic Chemistry Lab - II	18BSC602P	Core	1	0-0-2
	Elective (anyone)				
7	Petroleum Chemistry	18BSC605E	Elective	3	3-0-0

8	Chemistry of Paints and Dyes	18BSC606E	Elective	3	3-0-0
9	Introduction to Fuel Cell Science and Technology	19BSC609E	Elective	3	3-0-0
10	Chemistry of Cosmetics & Perfumes	18BSC608E	Elective	3	3-0-0
				21	23

Semester - VII

B.Sc CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
	Chemistry Major				
7	Nano Chemistry	19BSC701	Core	4	4-0-0
8	Advance Spectroscopy	19BSC702	Core	4	4-0-0
9	Reagents and Name Reactions	19BSC703	Core	4	4-0-0
10	Organic Chemistry Lab-3	19BSC701P	Core	1	0-0-2
11	Inorganic Chemistry Lab -2	19BSC702P	Core	1	0-0-2
12	Seminar	21BSC708	Core	8	X-X-X
	Electives (any Two)				
13	Computer Application in Chemistry	19BSC705E	Elective	3	3-0-0
14	Heterogeneous Catalysis	19BSC706	Elective	3	3-0-0
15	Supramolecular Chemistry	19BSC707	Elective	3	3-0-0
	OR One Elective and one NPTEL				
	NPTEL Subjects (under discussion)		Elective	3	3-0-0
				28	22+16

Semester - VIII

B.Sc. CHEMISTRY (Hons.)

Sr. No.	Paper Title	Course Code	Core/Elective	Credit	L-T-P
	Chemistry Major				
1	Natural Products	19BSC801	Core	4	4-0-0
2	Analytical Methods and Equipments	19BSC802	Core	4	4-0-0
3	Project	21BSC803	Core	7	X-X-X
4	Dissertation	21BSC804	Core	8	X-X-X
5	Quantum and Computational Chemistry	21BSC805	Core	4	3-1-0
				27	11+30

BSP101P					University Physics-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To acquire the basic knowledge of the inadequacies of classical physics & other concepts of modern physics
- To understand and analyze the motion of the particle under central forces.
- To demonstrate a basic understanding of kinematics and dynamics.
- To explain the basic concepts of waves and heat.

UNIT 1 INTRODUCTION TO PHYSICAL SCIENCE **12 Hrs.**

Introduction to various branches of Physics, Fundamental laws of classical and quantum physics, Failures of classical Physics: Ultraviolet catastrophe, Photoelectric effect, Compton effect, atomic spectra, Introduction to LASER and its applications, brief introduction of semiconductor physics, general rules for scalars and vectors, vector algebra.

UNIT 2 MOTION UNDER FORCES **08 Hrs.**

Kinematics, Newton's laws and applications, One, two, and three-dimensional motion under forces, Work, friction, energy, power, momentum, examples and applications.

UNIT 3 ROTATIONAL KINEMATICS AND DYNAMICS **10 Hrs.**

Centre of mass, conservation law: force and energy, non-conservative forces and energy dissipation, Rotational Kinematics, dynamics and statics, torque, angular momentum, moments, Simple Harmonic Motion-force and energy.

UNIT 4 BASIC CONCEPTS OF WAVES AND HEAT **10 Hrs.**

Introduction to waves, Description of Wave motion, types of waves: mechanical, electromagnetic, matter and standing, wave propagation in a medium, Concept of heat and temperature, Kinetic theory of gases, ideal gas laws, mode of heat transfer, specific heat, concept of entropy.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify and understand the experimental results incompatible with classical physics and introduce concepts of quantum theory.
CO2 – Understand the important concepts of modern physics.
CO3 – Demonstrate an ability to identify and analyze various motion under central forces.
CO4 – Apply basic laws of kinematics and dynamics to various motions.
CO5 – Understand underlying principles of physics for waves and heat.
CO6 – Solve the numerical based on the various concepts of physics.

TEXT/REFERENCE BOOKS

1. Resnick, Halliday and Krane, Physics part I and II, 5th Edition John Wiely (2002).
2. Mechanics by D. S. Mathur (S Chand & Co. Ltd., N Delhi, 2006).
3. Heat and Thermodynamics by Brij lal and N Subramaniyam, (S Chand & Co.Ltd, New Delhi).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks

BSP101P					University Physics-I Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand the working of various electrical, mechanical and optical instruments in the laboratory.
- To gain practical knowledge in Physics through experiments.
- To understand basics concepts of Physics and be able to apply in performing the experiments.

LIST OF EXPERIMENTS

1. Forced Oscillator
2. Ultrasonic waves
3. Four probe method
4. Heat Pump
5. Thermal expansion
6. Ohm's law
7. Viscosity measurement
8. Diode characteristics
9. 'g' by simple pendulum
10. To find coefficient of friction
11. Introduction of oscilloscope
12. Rectifier
13. Transistor characteristics
14. Dielectric constant

** Any 10 experiments will be conducted relevant to the theory course.

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1– Apply and analyze the concepts of electricity and magnetism.
CO2– Understand the various concepts of kinematics.
CO3– Demonstrate and implement the phenomenon related to waves.
CO4– Investigate the electrical properties of a given semiconductor device.
CO5– Examine the heat transfer mechanism in heat pump-based devices.
CO6– Design and analyze the circuits applications based on the semiconductor diode.

TEXT/REFERENCE BOOKS

1. Kittel, Knight and Ruderman, Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill.
2. Avadhanulu, A text book of engineering Physics, S. Chand & Company, Ltd.
3. Brij Lal, N. Subrahmanyam, Heat and Thermodynamics, S. Chand & Company, Ltd
4. Halliday, Resnick, Walker, Fundamentals of Physics (Wiley)

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Continuous evaluation 50 marks
End semester examination and Viva-voce 50 marks

16BSC101					Chemistry – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Identify the different state of matter and its characteristics features.
- Comprehend the various aspects of real gas compare to ideal gas.
- Understand the pH phenomena of different buffer solution.
- Analyze the periodic trend of group elements in respect to physical properties.
- To understand the basic of organic reactions.

UNIT 1 STATES OF MATTER **5 Hrs.**

Describing the states of a system: variable of state and equations of state; phase changes; kinetic molecular model of a gas; Van der wals equation of state, Maxwell speed distribution and its features, virial equation of state, critical constant of real gas, qualitative treatment of the structure of the liquid state; nature of the solid state.

UNIT 2 IONIC EQUILIBRIUM **15 Hrs.**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Acids and bases: Ionization of weak acids and bases, pH scale, buffer solutions; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Qualitative treatment of acid – base titration curves (calculation of pH at various stages), theory of acid–base indicators; selection of indicators and their limitations. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Multi stage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

UNIT 3 GROUP ELEMENTS **8 Hrs.**

General aspects and properties of s-, p-,d and f-block elements, colour in coordination compounds, biological importance of s- and p-block elements.

UNIT 4 BASICS OF ORGANIC CHEMISTRY **12hrs.**

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; 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. Organic acids and bases; their relative strength.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the concept of critical constant and its effect on real gas

CO2– Apply Maxwell speed distribution to derive kinetic energy, most propable speed of a gaseous molecule

CO3– Comprehend the ionic effect of any buffer solution to calculate the pH

CO4– Implement periodic trend to explain colour, magnetic moment value of group elements

CO5-To comprehend the basic of organic compounds.

CO6-Understand the fundamental of organic reactions and intermediates.

TEXT/REFERENCE BOOKS

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University
2. Lee, J.D. Concise Inorganic Chemistry,
3. Finar, I. L. Organic Chemistry (volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
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. and Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks

Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

16BSC101P					Chemistry –I Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
								LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- Learn the safety rules regarding working in the chemical laboratory.
- Imparting scientific methodology for importance of chemistry for industrial and domestic use.
- Acquire the concept of sampling method which are practical used.
- Comprehend the theoretical back ground of each practical.
- Able to calculate the unknown concentration through different titration procedure.
- To enhance the thinking capabilities in line with the modern trends in science and technology.

LIST OF EXPERIMENTS

1. **Calibration and use of apparatus**
   (a) Preparation of solutions of different Molarity/Normality of titrants, (b) Calibration of burette and pipette
2. **Acid-Base Titrations**
   (a) Estimation of carbonate and hydroxide present together in mixture, (b) Estimation of carbonate and bicarbonate present together in a mixture, (c) Estimation of free alkali present in soaps/detergents
3. **Oxidation-Reduction Titrimetry**
   (a) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution, (b) Estimation of oxalic acid and sodium oxalate in a given mixtur Estimation of Fe(II) with $K_2Cr_2O_7$.
4. **Complexometric titration**
   (a) Estimation of Hardness of water by EDTA, (b) Estimation of chloride in water sample
5. Determine the surface tension by (i) drop number (ii) drop weight method.
6. Viscosity measurement using Ostwald's viscometer of (i) polymer (ii) ethanol and sugar at RT.
7. Quantitative estimations of Ni^{+2} as Ni-dimethyl glyoxime.
8. Preparation of Prussian blue from iron fillings.
9. Preparation of tetraamine cupric sulphate.
10. To study the distribution of iodine between water and CCl_4.
11. Determine the number of molecules of water of crystallisation in ferrous ammonium sulphate $FeSO_4$ $(NH_4)_2SO_4.xH_2O$, 20 gm of which have been dissolved per litre provided app. $N/20$ $KMNO_4$ solution.
12. To determine the percentage purity of the given sample of $MgSO_4$.7H2O and also determine the percentage of magnesium in it by $N/20$ EDTA solution.
    14. To determine the specific reaction rate of the hydrolysis of ethyl acetate (or methyl acetate) catalyzed by hydrogen ions at room temperature.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Able to design and perform a set of experiment
CO2– Capable to synthesis different inorganic complexes
CO3– Analyze the hard and soft water limit in water through complexometric titration
CO4– Apply basic techniques for laboratory for sample preparation, purification and concentration measurement
CO5–Identify, interpret and analyse the data integrity and the results from the experiments
CO6– Use the scientific method to create, test, and evaluate a hypothesis

TEXT/REFERENCE BOOKS

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. A. I. Vogel, A text book of quantitative Inorganic Analysis, ELBS.
3. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007. Vogel's Text Book of Practical Organic Chemistry (5th Edn).

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal maintain each 25 marks) 50 Marks
LE (Viva-voce plus Lab examination each 25 marks) 50 Marks

BSM101					Calculus-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVE

- To make familiar the students to basic elements of calculus in sufficiently rigorous manner.

UNIT 1 DERIVATIVES OF A FUNCTION **10 Hrs.**

Hyperbolic functions, Higher order derivatives, Applications of Leibnitz rule. The first derivative test, concavity and inflection points, Second derivative test, Curve sketching using first and second derivative test, limits at infinity, and graphs with asymptotes. Graphs with asymptotes, L'Hopital's rule, applications in business, economics and life sciences.

UNIT 2 PARAMETRIC REPRESENTATION OF CURVE **10 Hrs.**

Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates. Reduction formulae, derivations and illustrations of reduction formulae of the type.

UNIT 3 APPLICATIONS OF CALCULUS **10 Hrs.**

Volumes by slicing; disks and washers methods, Volumes by cylindrical shells. Arc length, arc length of parametric curves, Area of the surface of revolution. Rotation of axes and second degree equations, classification into conics using the discriminant.

UNIT 4 VECTOR FUNCTION **10 Hrs.**

Introduction to vector functions and their graphs, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions. Modeling ballistics and planetary motion, Kepler's second law, Curvature.

40 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to
CO1– Evaluate the derivative of a function.
CO2– Apply calculus to calculate the volume, area etc. of one dimensional object.
CO3– Analyze the applied problems using concept of derivative.
CO4– Analyze vector functions to find derivatives, tangent lines, integrals, arc length and curvature.
CO5– Determine the properties of a graph of a function using derivative.
CO6– Solve wide range of problems of mathematical applications using derivative or integral of vector function.

TEXT/REFERENCE BOOKS

1. J. Stewart, Essential Calculus-Early Transcendentals-Second Edition, Cengage Learning.
2. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pvt Ltd., Singapore, 2002.
3. F. Ayres and E. Mendelson, Schaum's outline of Calculus, 6th edition, McGraw-Hill Education.
4. Tom M. Apostol, Calculus, volume I, 2nd edition, John Wiley & sons.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : 6 questions of 5 marks each	30 Marks (50 mins.)
Part B: 4 questions 10 marks each	40 Marks (80 mins.)
Part C: 2 questions 15 marks each	30 Marks (50 mins.)

20BSM102					Basic Mathematics-I (Group B)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make students acquainted with basic of sets, relation and functions.
- To familiarize the students with concept complex variable.
- To introduce concept of matrix, determinants and their use to solve system of equation
- Learn fundamental of differential and integral calculus.
- Demonstrate concepts and visualization of analytical geometry.

UNIT 1 SETS, RELATIONS, FUNCTIONS AND COMPLEX NUMBERS **10Hrs.**

Sets and their representation. Union, intersection and compliment. Mapping or function. One-one, onto mappings. Inverse and composite mappings. Definition and geometrical representation. Algebra. Complex conjugate. Modulus and amplitude. Polar form. DeMoivre's theorem. Roots of complex numbers. Simple functions.

UNIT 2 MATRICES AND DETERMINANTS **10Hrs.**

Algebra of matrices. Determinant of a square matrix. Properties of determinants. Some simple type of matrices. Inverse of a matrix. Solution of equations. Intersections. Distance between two points. Shortest distance between lines.

UNIT 3 DIFFERENTIAL AND INTEGRAL CALCULUS **10Hrs.**

Basic concept of limit and continuity. Derivative. Rules of differentiation. Tangent to a curve. Taylor's series. Maxima and minima.
Antiderivative, Fundamental theorem of calculus (statement only). Integrals of elementary functions. Substitution and partial fractions. Definite integral as a limit of sum. Properties of definite integrals. Application to areas and lengths.

UNIT 4 TWO DIMENSIONAL COORDINATE GEOMETRY **10Hrs.**

Cartesian coordinate system. Distance between two points. Equation of line in different forms. Equations of circle, ellipse and parabola. Equation of a tangent to a curve. Area of a triangle.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Perform set operations.
CO2– Understand functions and its composition.
CO3– Perform operations on complex variables.
CO4– Perform basic matrix operations.
CO5– Solve linear system of equations.
CO6– Find rate of change of any function and further maxima and minima.

TEXT/REFERENCE BOOKS

1. Thomas, G. B. and Finney, R. L., Calculus and analytical geometry, 9th Ed., Pearson Education Asia (Adisson Wesley), New Delhi, 2000
2. NCERT, Mathematics Textbook for class XI and XII, 2009.
3. Sharma, R.D., Mathematics, Dhanpat Rai Publications, New Delhi, 2011.
4. Raisinghania, M.D., Ordinary and Partial Differential Equations by, 8th edition, S. Chand Publication (2010).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : 10 questions of 2 marks each	20 Marks (40 mins)
Part B: 5 questions 6 marks each	30 Marks (50 mins)
Part C: 5 questions 10 marks each	50 Marks (90 mins)

16A 101					English Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand various aspects of communication, its process, interpersonal communication
- To expose students to the varied uses of language in communication and interpersonal communication
- To expose students to various aspects of verbal and non-verbal communication, group communication
- To differentiate between various forms of written communication like formal, creative, business etc.

UNIT 1THEORIES OF COMMUNICATION **12 Hrs.**

Nature, Significance, Process & Barriers of Communication, Listening Skills, Overcome the Barriers

UNIT 2 SPEAKING & PRESENTATION SKILLS **16 Hrs.**

Individual Presentation, Group Presentation, Group Discussion, Art of Debating, Extempore

UNIT 3 READING SKILLS **16 Hrs.**

Reading skill, Reading Comprehension, Prose, Verse, Graphics and Maps, Note Making from Newspaper

UNIT 4 WRITING SKILLS& APPRECIATION OF ARTS **16 Hrs.**

Creative Writing, Essay Writing, Event Report Writing, Précis Writing, Resume Writing, Strategies for Appreciating Art Forms like Film, Dance/Music Performance, Painting/Sculpture, Monument

60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the various aspects, challenges of communication
CO2– Distinguish the usages of verbal and non-verbal communication, oral and written communication
CO3– Analyse effective interpersonal communication
CO4– Illustrate the use of creativity in communication
CO5– Produce written documents on formal, business and creative writing
CO6– Develop own style of oral communication in formal talks, public speaking, presentations etc

TEXT/REFERENCE BOOKS

1. Bovee, Courtland, John Thill& M. Chaturvedi. Business Communication Today. Delhi: Dorling kindersley, 2009
2. Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
3. Monippally, Matthukutty M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Ltd., 2005.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100	**Time: 3 hours**
Part A: 2 questions of 10 marks each with internal choice	20 marks
Part B: 4 questions situation or example based with internal choice	40 marks
Part C: 2 questions for drafting/ creating/ evaluating/ modifying	40 marks

16A108					Foreign Language French					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn sounds and letters of a new language
- To speak and write basic sentences in a foreign language
- To translate ideas in a foreign language
- To get basic cultural exposure through the foreign language

UNIT 1 BASIC INTRODUCTION OF ONESELF IN FOREIGN LANGUAGE	**10 Hrs.**
UNIT 2 BASIC LANGUAGE SKILLS AND GRAMMAR	**10 Hrs.**
UNIT 3 READING AND WRITING COMPREHENSION	**15 Hrs.**
UNIT 4 LISTENING EXERCISES	**10 Hrs.**
	45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Comprehend letters and sounds in foreign language.
CO2– Apply rules of grammar and phonetics
CO3– Create real time everyday situation and converse in foreign language for the same
CO4– Examine listening nuances in a foreign language
CO5– Translate from one language to another
CO6– Demonstrate understanding by performances

TEXT/REFERENCE BOOKS

1. Saison 1 A1 Plus and Saison A2 plus by Marie Noeille Cocton

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 2 questions of 10 marks each with internal choice	20 marks
Part B: 4 questions situation or example based with internal choice	40 marks
Part C: 2 questions based on analytical study	40 marks

16A109					Foreign Language Chinese					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn sounds and letters of a new language
- To speak and write basic sentences in a foreign language
- To translate ideas in a foreign language
- To get basic cultural exposure through the foreign language

UNIT 1BASIC INTRODUCTION OF ONESELF IN FOREIGN LANGUAGE **10 Hrs.**
UNIT 2 BASIC LANGUAGE SKILLS AND GRAMMAR **10 Hrs.**
UNIT 3 READING AND WRITING COMPREHENSION **15 Hrs.**
UNIT 4 LISTENING EXERCISES **10 Hrs.**

45Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Comprehend letters and sounds in foreign language.
CO2 – Apply rules of grammar and phonetics
CO3 – Create real time everyday situation and converse in foreign language for the same
CO4 – Examine listening nuances in a foreign language
CO5 – Translate from one language to another
CO6 – Demonstrate understanding by performances

TEXT/REFERENCE BOOKS

1. Learn Chinese with Me – Book 1 by GBD Books People's Education Press

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 2 questions of 10 marks each with internal choice 20 marks
Part B: 4 questions situation or example based with internal choice 40 marks
Part C: 2 questions based on analytical study 40 marks

16A110					Foreign Language Japanese					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn sounds and letters of a new language
- To speak and write basic sentences in a foreign language
- To translate ideas in a foreign language
- To get basic cultural exposure through the foreign language

UNIT 1BASIC INTRODUCTION OF ONESELF IN FOREIGN LANGUAGE	**10 Hrs.**
UNIT 2 BASIC LANGUAGE SKILLS AND GRAMMAR	**10 Hrs.**
UNIT 3 READING AND WRITING COMPREHENSION	**15 Hrs.**
UNIT 4 LISTENING EXERCISES	**10 Hrs.**
	45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Comprehend letters and sounds in foreign language.
CO2– Apply rules of grammar and phonetics.
CO3– Create real time everyday situation and converse in foreign language for the same.
CO4– Examine listening nuances in a foreign language.
CO5– Translate from one language to another.
CO6– Demonstrate understanding by performances.

TEXT/REFERENCE BOOKS

1. UME By Japanese foundation

END SEMESTER EXAM QUESTION PAPER PATTERN

Maximum marks: 100 **Exam Duration: 3 Hrs**

Part A: 2 questions of 10 marks each with internal choice	20 marks
Part B: 4 questions situation or example based with internal choice	40 marks
Part C: 2 questions based on analytical study	40 marks

A-104					Introduction to Computer Science (B.Sc. Sem 1)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic working of Computers, Number Systems and Programming.
- To have a better understanding of documentation and work sheets.
- To acquaint with process of preparing and editing presentations and working on databases.
- To develop reasonable understanding about movie making.

UNIT 1 BASIC UNDERSTANDING OF COMPUTERS AND NUMBER SYSTEM **14 Hrs.**

Hardware & Software - Operating systems -Directories and File properties. Definition, characteristics, history, computer terminology, computer organization, Computer Fundamentals: input & output devices, storage devices (including latest devices), classifications of computers (including current computer systems), binary conversions and ASCII code, introduction to computer virus. Conversion from and to – binary, octal, decimal, hexadecimal .ASCII , BCD, EBCBIC, UNICODE, Algorithm and Flowcharts.

UNIT 2 MS OFFICE – WORD AND EXCEL **10 Hrs.**

Basics of documentation, working knowledge on working on documents Tables -Working within tables Mail Merge usage. Basics of worksheets Working with multiple worksheets, Working & entering a Formula - Creating and editing charts and other relevant functions

UNIT 3 MS OFFICE POWERPOINT, ACCESS **11 Hrs.**

Creating and editing presentations, Design and graphics, Animation, Animating text and hyperlinking.
Working knowledge of Access. Fundamentals of Database Management.

UNIT 4 MOVIE MAKING **10 Hrs.**

Shooting, Recording, Editing, Acting, adding music and adding narration

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Define Basics of Computer, Number System.
CO2– Develop Algorithms and Flowcharts
CO3– Prepare Word Documents and Spreadsheets with formulae and functions
CO4– Prepare PowerPoint Presentations
CO5– Develop understanding Database management with MS-Access.
CO6– Develop basic understanding about Movie Making.

TEXT/REFERENCE BOOKS

1. Jerry Joyce, and Marianne Moon, MS Office: Plain & Simple, Prentice Hall of India,
2. Joyce Cox, Office: Step by Step, Prentice Hall of India, New Delhi

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 2 questions of 10 marks each with internal choice	20 marks
Part B: 4 questions situation or example based with internal choice	40 marks
Part C: 2 questions based on analytical study	40 marks

19BSM103E					ELEMENTARY ALGEBRA					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. /Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make familiarize with various number systems.
- To be able to form and solve equations up to degree 4.
- To make students understand the role of scalars and vectors and their applications.
- To acquaint the students with computing inverse of a matrix

.

UNIT 1 NUMBER SYSTEMS **09 Hrs.**

Natural numbers, Integers, Rational and Irrational numbers, Real numbers, Complex numbers, Mappings, Equivalence relation and partitions, Congruence modulo no.

UNIT 2 ROOTS OF EQUATIONS **11 Hrs.**

Fundamental Theorem of Algebra, Relations between Roots and Coefficients, transformation of equations, *Descartes rule of signs, Algebraic Solution of a cubic equations (Cardan's method), Bi-quadratic Equations.

UNIT 3 SCALARS AND VECTORS **10 Hrs.**

Introduction to vectors and scalars, Vector addition and subtraction, Scalar multiplication, Magnitude of vectors, Unit vectors, Dot Product, Cross Product, vector triangle inequality, Properties, Application of vectors: pushing a box, tug of war, hiking.

UNIT 4 MATRICES AND DETERMINANTS **10 Hrs.**

Introduction, Matrix notations, Types of matrices- symmetric, skew-symmetric, Hermitian and skew-Hermitian, Matrix Multiplication, elementary operations on matrices, *Determinants- Properties and value of a determinant, adjoint and inverse of a matrix.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the concept of various number systems and apply the knowledge to practical problems.
CO2– Apply theory of equations to solve real life problems.
CO3– Distinguish scalars and vectors and understand their individual role
CO4– Formulate a problem and solve using an appropriate tool.
CO5– Classify various types of matrices and apply elementary operations.
CO6– Evaluate inverse of a matrix.

TEXT/REFERENCE BOOKS

1. Leonard E. Dickson, "First Course in the Theory of Equations", Wentworth Press, 2019.
2. John Bird, "Engineering Mathematics", Oxford, Fifth edition, 2005.
3. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.
4. Aufmann, Barker, and Lockwood, "Beginning Algebra with Applications", Houghton Mifflin Company, 6th ed., 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 questions of 2 marks each 20 Marks (40 mins.)

Part B: 5 questions 6 marks each 30 Marks (50 mins.)

Part C: 5 questions 10 marks each 50 Marks(90 mins.)

*** These topics are for self-study, included in examinations; notes will be provided.**

CECC 81					Leadership					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make students apply their minds to challenges of India and work on solutions.
- To encourage students to develop belongingness towards the nation.
- To work in a team on projects showing leadership potential while maintaining team work at the same time.

UNIT 1 WHAT IS LEADERSHIP AND ART OF PERSUASION? NO VERBAL COMMUNICATION BY LEADERS. 10 Hrs.

UNIT 2 INDIA AND IT'S CHALLENGES, AUDIT OF INDEPENDENT INDIA, INCLUSIVE EDUCATION, BRANDING INDIA, INDIANS AND INDIANNESS 10 Hrs.

UNIT 3 MOTIVATION AND EMPATHY, THEORIES OF MOTIVATION, JONATHAN LIVINGSTON SEAGULL, SERVANT LEADERSHIP 10 Hrs.

UNIT 4 LEADERSHIP ACTIVITIES- LEADERSHIP SHIELD, XXXX IS YOUR LEADER, LEADERSHIP SEMESTER PROJECT 15 Hrs.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– To acquire basic knowledge about the concept, paradigms and determinants of rural development.

CO2– To construct an overview on policies and strategies adopted for rural development.

CO3– To orient the students towards developmental interventions through programmes and institutional support mechanism.

CO4– To familiarize the students with the sector specific reforms and interventions made through financial inclusion.

CO5– To brief the students about agrarian structure and the caste, class complexities.

CO6– To apprise the students regarding the various success stories of rural development concentrating upon food security, Income generation, Health and poverty alleviation.

TEXT/REFERENCE BOOKS

1) Shamlal. ndian Realities in Bits and Pieces, Rupa and Company, New Delhi.
2) Surendra Kumar and Pradeep Kapoor. India of my Dreams, Academic Foundation, New Delhi.
3) Drunker, Peter and Maciariello, Joseph. 366 Days of Insight and Motivation for Getting the Right Things Done, Rutledge.

END SEMESTER EXAMINATION PAPER PATTERN

Maximum marks: 100 **Exam Duration: 3 Hrs**

Part-A4 questions 10 marks each with choice 40 Marks

Part-B4 questions 15 marks each with choice 60 Marks

16A107					Understanding of Theatrical Arts					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- Enable understanding of dramatic theories and history of theatre.
- To expose students to dramatic techniques
- To acquaint students with inter-disciplinary theatrical arts like music, dance and drama
- To facilitate students to explore their art of performance

UNIT 1 INTRODUCTION TO INDIAN DRAMATIC ARTS AS PROMULGATED BY BHARATA AND THE USE OF THESE TECHNIQUES IN TODAY'S THEATRE. 15 Hrs.

UNIT 2 INTRODUCTION TO VARIOUS GENRES OF THEATRE 15 Hrs.

UNIT 3 ORIENT STUDENTS TO VARIOUS ASPECTS OF THEATRE - SCRIPTING, ACTING, DIRECTION DESIGNING. 15 Hrs.

UNIT 4 PERFORMANCES 30 Hrs.

75 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand nine rasas and stage techniques.
CO2– Apply various theories of theatre into practice.
CO3– Evaluate classics of theatre for subtle nuances.
CO4– Prepare script in a team.
CO5– Use various types of setting for performances.
CO6– Construct final production.

TEXT/REFERENCE BOOKS

1. AshadhKaEk Din' and 'Laramie Project.'
2. The Oxford Encyclopedia of Theatre and Performance: Two Volumes by Dennis Kennedy

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Questions 2 Questions Of 10 Marks Each With Internal Choice	20 Marks
Part B/Questions 4 Example Based Questions With Internal Choice	40 Marks
Part C/Questions 2 Questions Based On Analytical Study	40 Marks

16BSP201T					University Physics-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the basic understanding of electricity and magnetism.
- To provide fundamental knowledge of basic thermodynamics.
- To understand the concepts of elementary optics and its applications.
- To understand the origin of quantum physics

UNIT 1 CONCEPTS OF ELECTRICITY AND MAGNETISM **12 Hrs.**

Coulomb's law, Electric field, Gauss's law, potential; capacitors, dielectric, dc circuits, RC-RL-LC circuits, electric fields in matter, polarization. Sources of magnetism, magnetic force on a moving charge, Biot-Savart law, Ampere's law, induced emf, torque on a current loop in B field, magnetic dipoles in atoms and molecules, gyro magnetic ratio.

10 Hrs.

UNIT 2 BASIC THERMODYNAMICS

Continuum and macroscopic approach, thermodynamic systems (closed and open), thermodynamic properties and equilibrium, state of a system, concepts of heat and work, different modes of work, zeroth law of thermodynamics, First Law of Thermodynamics, Concept of energy and various forms of energy, internal energy, enthalpy, first law applied to elementary processes.

08 Hrs.

UNIT 3 ELEMENTARY OPTICS

Reflection, Refraction, Image formation by mirrors & thin lenses, Optical instruments: Digital camera, Microscope, Telescope, Magnification, Interference, Thin films, Diffraction, Some applications of optics in various fields.

10 Hrs.

UNIT 4 ELEMENTS OF MODERN PHYSICS

Failure of Classical Mechanics, Introduction to Quantum Mechanics, Plank's Hypothesis, De Broglie's Dual Nature Principle, Introduction to special theory of relativity: twin paradox, time dilation, length contraction.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Acquire knowledge about basic concepts of electricity and magnetism.
CO2– Understand and apply the concepts of basic thermodynamics.
CO3– Understand the concepts of elementary optics and apply in various optical instruments.
CO4– Apply the concepts in electromagnetism, thermodynamics and optics to solve numerical problem.
CO5– Differentiate between classical and quantum physics.
CO6– Develop the understanding to deal with higher level courses in physics.

TEXT/REFERENCE BOOKS

1. Electromagnetism by B B Laud 2nd Edition, Wiley eastern limited.
2. Electricity and Magenetism with Electronics by K. K. Tiwari (S. Chand & Company Ltd. 2007)
3. Heat and Thermodynamics by Brij lal and N Subramaniyam ,(S Chand & Co.Ltd, New Delhi).
4. Optics by Brij lal and N Subramaniyam ,(S Chand & Co.Ltd, New Delhi).
5. Concepts of modern Physics by Arthur Beiser, TMH.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

16BSP201P					University Physics-II Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

- To understand the working principle of electrical and magnetic devices in the laboratory.
- To gain practical knowledge in Physics through experiments.
- To understand basics concepts of Physics and be able to apply in performing the experiments.

LIST OF EXPERIMENTS

1. Introduction of oscilloscope
2. Optical fiber characteristics
3. e/m Thomson method
4. Newton's ring experiment
5. Photo conductivity measurement
6. Charging and discharging of capacitor
7. Di-electrical constant measurement
8. Electrical conductivity measurement
9. Filter in power supply
10. Thermal conductivity of the material
11. Resistivity measurement using Hall effect method
12. Biot Savart's law
13. Single, double slit laser diffraction experiment

** Any 10 experiments will be conducted relevant to theory course.

COURSE OUTCOMES

On completion of the course, the students will be able to
CO1– Apply and analyze the concepts of electricity and magnetism.
CO2– illustrate the various properties and working of optical fibre.
CO3– Demonstrate interference phenomena due to thin films.
CO4– Investigate the electrical and thermal conductivity of a given material.
CO5– Examine the charging and discharging phenomenon in capacitor.
CO6– understand the resistivity measurement for given semiconductor.

TEXT/REFERENCE BOOKS

1. Electromagnetism by B B Laud 2nd Edition, Wiley eastern limited.
2. Electricity and Magenetism with Electronics by K. K. Tiwari (S. Chand & Company Ltd. 2007)
3. Heat and Thermodynamics by Brij lal and N Subramaniyam ,(S Chand & Co.Ltd, New Delhi).
4. Optics by Brij lal and N Subramaniyam ,(S Chand & Co.Ltd, New Delhi).
5. Concepts of modern Physics by Arthur Beiser, TMH.

SEMESTER EXAM PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Continuous evaluation 50 marks
End semester examination and Viva-voce 50 marks

16BSC201					Chemistry II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals concepts of organic chemistry
- To understand the structure of solids
- To understand the interaction of radiation with matter, basic concepts of spectroscopy and its application in structure elucidation
- To learn the basic concepts and techniques for chemical analysis

UNIT 1 BASICS OF ORGANIC CHEMISTRY **10 Hrs.**

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reaction; Direct displacement process:S_N2 reactions, carbonium ion process:S_N1 reactions, stereochemistry of substitution reactions, neighboring group participation, S_Ni reactions, factors affecting reactivity in substitution reactions. Electrophilic addition and nucleophilic additions reaction, addition of carbine; β-eliminations, α-eliminations, thermal eliminations; factors affecting elimination vs substitution.

UNIT 2 STRUCTURE OF SOLIDS **10 Hrs.**

Structure based on packing of spheres, structure of compounds, Seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Ionic model, Calculating lattice energy, Predicting bond types.

UNIT 3 MOLECULAR SPECTROSCOPY **10 Hrs.**

Introduction to spectroscopy – Electromagnetic spectrum-interaction of radiation with matter – UV-visible spectroscopy – Electronic transitions in organic molecules (Woodward Fischer rule) –Mathematical derivation of Beer Lambert's law – IR spectroscopy- Vibrational spectroscopy – Normal modes of vibrations – Vibrations of polyatomic molecules (CO_2 and H_2O) – Determination of Force constant – Rotational spectroscopy, NMR Spectroscopy – basic principle, chemical shift, instrumentation and application. Applications of spectroscopy for interpretation of molecular structure.

UNIT 4 ANALYTICAL CHEMISTRY **10 Hrs.**

Basic concepts, analysis of data, electrochemical methods of analysis- (pH-metry, conductometry, potentiometry, chromatographic techniques- TLC, GC, HPLC, Thermal Analysis (TG-DTA-DSC), spectroscopic methods of analysis.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Comprehend the basic concepts of organic chemistry
CO2– Understand the structure of solids and predict the nature of bonds
CO3– Analyse the interaction of radiation with matter in spectroscopic techniques
CO4– Implement the principles of spectroscopy for molecular characterization
CO5– Elucidate (Interpret) the molecular structure with the help of knowledge of characterization techniques
CO6– Apply the concepts of analytical chemistry for chemical analysis and their characterization

TEXT/REFERENCE BOOKS

1. Burrows, A., Holman, J., Parsons, A, Pilling G., Price, G. Chemistry3 introducing inorganic, organic and physical chemistry, Oxford University>
2. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University>

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

16BSC201P					Chemistry II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	--	100	100

COURSE OBJECTIVES

- To enhance and develop scientific and analytical skills.
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments.
- To demonstrate safe and proper use of standard chemistry glassware and equipment.

LIST OF EXPERIMENTS

1. Purification of organic compounds by crystallization using the following solvents: Water/Alcohol.
2. Determination of the melting points of above compounds and unknown organic compounds electrically heated melting point apparatus).
3. To determine the λmax and concentration of given unknown potassium permanganate using UV-Visible Spectroscopy technique.
4. To separate, by gas chromatographic techniques, a mixture of the four isomeric alcohols and to determine the percentage of each an unknown mixture.
5. To separate mixture of organic compounds by chromatrotron.
6. To prepare aspirin by conventional, microwave and sonochemical method.
7. To determine the strength of given HCl solution using a standard NaOH solution by pH-metric titration.
8. To determine the strength of given HCl solution using a standard NaOH solution by potentiometric titration.
9. Conductometric titration of acid and base.
10. To study the kinetics of decomposition of sodium thiosulphate by a mineral acid.
11. To measure the optical rotation of various dilutions of sucrose by polarimetry, and calculate the specific rotation of sucrose from the data obtained.
12. To prepare pure sample of Iodoform .
13. To prepare a sample of p-Nitroacetanilide from acetanilide.
14. To purify a given sample of phthalic acid by sublimation.
15. Estimation of NH_4Cl and NH_3 in the polluted water sample.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Apply the concepts learned in chemistry and engineering to the real-world situations.

CO2– Identify, analyse and interpret the results from the experiments

CO3– Determine the concentration of unknown solutions by Spectrophotometric method.

CO4– Synthesize organic compounds with knowledge of organic reactions.

CO5– Investigate reaction mechanism and predict the order and rate constants.

CO6– Demonstrate safe and proper use of standard chemistry glassware and equipment

TEXT/REFERENCE BOOKS

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.
2. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University>

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 10 **Exam Duration: 3 Hrs**

Part A: Practical Examination 100 Marks

16BSM201T					Calculus-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide basic understanding of calculus of several variables.
- To be able to obtain extreme values of multivariate function.
- To study the multiple integration, understand it geometrically and explore its applications.
- To use this basic course in upcoming courses in respective specializations in higher classes.

UNIT 1 **11 Hrs.**

Functions of several variables, limit and continuity of functions of two variables. Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT 2 **07 Hrs.**

Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl

UNIT 3 **11 Hrs.**

Double integration over rectangular region, double integration over nonrectangular region. Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.Change of variables in double integrals and triple integrals

UNIT 4 **11 Hrs.**

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stokes' theorem, The Divergence theorem. **40 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Define Function of several variables along with the concept of its limit, continuity and derivative.
CO2 – Evaluate the extreme value of multivariate function.
CO3 – Understand the technique of finding multiple integral and their applications
CO4 – Analyze the applications of line integrals.
CO5 – Understand the basics of vector calculus.
CO6 – Apply calculus of several variables and vector calculus to various problems of science and engineering.

TEXT/REFERENCE BOOKS

1. E. Marsden, A. J. Tromba and A. Weinstein, Basic multivariable calculus, Springer (SIE), Indian reprint, 2005.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry-Ninth Edition, Addison-Wesley Publishing Company.
3. J. Stewart, Essential Calculus-Early Transcendentals- Second Edition, Cengage Learning.
4. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 6 questions of 4 marks each	24Marks
Part B: 6 questions 8 marks each	48 Marks
Part C: 2 questions 14 marks each	28 Marks

16BSM202T					Basic Mathematics – II (Group B)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the applications of vectors in real world.
- To be able to solve differential equations.
- To be able to classify the data and can measure the central tendency and other
- To study the finite differences and effect of errors in real life situations.

UNIT 1 VECTORS AND COORDINATE GEOMETRY (3D) **10 Hrs.**

Vectors and their algebra. Simple applications to geometry and mechanics. Unit vectors, vectors i, j and k . Components of a vector. Position vector. Direction cosines and direction ratios. Dot and cross products. Projection of a vector on another. Distance between two points. Equations of a line, plane and sphere. Intersections. Distance between two points. Shortest distance between lines.

UNIT 2 ELEMENTARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Definitions of order, degree, linear, nonlinear, homogeneous and non-homogeneous. Solution of first order equations. Complementary function and particular integral. Initial and boundary value problems. Linear differential equations with constant coefficients. Cauchy-Euler equation.

UNIT 3 BASIC STATISTICS **10 Hrs.**

Classification of data. Mean mode, median and standard deviation. Frequency distributions and Measures of Central Tendency, Measures of Dispersion, Skewness and Kurtosis.

UNIT 4 BASICS OF NUMERICAL METHODS **10 Hrs.**

Calculus of finite differences, Difference formula, difference table, Effects of an error in a tabular value, The operator E, Properties of two operators E and Δ, Factorial Notations, Methods of any given polynomial in factorial notation, Leibnitz rule.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of 2D and 3D vectors in daily life.
CO2 – Understand the concept of basic distance formulas in 1D, 2D and 3D and their applications.
CO3 – Develop the ability to classify differential equations and solve according to various categories and shortcut methods.
CO4 – Analyze the supplied data statistically and measure the results according to the requirement.
CO5 – Appraise the significance of finite differences in all simple calculations and also able to get the idea of errors occurring therein.
CO6 – Evaluate problems on the basis of operators and develop a polynomial in factorials.

TEXT/REFERENCE BOOKS

1. Thomas, G. B. and Finney, R. L., Calculus and analytical geometry, 9th Ed., Pearson Education Asia, (2000)
2. NCERT**,** Mathematics Textbook for class XI and XII (2009).
3. Sharma, R.D.**,** Mathematics, Dhanpat Rai Publications, New Delhi (2011).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 questions of 3 marks each	30 Marks (40 mins.)
Part B: 5 questions 6 marks each	30 Marks (50 mins.)
Part C: 5 questions 8 marks each	40 Marks (90 mins.)

16BSP203					Elements of Environmental Studies					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand basic concepts of environment
- To make students aware about the environmental systems and environmental issues
- To develop ability to work effectively on complex problems
- To think across and beyond existing disciplinary boundaries, mindful of the diverse forms of knowledge and experience that arise from human interactions with the world around them.

UNIT 1 INTRODUCTION TO ENVIRONMENTAL STUDIES **12 Hrs.**

Importance of environmental Studies, multidisciplinary nature, Ecology and Ecosystem, types of ecosystems, functioning of an ecosystem; Biodiversity – its importance, threats and conservation; Natural Resources – Forest, Water, Mineral, Energy, Minerals, environment and human health.

10 Hrs.

UNIT 2 ENVIRONMENTAL POLLUTION

Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, role of an individual in prevention of pollution, pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

UNIT 3 ENVIRONMENTAL LEGISLATION AND PUBLIC AWARENESS **08 Hrs.**

Environment Protection Act, Wildlife Protection Act, Issues involved in enforcement of environmental legislation, Public awareness, Environmental impact assessment.

12 Hrs.

UNIT 4 SOCIAL ISSUES AND THE ENVIRONMENT

Climate change, global warming, acid rain, ozone layer depletion, Water conservation, rain water harvesting, Urban problems related to energy, Sustainable development, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions.

42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand core concepts and methods from ecological and physical sciences
CO2– Knowledge of the environment and the role of human beings in shaping the environment
CO3– Critically examine the interlink between development and the environment.
CO4– Develop the skills in solving various real world problems in environmental studies.
CO5– Identify the multiple scales, actors, and stakes of an issue
CO6– Apply concepts and methodologies to analyse and understand interactions between social and environmental processes.

TEXT/REFERENCE BOOKS

1. Rao, M. N. & Rao H. V. N., Air Pollution, Mc Graw Hill.
2. Dave, D. & Katewa, S. S., Textbook of Environmental Studies, Cengage Learning, 2e.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks
Part B/Question: <Details> <> Marks

16BSP202E					Mechanics					
Teaching Scheme					Examination Scheme					
					Theory			Practical		
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Total Marks
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- **T**o acquire the basic knowledge of vector calculus and various co-ordinate systems.
- To apply Newton's second law in real world problems.
- To understand the various types of motion under central force.
- To discuss the basic concepts of mechanics of continuous media.

UNIT 1 SCALAR AND VECTOR FIELD **12 Hrs.**

Vectors and their properties; vector operations (Addition, Subtraction, dot product, cross product, triple product); partial differentiation; scalar and vector field; divergence, gradient and curl of the vector field, electric and magnetic field, divergence and stoke's theorem, definitions for electricity and magnetism, relations between flux and field lines, Gaussian surface, Gauss's law, Comparison between coulomb's law and Gauss's law, Cartesian, cylindrical and spherical co-ordinate system.

UNIT 2 APPLICATIONS OF NEWTON'S SECOND LAW **08 Hrs.**

Newton's second law, Equations of motion, motion under Gravity, motion against resistive forces, dry friction, fluid friction, System for varying mass, Uniform circular motion, Numerical based on Newton's second law.

UNIT 3 MOTION UNDER CENTRAL FORCE **10 Hrs.**

Motion under a central force, Conservation of angular momentum, Kepler's laws, Gravitational Field and potential due to spherical bodies, Gauss and Poisson equations, Gravitational self-energy, Two-body problem; Reduced mass, scattering by hard spheres, Centre of mass and laboratory reference frames, Collisions in 2D & 3D, Calculation of final velocities of colliding particles and scattering angle. Galilean transformation, frame of references with linear acceleration, Galilean invariance.

UNIT 4 MECHANICS OF CONTINUOUS MEDIA **10 Hrs.**

Elastic constants of an isotropic solid, Poisson's ratio, Relations connecting the elastic constants, Determination of Young's Modulus of a Material, Determination of Poisson's ratio, Dynamical method (Maxwell's needle) of determination of the coefficient of rigidity (η) of a wire. Bending of beam, Bending Moment, The cantilever, moment of inertia, General theorem of moment of inertia, calculation of moment of inertia for particular cases, kinetic energy of rotation, moment of inertia of fly wheel

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Recognize various properties of vector calculus and understand different co-ordinate systems.
CO2– Apply basic knowledge of Newton's second law to solve real world problems.
CO3– Demonstrate an ability to identify and analyze various motion under central forces.
CO4– Generalize the various properties of Galilean transformation.
CO5– Understand underlying principles of mechanics of continuous media.
CO6– Reproduce the expression of moment of inertia of various cases.

TEXT/REFERENCE BOOKS

1. Mechanics by D. S. Mathur (S Chand & Co. Ltd., N Delhi, 2006)
2. Berkley physics course (Vol. I) Asian student Edition
3. Classical Mechanics: J.R. Taylor (2005) University Science Books
4. Mechanics by Somnath Dutta, S. Chand

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks
Part B/Question: <Details> <> Marks

16A215					Fundamentals of Programming and Data Structure (B.Sc.)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- Develop a greater understanding of the issues involved in programming language, design and implementation
- To inculcate functional and logical problem-solving skills through programming.
- To understand the basic concepts of C programming
- To understand design and implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing and file handling

UNIT 1 BASICS OF C PROGRAMMING **12 Hrs**

Writing C Programs to implement: Input, Output constructs, different data types, types of Operators, Precedence and associatively of Operators, Control Structure and Loop Structure.

UNIT 2 ARRAY AND STRINGS **12 Hrs**

Writing C Programs to implement: 1-dimensional and 2-dimensional arrays, different types of user defined functions, String operations in form of Character arrays, In-built String functions.

UNIT 3 POINTERS AND DATA STRUCTURE **11 Hrs**

Writing C Programs to implement: Basic pointer arithmetic, arrays and String using Pointer, call the functions using Call-by reference property, stack, Queue and Circular Queue.

UNIT 4 FILE HANDLING **10 Hrs**

Writing C Programs to implement: reading and writing of the data from and into the file, handle various File operations

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand functional and logical problem-solving skills through programming
CO2 – Write, compile and debug programs in C language
CO3 – Use basic and derived data types in C and Operators in C.
CO4 – Design programs involving decision structures, loops, and functions in C.
CO5 – Implement Programs to perform pointer arithmetic and array handling with Pointers.
CO6 – Perform File-handling operations in C.

TEXT/REFERENCE BOOKS

1. Yashavant Kanetkar, Let Us C, BPB
2. E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
3. Herbert Scheild, The Complete Reference: C, Tata McGraw-Hil

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 2 questions of 10 marks each with internal choice	20 marks
Part B: 4 questions situation or example based with internal choice	40 marks
Part C: 2 questions based on analytical study	40 marks

16BSC203E					Introduction to Biochemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding on Biochemistry.
- To provide the knowledge on the biological importance of different amino acids, peptides and proteins
- To provide the knowledge on the importance of carbohydrate and nucleic acid in biochemistry.
- To provide the knowledge about the structure, properties and physiological importance of lipid, enzymes and vitamins.

UNIT 1 INTRODUCTION TO BIOCHEMISTRY **12 Hrs.**

Definition and history of biochemistry, modern developments in biochemistry, Applications of biochemistry, introductions to important concepts in biochemistry, pH, pOH, pKa, Kw and their physiological importance, Henderson–Hasselbalch equation, water and its biological importance, Chemical bonding related to biochemistry, origin of life, Introduction to the cell and evolution of life.

UNIT 2 AMINO ACIDS, PEPTIDES, PROTEINS **10 Hrs.**

Amino acids: structure, classification, biological importance, properties, reactions, titration curves. Peptides: structure, peptide bond formation and biological importance of peptides, Proteins: importance, primary, secondary and tertiary structures of proteins, function of some selected proteins (keratin, collagen, protein fibres, glycoprotein, haemoglobin, lipoprotein).

UNIT 3 CARBOHYDRATES AND NUCLEIC ACIDS **10 Hrs.**

Introduction, structure, classification, representation of structure, physiological importance, reactions. Introduction to oligosaccharides and polysaccharides Introduction to nucleic acids, Nucleosides and nucleotides, RNA, DNA and their importance.

UNIT 4 LIPIDS, ENZYMES AND VITAMINS **10 Hrs.**

Lipids: introduction, properties, functions of lipids, introduction to fatty acids, cholesterol, Enzymes: Introduction and functions, mechanism of enzyme action, examples of some enzymatic reactions, urea cycle Vitamins: Introduction, structure and functions of common vitamins.

42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the importance of biochemisry over other branch of chemistry.
CO2– Acquire knowledge about amino acid, peptide and protein and their biological importance.
CO3– Understand and learn the phisiological importance of different carbohydrates and nucleic acids.
CO4– Explain the mechanism of enzyme reaction in biological systems.
CO5– Develop the knowledge on lipids, fatty acid and cholesterol and their biological importance.
CO6– Develop the knowledge on structure and function of vitamins in biological systems.

TEXT/REFERENCE BOOKS

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 5th Edition, W. H. Freeman & Company
2. Lubert Stryer, Biochemistry, 6 th Edition, W. H. Freeman and Company, 2007
3. Graham Solomons and Craig B. Frhyle , Organic Chemistry, Eighth Edition John Wiley and Sons, 2004

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 5 Questions from each unit, each carrying 1 mark 20 Marks
Part B/Question: 2 Questions from each unit, each carrying 10 marks 80 Marks

16BSM203E					THEORY OF EQUATIONS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the students with fundamental theorem of algebra and it's uses.
- To study the relations between the roots and coefficients of general polynomial equation.
- To study the properties of symmetric functions and derived functions.
- To introduce various methods to solve non-linear equations.

UNIT 1 POLYNOMIAL EQUATIONS **10 Hrs.**

Numerical and algebraic equations, polynomials and their graphical representation, maximum and minimum values of polynomials, fundamental theorem of algebra, theorem on complex roots, theorem on reciprocal roots, theorem on multiple roots.

UNIT 2 RELATION BETWEEN THE ROOTS AND COEFFICIENTS OF A POLYNOMIAL EQUATION **10 Hrs.**

Relation between roots and coefficients of equations, Symmetric functions, Applications symmetric function of the roots, Newton's Theorem on the Sum of the Powers of the Roots, Descarte's rule of signs positive and negative rule.

UNIT 3 ALGEBRAIC SOLUTIONS OF EQUATIONS **10 Hrs.**

Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

UNIT 4 NUMERICAL SOLUTIONS OF EQUATIONS **10 Hrs.**

Solution of transcendental and non-linear equations by Bisection, Regula-Falsi, Fixed-point iteration method, Newton's Raphson and Secant method.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand and provefundamental theorems of the subject.
CO2 – Use therelation between roots and coefficients of equations to establish various identities.
CO3 – Analyzenature of the roots of an equation without explicitly solving the equation.
CO4 – Solve polynomial equations having conditions on roots.
CO5 – Apply various methods to solve cubic equations (Cardon's method) andbiquadratic equations analytically.
CO6 – Solve algebraic and transcendental equations by various numerical methods.

TEXT/REFERENCE BOOKS

1. ChandrikaPrasad : Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad
2. W.S. Burnstine and A.W. Panton, Theory of equations, 2007
3. C. C. Mac Duffee, Theory of Equations, John Wiley & Sons Inc., 1954.
4. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5th Ed., New Age International (2007).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 questions of 2 marks each 20 Marks (40 mins)
Part B: 5 questions 6 marks each 30 Marks (50 mins)
Part C: 5 questions 10 marks each 50 Marks (90 mins)

16A209					Musical Styles					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	5	25	50	25	--	--	100

COURSE OBJECTIVES

- To have exposure to either vocal or instrumental music
- To understand technicalities of music
- To demonstrate above understanding through performances
- To apply Aesthetics of music to other art forms

UNIT 1 SWAR, LAYA, BANDISH AND RAAG	**20 Hrs.**
UNIT 2 TECHNICAL ASPECTS OF ONE MUSICAL INSTRUMENT	**15 Hrs.**
UNIT 3 INTEGRATION OF TONE AND MUSIC	**15 Hrs.**
UNIT 4 PRACTICE SESSIONS	**25 Hrs.**
	75 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to
CO1– Understand swar, laya, bandish and raag.
CO2– Discover technical aspects of one musical instrument.
CO3– Synthesize knowledge of swar and laya.
CO4– Practice on given modules.
CO5– Develop voice culture.
CO6– Demonstrate understanding by participating in performances.

TEXT/REFERENCE BOOKS

1. SangeetVisharad by Dr. Laxminarayan Garg.
2. Sangeet Saurabh by Laxmiprasad B Thaker.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks 100	**Exam Duration 3:00 Hrs**
Part A/Questions 2 Questions of 10 Marks Each With Internal Choice	20 Marks
Part B/Questons 4 Example Based Questions with Internal Choice	40 Marks
Part C/Questions 2 Questions Based On Analytical Study	40 Marks

16A217					Overview of Indian Art					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1		2	3	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To expose students to great artists of the world and India
- To understand different styles of art
- To expose students to experiential learning
- To develop imagination skills and value for aesthetics

UNIT 1WORLD ARTISTS AND THEIR STYLES **10 Hrs.**
UNIT 2 STYLES OF PAINTING **10 Hrs.**
UNIT 3 GREAT INDIAN ARTISTS **10 Hrs.**
UNIT 4 DEVELOPING PORTFOLIO OF PAINTINGS **15 Hrs.**
40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Comprehend various styles and forms of paintings
CO2 – Know great artists and their work
CO3 – Create portfolio of paintings
CO4 – Construct art appreciation
CO5 – Recreate famous paintings
CO6 – Apply principles of logic, ethics and Aesthetics on works of art

TEXT/REFERENCE BOOKS

1. The Civilisations of the Rennaissance in Italy. J. Burckhardt.
2. The Italian Painters of The renaissance. B Berenson.
3. The Gothic Image. E Male` Discourses on Art. J. Reynolds.
4. Essential Impressionists.. Antonia Cunningham.
5. Barefoot Across the Nation. Sumathi Ramaswami
6. Amrita Sherghill. A Life. Yashodhara Dalmia
7. Contemporary Art in India. A Perspective. PranNath Mago
8. Colour and culture. Practice And Meaning from Antiquity to Abstraction. J Gage
9. The Classical Language of Architecture. John Summerson

END SEMESTER EXAM QUESTION PAPER PATTERN

Maximum marks: 100 **Exam Duration: 3 Hrs**

Part A: 2 questions of 10 marks each with internal choice 20 marks
Part B: 4 questions situation or example based with internal choice 40 marks
Part C: 2 questions based on analytical study 40 marks

17BSC301T					Thermodynamics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the knowledge about fundamental of laws of thermodynamics
- To provide the concept of entropy and its relation to other thermodynamic parameters
- To develop the knowledge about the chemical and phase equilibrium
- To provide the knowledge about the thermodynamics of ions.

UNIT 1 FIRST LAW OF THERMODYNAMICS **14 Hrs.**

Thermodynamic system types and properties. Systems and surroundings, Reversible an irreversible P-V work; Laws of thermodynamics: Zeroth, First, Second and Third law.

Conservation of energy, Molecular interpretation and measurement of work, heat and temperature. Energy conversion in organisms. Definition of Internal energy and Enthalpy. Enthalpy changes accompanying physical processes, Temperature dependence of enthalpy, Kirchoff's law.

UNIT 2 THE SECOND LAW **14 Hrs.**

Heat engines, Carnot's principle; The Second Law, Definition of entropy, Entropy changes accompanying heating, phase transition, chemical reactions; Absolute entropies and the Third Law of Thermodynamics. Boltzmann formula of entropy, relation between thermodynamic and statistical entropy. Residual entropy. The spontaneity of chemical reactions; Life and the Second Law.

UNIT 3 EQUILIBRIUM: CHEMICAL AND PHASE **14 Hrs.**

Entropy and Equilibrium: Gibbs and Helmholtz energy, Work and the Gibbs energy change. Estimating a change in Gibbs energy for a metabolic process, Action of adenosine triphosphate (ATP); Variation of Gibbs energy with pressure, temperature Condition of stability; Thermodynamics of phase transition, Phase diagrams, phase boundaries, characteristic point; Chemical potential, Chemical potential of gas, solvent and solute. Real solutions, Concept of activity and fugacity. Maxwell relations. Thermodynamic description of mixtures.

UNIT 4 THERMODYNAMICS OF IONS **14 Hrs.**

Donnan equilibrium, Analyzing Donnan equilibrium, Thermodynamics of dissolving Thermodynamics of ion and electron transport Ions in solution, Transport of ions across biological membranes; Nernst equation, Thermodynamic standard potentials, Variation of potential with pH. The biological standard potential, Converting a standard potential to a biological standard value; Electron transfer reactions, Oxidative phosphorylation, Photosynthesis; Introduction to Statistical Thermodynamics.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the concept of thermodynamics and its importance in natural systems.

CO2– Acquire understanding of the relationship between various thermodynamics parameters and their significances.

CO3– Apply theoretical knowledge to quantify efficiency of cycles (e.g., Carnot).

CO4– Comprehend the concept of equilibrium in chemical systems and in phase transition systems.

CO5– Appreciate the distinction between thermodynamic and biological standard potentials, with their applications.

CO6– Conceptualize the role of thermodynamics of ions in biological processes.

TEXT/REFERENCE BOOKS

1. W.D. Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
2. MW Barsoum, Fundamental of Ceramics, IOP publishing (2003).
3. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
4. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks

Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

17BSC302T					Chemistry –III					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- **D**etermine the structure and its features of inorganic compounds by hybridisation and VSEPR.
- Comprehend the chemistry of D block elements.
- Understand the colour, magnetism of the inorganic complexes.
- Know the chemistry of lanthanide metal.

UNIT 1 CHEMICAL BOND **16 Hrs.**

The Lewis theory, Sidgwick-Powell theory, Valence Shell Electron Pair Repulsion (VSEPR) Theory, effect of lone pair, effect of eletronegativity, isoelectronic principle, some example using VSEPR Theory, valence bond theory (VBT), hybridization involving s and p orbitals (sp, sp^2, sp^3), Molecular orbital method, examples of molecular orbital treatment for homo nuclear diatomic molecules H_2^+, H_2, He_2^+,He_2, Li_2, Be_2, B_2, C_2, N_2,O_2, O_2^-, O_2^{-2} and F_2.

UNIT 2 CHEMISTRY OF D-BLOCK ELEMENTS **16 Hrs.**

Introduction, position of d-block elements in the periodic table, electronic configurations and definition, classifications of d-block elements in 3d, 4d, 5d and 6d series, physicochemical properties: atomic radii, Ionic radii, metallic character and related properties, atomic volumes and densities, melting and boiling points, Ionization energies, standard reduction potential values, variable oxidation states, colour of transition metal complex ions, magnetic properties of transition metal ions and their complexes, tendency of transition metals to form complex compounds.

UNIT 3 VBT AND CFT OF INORGANIC COMPLEXES **12 Hrs.**

Valence bond theory of complexes, principle and its application to determine structure and magnetic properties of complexes, limitation of VB theory, postulate of CFT, d-orbital splitting of octahedral and tetrahedral complexes in strong and weak field, effect and application of crystal field splitting, magnetic properties of high and low spin complexes, thermodynamic properties of crystalfield splitting.

UNIT 4 LANTHANIDES **12 Hrs.**

Electron configuration, oxidation states, magnetic properties, color and absorption spectra of lanthanide ions, lanthanide contraction, separation and purification of lanthanides**:** Ion-exchange and solvent extraction methods.

56 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1-Explain the behaviour of the homo nuclear diatomic molecules by molecular orbital theory.
CO2-Determine the structure of the inorganic molecule.
CO3-Analyze the periodic trend of the D block elements.
CO4-Apply the CFT concept to split the d orbital in different crystal field.
CO5-Evaluate the stability trend of the inorganic complexes in several crystal field.
CO6-Understand the physical properties such separation, magnetism, colour of the lanthanides.

TEXT/REFERENCE BOOKS

1. Inorganic Chemistry, FA Cotton, G Wilkinson, John Wiley and Sons, New York.
2. Concise Inorganic Chemistry, 5th Edition, J D Lee,
3. Advanced Inorganic Chemistry Volume I, Satyaprakash, G D Tuli, S K Basu, R D Madan.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice. 80 Marks

17BSC302P					Chemistry-III Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- Learn proper safety precaution while working in the laboratory.
- Knowledge on sampling methods for laboratory purpose.
- Able to calculate the unknown concentration or mass through different analytical procedure.
- Apply the laboratory concept of chemistry for industrial and domestic use.
- To enhance the thinking capabilities in line with the modern trends in science and technology.

LIST OF EXPERIMENTS

1. Determination of amount of Na_2CO_3 and $NaHCO_3$ in a mixture with standard HCl.
2. Determination of alkali content of antacid tablets.
3. To determine the purity of given ascorbic acid by titrating against standard (N/10) iodine solution.
4. To determine the dissolved oxygen in given water sample.
5. To verify Lambert-Beer law and determine concentration of an unknown solution.
6. Preparation of sodium ferri-oxalate and determination of its melting point.
7. Determination of the amount of Calcium and Magnesium in milk powder by EDTA complexometry.
8. To determine the concentration of KCl present in the given solution by conductometric titration.
9. Estimation of Iron as ferric oxide in Mohr's salt.
10. Estimation of Iron in Portland cement.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Capability to design new experimental method for unknown experiment
CO2– Able to calculate the alkali content in anta acid
CO3– Anayze the purity of organic compound through titration techniques
CO4– Justify the Lambert-Beer law
CO5– Realisation of theoretical background of complexometric titration to calculate hardness limit in drinking water
CO6– Understand the conductometirc titration for determination of unknown concentration

TEXT/REFERENCE BOOKS

1. A. I. Vogel, A text book of quantitative Inorganic Analysis, ELBS.
2. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007. Vogel's Text Book of Practical Organic Chemistry (5th Edn).
3. Finar, I. L. Organic Chemistry (volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal maintain each 25 marks) 50 Marks
LE (Viva-voce plus Lab examination each 25 marks) 50 Marks

17 BSP304T					Introduction to Modern Physics (Subsidiary)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide the basic understanding of atomic spectroscopy
- To develop the fundamental understanding of materials science.
- To provide the comprehensive knowledge of wide range of materials characterization techniques.
- To introduce various techniques for the synthesis of nanomaterials and its and applications.

UNIT 1 ATOMIC SPECTROSCOPY **14 Hrs.**

Basics of Quantum Physics: Postulates and operators. Introduction to hydrogen atom spectrum, Bohr Magneton Larmor's precession, Stern Gerlach experiment, Electron Spin and gyro magnetic ratio, Vector atom model, spin orbit interaction and fine structure, total angular momentum for many e atom; L-S & J-J coupling (in brief)

UNIT 2 CRYSTALLOGRAPHY **16 Hrs.**

Crystalline and amorphous solids-Fundamental crystallographic parameters-primitives-inter Facial or interaxial angles-Bravais lattices and crystal systems-Miller indices-Characteristics of unit cell-Simple cubic, BCC and FCC structures-Atomic radius-Co-ordination number-Hexagonal close-packed structure-Number of atoms per unit cell-continuous and characteristic x-rays-X-ray diffraction and Bragg's law in crystals. Problem solving.

14 Hrs.

UNIT 3 BASIC ANALYTICAL INSTRUMENTATION

Classification of analytical methods - Spectroscopic Characterizations: Introduction to Spectroscopic Techniques - UV-Vis Infra-Red and FTIR, AAS, NMR Spectroscopy, X-ray Diffraction (XRD). Microscopic Characterizations: Basic principle, Instrumentation and Applications of SEM, TEM and AFM. Thermal Characterization: The basis of thermal analysis-DTA, DSC and TGA.

UNIT 4 PHYSICS OF NANOMATERIALS **12 Hrs.**

Nanoscale-Surface to volume ratio- Quantum Size effect- Electron confinement - one two and three dimensional Nanoparticles - Properties of Nanomaterials - Disadvantages of Nanomaterials - Carbon Nano Tubes(CNT) - structure of CNT - Synthesis of CNT - Arc Discharge Method - Pulsed Laser Deposition CVD- Properties of CNT- Applications of CNT.

Max. <56> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the basic Physics in atomic spectroscopy

CO2 - Apply the concepts of spectroscopy to solve related problems in spectroscopy

CO3 - Understand the crystal structure of solids.

CO4 - Develop the knowledge of the physics of the material's analytical techniques.

CO5 - Explain the working mechanism of surface analysis tools.

CO6 - Differentiate between various techniques for the synthesis and applications of nanomaterials.

TEXT/REFERENCE BOOKS

1. Modern Physics by G. Aruldhas and P. Rajagopal, PHI Learning Pvt. Ltd.
2. Concepts of Modern Physics by Arthur Beiser, McGraw-Hill Higher Education
3. Elements of Solid-State Physics (2 Edition) by J. P. Srivastava, PHI Learning
4. Introduction to Solid State Physics (7 Edition) by C. Kittle, Wiley (India)
5. Robert, D.Braun, Introduction to Instrumental analysis, McGraw Hill.
6. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, john wiley & Sons (2001)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks

Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

17BSC304					Modern methods of water treatment (Subsidiary)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES:

- To learn about present status of water globally and the issues related to it.
- To know about the fundamentals of waste water treatment process.
- To learn about the advanced techniques used for waste water treatment, drinking water and saline water.
- To know about the unique methods of desalination, advanced cooling processes, and specialised water treatment processes.

UNIT 1 WATER & ITS PURIFICATION **12 Hrs.**

Sources of water, types of water, The Clean water act, , emerging issues with increasing water demand, water quality parameters, quality of water required for various domestic and industrial purposes. National water Mission.
Water Treatment: Domestic & Industrial level, Ultrapure water production, treatment goals and options, Failures of water treatment plants.

UNIT 2 FUNDAMENTALS OF WASTEWATER TREATMENT **14 Hrs.**

Introduction, sources and constituents of wastewater, wastewater treatment methods, levels of wastewater treatment, residual and bio-solids management, types of biological treatment processes, Sterilization of water (chemical and physical methods) and treating the Sludge.
New and emerging Drinking Water Purification Techniques: Traditional Methods Used for Water Filtration, Technologically Advanced Water Purification Methods: Reverse Osmosis (RO) Filtration Process, Ultrafiltration (UF) Purifying Process, low pressure/ high pressure membrane, UV irradiation technology, Advanced oxidation technology, Ion Exchange Technology, water softening (Lime and soda Numericals).

UNIT 3 DRINKING WATER DISTRIBUTION SYSTEM **12 Hrs**

Types of distribution system, biofilms (Significance & control) Water Desalination: Membrane processes, types of desalination Ion Exchange: Applications at industrial scale, regenerating wasted water
Different types of water filters: Drinking water filters, Hot tub filters, pool filters, aquarium filters. Biofilters.
Specialised water treatment techniques: Photocatalytic water purification, zeolite, acoustic nanotechnology, sun spring system, tata swach, Continuous Electrodeionization, Life straw, Polyglu, Alkaline RO.
Advanced cooling and water treatment concepts: Thermo-syphon cooler system, dew point cooling towers, Hybrid Dry/Wet Dephlegmator, membrane distillation technology, Carbon nanotube-enabled membrane distillation, Reverse Osmosis Advanced Membrane Monitoring.

UNIT 4 FUTURE SCOPE **14 Hrs.**

ICT for smart water management: mapping of water resources, asset management for water distribution, setting up early systems and meeting water demand in cities of the future, just in time irrigation in agriculture. India and water management.

52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Comprehend the basic concepts of water crisis, availability and water quality management.
CO2 - Understand the processes involved in waste water treatment processes.
CO3 – Categorise the best available technique for drinking water treatment on the basis of type of pollution load.
CO4 - Implement the role of ICT in smart water management.
CO5 –understand the role of new and advanced technologies used for waste water treatment.
CO6 –understand the role of India in water crisis management and technology advancement.

TEXT/REFERENCE BOOKS

1. Wastewater and Biosolids Treatment Technologies by Nicholas P. Cheremisinoff
2. Fundamentals of Wastewater Treatment and Engineering by Rumana Riffat

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

17A308					Films and Society (Elective Paper)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce basic concepts of filmmaking technique.
- To establish the relevance of important film theoretical concepts.
- To establish relationship between visualization and creativity.

UNIT 1 LANGUAGE OF CINEMA **10 Hrs.**

Theory of Society, Media and Culture -Indian Theatrical & Storytelling Tradition Semiotics of Cinema - A Brief History of Indian Cinema Representation in Practice/Making Identities Onscreen – Indian Cinema.

UNIT 2 STAGES OF FILM PRODUCTION **10 Hrs.**

Development – Ideation- Pre production, Production- Post production - Distribution and Exhibition Continuity: space & time -Camera movements, angles & shots, Mise-en-scene.

UNIT 3 READING A FILM **10 Hrs.**

Genres of Cinema, Forms of Films, Short Films, Feature Flims, Documentaries Film, Music, & Identity Cinema - Viewer relationship, Popular/Commercial Cinema and Art Cinema, Role of Audience, The Role of Digital Technology, Theory of Gender: Representation & Identity, Auteur Theory.

UNIT 4 SCREENING AND DISCUSSION OF THE FILMS **15 Hrs.**

Pyaasa (Guru Dutt,1957) Mughal-e-Azam (K. Asif, 1960) Godfather (1972 Francis Ford Coppola) Sholay (1975) Lagaan (Ashutosh Gowarikar, 2001) Anand (1971 Hrishikesh Mukherji) Mother India (1957 Mehboob Khan), Jane Bhi Do Yaro (Kunda Shah, 1983)
It's a Wonderful Life (1946, Frank Capra) Etc.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Identify the different forms and genres of the films.
CO2– Understand the different stages of film production & the semiotics of the cinema.
CO3– Construct a blog and illustrate the contribution of the cinema elements.
CO4– Distinguish between the various Indian theatrical and storytelling traditions.
CO5– Appraise films with in-depth understanding and knowledge of the subject.
CO6– Validate the role of audience and the digital technology in producing better films.

TEXT/REFERENCE BOOKS

1. Andrew, Dudly J, the Major Film Theories: AN Introduction, New York, Ozxford University press Bhawan, Somayya. Jigna Kothari and Supriya Madangarli, Mother Maiden Mistress: Women in Hindi Cinema 1950:2010, New Delhi, Harper Kollins

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks 100 **Exam Duration: 3 Hours**

Part A: Short Questions with choice, each question carries 10 marks 40 Marks
Part B: Long Questions with choice, each question carries 15 marks 60 Marks

Pandit Deendayal Petroleum University School of Technology

17A309					Workplace Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3			3	3	25	50	25	--	--	100

COURSE OBJECTIVE

- To introduce students to the workplace scenario.
- To explain how workplace communication is different to the routine communication.
- To prepare students to communicate during the time of crisis, natural or manmade.
- To guide students to learn the ethics of workplace communication.

UNIT 1IDENTIFYING THE WORKPLACE PERSONALITIES, OFFICE POLITICS, UNDERSTANDING & BUILDING A BRAND IMAGE **12 Hrs.**

UNIT 2 COMMUNICATION THROUGH ADVERTISING AND COMMERCIALS, E COMMUNICATION GENERATION GAP IN WORKPLACES **12Hrs.**

UNIT 3 CONFLICT RESOLUTION THROUGH COMMUNICATION, COMMUNICATING THE NEGATIVE NEWS CRISES COMMUNICATION **12 Hrs.**

UNIT 4 COMMUNICATING WITH NON-TECHNICAL PEOPLE, LOOKING THROUGH THE EYES OF EMPLOYERS CREATING A COMPANY PROFILE **09 Hrs.**

45 Hrs.

SELF STUDY TOPICS

- Communicating with non-technical people
- Communicating in a multi-lingual workplace
- Office – etiquettes
- Workplace Visit and Interview:

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify what is workplace communication
CO2 – Explain how communication is crucial to create a brand image
CO3 – Apply the communication skills to resolve conflicts
CO4 – Analyse the relation with Generation Y and non-technical people at workplace
CO5 – Assess the critical insight through case studies
CO6 – Create reports on the workplace visits made or interviews taken during the semester

TEXT/REFERENCE BOOKS

1. Corporate Communication by Paul A Argenti.
2. Corporate Communications: Conventions, Complexity, and Critique by Lars thoger Christensen, MetteMorsing and George Cheney.
3. Corporate Communication: A Guide to Theory and Practice by JosephCornelissen.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 100 **Exam Duration 3:00 Hrs**

Part A/Questions 2 Questions of 10 Marks Each With Internal Choice	20 Marks
Part B/Questions 4 Example Based Questions with Internal Choice	40 Marks
Part C/Questions 2 Questions Based On Analytical Study	40 Marks

17A310					ENVIRONMENTAL PSYCHOLOGY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	3	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To examine the inter-relationship between human psychology and the impacts on the environment.
- To explore and understand various perspectives on human environmental relationship.
- Gain insight into the ways in which environment influences our feelings and experiences
- To understand the impact of thoughts and actions on the environment (and vice versa).

UNIT 1 INTRODUCTION TO ENVIRONMENTAL PSYCHOLOGY AND ENVIRONMENTAL EDUCATION **05 Hrs.**

UNIT 2 THEORIES OF ENVIRONMENT **10 Hrs.**

UNIT 3

a. ENVIRONMENTAL STRESS **10 Hrs.**

b. Effect of Environment on Behaviour and Crowding **10 Hrs.**

UNIT 4 ENVIRONMENTAL PERCEPTION, COGNITION AND ATTITUDES **10 Hrs.**

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understanding the role of psychological processes in peoples responses to environmental problems.
CO2- Understanding the processes related to environmental degradation & their impact on human life.
CO3- Understanding pro-environment behaviour and human-environment transaction, to design behavioural interventions to minimize the adverse effects of anti- environment behaviour.
CO4- Will help develop an understanding of how human psychology, preferences and values, as well as resulting behaviour, aids or hinders solutions to environmental issues
CO5- Will help in developing an environmentally concerning behaviour and cognition.
CO6- Will provide knowledgebase on emerging trends, complexities, challenges and choices related to environmental psychology.

TEXT / REFERENCE BOOKS

1. Bell, P. A., Greene, T. C., Fisher, J. D. and Baum, A. (2001). Environmental Psychology (Vth Edition). USA: Wadsworth Group / Thomson learning, 10 Davis Drive Belmont CA.
2. Ittelson W. H., Proshansky, H. M., Rilvin, E. G., Winkel, G. H. and Dempsey, D. (1974). An Introduction to Environmental Psychology. New York: Holt Rinehart and Winston.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Durations: 3 Hours**

Part A: 10 questions of 2 Marks each-No Choice 20 Marks

Part B**:** 2 questions from each unit of internal choice, each carrying 20 marks 80 Marks

17A311					An Introduction to Atmospheric Sciences					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know about the physical laws governing the structure and evolution of atmosphere.
- To learn basic concepts of atmosphere such as weather, climate, hydrological cycle, natural/anthropogenic sources, aerosol-cloud interaction and global warming.
- To make students aware about various systems comprising the Earth's atmosphere

UNIT 1 EVOLUTION OF EARTH AND ITS ATMOSPHERE **12 Hrs.**

Big bang, formation of stars, various galaxies and our solar system, evolution of earth and its atmosphere, earth-sun radiation equilibrium, and green-house effect.

UNIT 2 EARTH'S ATMOSPHERE AND IMPORTANCE OF Aerosols **10 Hrs.**

Vertical and horizontal structure of atmosphere: temperature and pressure profiles, troposphere, stratosphere, mesosphere, ionosphere, scale height, Atmospheric radiation budget, Coriolis effect, Ozone hole, Introduction of aerosols, their role in global climate change.

UNIT 3 HYDROLOGICAL CYCLE **12 Hrs.**

Hydrological cycle and water budget, cloud types, wet and dry adiabatic lapse rate, various types of precipitates, rain formation process, monsoon system: solar heat distribution on earth, earth's tilt, seasons, south-west and north-east monsoon, cyclones.

UNIT 4 GLOBAL WARMING AND CLIMATE CHANGE **08 Hrs.**

Global warming, long and short term effects of global warming, components of the climate change process, Important findings of IPCC report, sustainability and our role.

42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand concepts of atmospheric processes at various spatial and temporal resolution.
CO2– Analyse impact of extreme weather events.
CO3– Evaluate interconnection between aerosol, cloud and rain formation processes.
CO4– Develop the skills to understand real atmospheric problems, role of uncertainties and their impact to the lives at short and long term.
CO5– Evaluate the human contributions to cause global as well as regional climate variability.
CO6– Apply knowledge of weather modulations on impact of future climate change.

TEXT/REFERENCE BOOKS

1. R. Freedman, Robert Geller and William J. Kaufmann, Universe, W. H. Freedman publishers.
2. Paul Fleisher, The Big Bang (Great Ideas of Science), twenty-first century books.
3. David G. Andrews, An introduction to atmospheric physics, Cambridge University press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 questions of 2 Marks each-No Choice 20 Marks
Part B: 2 questions from each unit of internal choice, each carrying 20 marks 80 Marks

17A312					INDIAN GOVERNMENT AND POLITICS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the genesis and making of the Indian Constitution
- To know the uniqueness of the Constitution of India
- To be aware of different organs of the governments
- Realisation of the working of the Indian Constitution and politics

UNIT 1 COLONIAL LEGACY AND NATIONALIST MOVEMENT **12 Hrs.**

a) Peaceful movements and revolutionary struggle
b) Major Acts and Missions
c) Making of the Constitution

UNIT 2 SALIENT FEATURES OF INDIAN CONSTITUTION **11 Hrs.**

a) The Preamble & Amendment
b) Fundamental Rights & Fundamental Duties
c) Directive Principles of State Policy & Federalism

UNIT 3 UNION GOVERNMENT **11 Hrs.**

a) The Legislature: Lok Sabha & Rajya Sabha
b) The Executive: President of India & Prime Minister of India
c) The Judiciary: Supreme Court and Judicial Review, PIL, Judicial Activism

UNIT 4 STATE GOVERNMENT **11 Hrs.**

a) The Legislature: Legislative Assembly & Legislative Council
b) The Executive: Governor & Chief Minister
c) The Judiciary: High Court

45 Hrs.

COURSE OUTCOMES

CO1– Admiration of freedom fighters' struggle in achieving the independence.
CO2– Understanding the values in the Constitution of India.
CO3– Able to identify the important political institutions of India.
CO4– Able to analyse the working of various organs of the governments.
CO5– Able to seek remedies and deliver responsibilities as a citizen.
CO6– To understand politics as complex phenomena of socio-economic and cultural factors.

TEXT/REFERENCE BOOKS

1. Himanshu Roy, M P Singh (2018) *Indian Political System*, Pearson Education India
2. Niraja G.J. & Pratap Bhanu Mehta (Ed) 2010, *Politics in India*, New Delhi: Oxford Companion Edition
3. Bakshi, P.M., (2018) *The Constitution of India*, Delhi: Universal Publishing Co.

END SEMESTER EXAMINATION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part- A: 2 questions 10 marks each with choice 20 Marks
Part-B: 4 questions 20 marks each with choice 80 Marks

17A317					Basics of Accounting System					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand meaning, concepts and conventions of accounting.
- To have a grasp of mechanics of accounting.
- To acquaint with process of finalization of accounts
- Gain the knowledge of accounting standards and computerization of accounts.

UNIT 1 INTRODUCTION TO ACCOUNTING **11 Hrs.**

Meaning and Definitions, External and Internal users of accounting information, Accounting concepts and conventions, Accounting Equation.

UNIT 2 MECHANICS OF ACCOUNTING **11 Hrs.**

Understanding the transactions, Journalizing the transactions, Preparing Ledger Accounts, posting the transactions and balancing the accounts, Preparing the Trial balance.

UNIT 3 FINAL ACCOUNTS **11 Hrs.**

Profit and Loss Account, Balance Sheet, Adjustments, Important Statutory provisions

UNIT 4 ACCOUNTING STANDARDS AND COMPUTERIZATION OF ACCOUNTS **12 Hrs.**

Meaning and Importance of standards, Valuation of Inventory AS – 2, Depreciation Accounting AS –6, Concept of Computerised Accounting System, Manual Vs. Computerised Accounting System, Advantages and Limitations of Computerised Accounting System.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Define various theoretical concepts of Accounting.
CO2– Understand importance of accounting equation.
CO3– Develop reasonable grip over mechanics of accounting
CO4– Prepare final accounts on normal basis.
CO5– Develop reasonable understanding of accounting standards.
CO6– Develop some understanding of computerization of accounts

TEXT/REFERENCE BOOKS

1. Introduction to Financial Accounting, Author: Prof. Horngren, Sunden, Elliott and Philbrick Publisher: Pearson Education.
2. Students' Guide to Accounting Standards Author: D. S.Rawat, Publisher: Taxman.
3. Financial Accounting Author: P. Tulsiani, Publisher: Pearson Education.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max Marks : 100 **Exam Duration : 3 Hours**

Part :A Concept based questions 50 Marks
Part :B Application based questions 50 Marks

17A318					Introduction to Human Resource Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the basic human resource management skills, covering the entire HR body of knowledge.
- Face the challenges of contemporary human resource management.
- Learn the importance of applying personal skills and business knowledge to human resource management.
- Learning the Management of in context of special issues.

UNIT 1 INTRODUCTION **11 Hrs.**

Managing Human Resources Today, Managing Equal Opportunity and Diversity, Mergers, Acquisitions, and Strategic Human Resource Management.

UNIT 2 STAFFING THE ORGANIZATION **11 Hrs.**

Personnel Planning and Recruiting, Selecting Employees, Training and Developing Employees.

UNIT 3 APPRAISING AND COMPENSATINGAND LABOR RELATIONS **11 Hrs.**

Performance Management and Appraisal, Compensating Employees Ethics, Employee Rights, and Fair Treatment at Work, Working with Unions and Resolving Disputes, Improving Occupational Safety, Health, and Security

UNIT 4 SPECIAL ISSUES IN HUMAN RESOURCE MANAGEMENT **12 Hrs.**

Managing Human Resources in Entrepreneurial Firms, Managing HR Globally, Measuring and Improving HR Management's Results.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Have an understanding of the basic concepts, functions and processes of human resource management
CO2– Understand how to make an appropriate staffing decision recruitment and selection, Training and Development
CO3– Understand HR compensation subjects including employee benefits, incentives and regulations governing
CO4– State the performance appraisal methods
CO5– Evaluate the developing role of human resources in the global arena.
CO6– Develop ways in which HRM might diagnose a business strategy and then facilitate the internal change.

TEXT/REFERENCE BOOKS

1. Fundamentals of HRM Content, Competencies and Applications : Gary Dessler and Biju Varkkey
2. A Textbook of Human Resource Management Author: R S Dwivedi Publisher: Vikas Publishing
3. Human Resource Management Author: Pravin Durai Publisher: Pearson
4. Human Resources Development and Management Author: Biswanath Ghosh Publisher: Vikas Publishing

END SEMESTER EXAM QUESTION PAPER PATTERN

Max Marks: 100 **Exam Duration : 3 Hours**

Part A Concept based questions 50 Marks
Part B Application based questions 50 Marks

17A320					Introduction to law and Governance					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To systematically study Governance initiatives with a greater emphasis on Law.
- To study the new frontier of Law and Society and the controversies, contradictions surrounding it.
- To focus on the key challenges confronting implementation of law in India.
- To create awareness among the students about various social laws and its importance in the society.

UNIT 1 CONCEPT OF LAW **10 Hrs.**

a) Jurisprudence, b) Rule of Law, c) Administrative and Constitutional law
d) Concept of Democracy

UNIT 2 LAW AND JUSTICE **10 Hrs.**

a) Indian Judicial System, b) Judicial Activism, c) Judicial review, d) judicial overreach

UNIT 3 INTRODUCTION TO INDIAN LEGAL SYSTEM – LAW AND GOVERNANCE **10 Hrs.**

a) IPC, b) CRPC, c) CPC d) Tribunals e) Law and E-governance

UNIT 4 Introduction to Social Law **15 Hrs.**

a) Gender law b) Anti dowry Act, c) POSCO Act, d) Domestic violence Act,
e) Anti ragging Act f) IT Act

45 Hrs.

COURSE OUTCOMES

On Completion of this course, student will be able to
CO1– Understand the Governance initiatives with a greater emphasis on Law.
CO2– Illustrate the new frontier of Law and Society and the controversies, contradictions
CO3– Focus on the key challenges confronting implementation of law
CO4– Interpret the Indian Legal System with reference to Acts.
CO5– Assess the impact of social laws in the society
CO6– Analyze the relation between Law, Public Policy and Governance.

TEXT / REFERENCE BOOKS

1. N. Prabha Unnithan, Crime and Justice in India (SAGE Law), 20 March 2013
2. Monica Chawla, Gender Justice : Women And Law In India, 2006
3. Alf Ross, On Law and Justice: 1, 16 December 2011
4. Ankit Oberoi, Exploring Law Ethics and Governance, February 2015
5. N. Douglas Lewis, Law and Governance, 1 August 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks 100 **Exam Duration: 3 Hours**

Part A: Short Questions with choice, each question carries 10 marks 40 Marks
Part B: Long Questions with choice, each question carries 15 marks 60 Marks

17BSC401					Fundamentals of Organic Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25			100

COURSE OBJECTIVES

- 1 Understand the concept of basics of organic chemistry
- 2 Apprehend the different functionality to impart the reactivity of organic compound
- 3 Appraise the concept, terms, and important events in the development of organometallic compounds
- 4 Analyze the reactivity of organic compounds in presence of different stimuli
- 5 Appreciation for the scope, diversity, and application of several reaction and their mechanism

UNIT 1 Alkanes, Alkenes and Alkynes **12 Hrs.**

Structure of alkanes, preparation of alkanes, Wurtz reaction, Corey-House Alkane synthesis, physical properties of alkanes, chemical properties of alkanes, halogenation of alkanes: mechanism, cracking: mechanism, conformations of alkanes, petroleum refining, synthetic petrol, octane number, petrochemicals,

orbital structure of ethylene, nomenclature of alkenes, preparation of alkenes, physical properties of alkenes, chemical properties of alkenes, mechanism of electrophilic addition, Markovnikov rule: mechanism, peroxide effect: mechanism, dienes, Diels-Alder reaction, orbital structure of acetylene, acidity of acetylene and terminal alkynes, nomenclature of alkynes, preparation of alkynes, physical properties of alkynes, chemical properties of alkynes, acetylides.

UNIT 2 Benzene and Homologues: Effect of Substituents **14 Hrs.**

Structure of benzene, resonance energy of benzene, aromaticity, Huckel rule, annulenes, mechanism of substitution reactions, halogenation of benzene: mechanism, nitration of benzene: mechanism, sulphonation of benzene: mechanism, Friedel-Crafts alkylation: mechanism, Friedel-Crafts acylation: mechanism, guidelines: writing mechanism of electrophilic substitution reactions, side-chain halogenation: mechanism, styrene.

Directive effects of substituents, ortho-para and meta directing groups, effect of substituents on reactivity, theory of directive effects, theory of activating ad deactivating effects, guidelines: determining the orientation effect and activating (or deactivating) effect of various substituents

UNIT 3 Organometallic Compound **10 Hrs.**

Mechanism with evidence and stereochemical features for the following Rearrangement to electron-deficient carbon: Wagner-Meerwein rearrangement, pinacol rearrangement, dienone-phenol; Wolff rearrangement in Arndt-Eistert synthesis, benzil-benzilic acid rearrangement, Demjanov rearrangement, Tiffeneau–Demjanov rearrangement. Rearrangement to electron-deficient nitrogen: rearrangements: Hofmann, Curtius, Lossen, Schmidt and Beckmann. Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, cumene hydroperoxidephenol rearrangement and Dakin reaction. Aromatic rearrangements: Migration from oxygen to ring carbon: Fries rearrangement and Claisen rearrangement.

UNIT 4 Organic Photochemistry and Pericyclic Reactions **12 Hrs.**

Principles of photochemistry, photochemistry of carbonyl compounds, photochemistry of olefins, photorearrangement of cyclohexadienones.

Electrocyclic reactions: FMO approach involving 4π- and 6π-electrons (thermal and photochemical) and corresponding cycloreversion reactions; Cycloaddition reactions: FMO approach, Diels-Alder reaction, photochemical [2+2] cycloadditions; Sigmatropic reactions: FMO approach, sigmatropic shifts and their order; [1,3]- and [1,5]-H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements

Max. <48> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- understand the fundamental of organic chemistry

CO2- Apply basic concept to predict reactivity of aromatic compounds

CO3-Analyze the reactivity of organometallic compounds and its importance

CO4–Assess the difference of photochemistry and pericyclic reaction with the normal organic chemistry reaction

CO5-Estimate the reaction types and mechanism and imply these two to comprehend the new reaction mechanism

TEXT/REFERENCE BOOKS

1. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
2. Clayden, J., Greeves, N., Warren, S. Organic Chemistry, Second edition, Oxford University Press 2012.
3. A Guidebook to Mechanism in Organic Chemistry, 6th Edition by Peter Sykes
4. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Gilchrist, T. L. & Storr, R. C. Organic Reactions and Orbital symmetry, Cambridge University Press.
6. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press.
7.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 4 Questions from each unit, each carrying 7 marks 28 Marks

Part B/Question: 8 Questions from each unit, each carrying 9 marks 72 marks

17BSC402					Polymers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamentals on polymers.
- To provide the knowledge about rubbers, engineering plastics and resins.
- To provide the knowledge on conducting polymer, molecular weight of polymers, and polymer processing.
- To provide the knowledge about polymer and petroleum industry, green polymer, bio polymer and polymer characterization.

UNIT 1 **14 Hrs.**

Introduction, Nomenclature, Types of polymerization: Addition polymerization, Condensation polymerization, Copolymerization and their mechanism. Differences between Addition and Condensation polymerization; Classification of Polymers based on source, structure, synthesis, growth polymer chain, thermal response, tacticity, number of monomers and application; Synthesis, properties and applications of some commercially important polymers: HDPE, LDPE, PVC, Teflon.

UNIT 2 **14 Hrs.**

Rubber, Vulcanization of rubber, Compounding of Rubber, Synthetic Rubber: Styrene rubber, Nitrile rubber, Butyl Rubber, their preparation, properties and application; Engineering Plastics: Polyamides (Nylon-6 & Nylon-6,6), Polycarbonates, Polyurethane and Teflon. Resins: Phenol-formaldehyde resin, Urea-formaldehyde resin, Epoxy resin, Melamine-formaldehyde resin, their synthesis properties and application.

UNIT 3 **14 Hrs.**

Conducting Polymers: Classification, Factors affecting conductivity, Preparation and application; Molecular weight of polymers: Types (M_n, M_w, M_v and M_z) and their mathematical expressions, Degree of polymerization (DP), Problems based on molecular weight and DP.Glass Transition Temperature (Tg) of Polymers; Plastic Processing: Molding, Extrusion, Thermoforming, Casting, Coating, Winding, Laminating; Effect of polymer properties on process technique.

UNIT 4 **14 Hrs.**

Polymers and Petroleum industry, Green Polymer Synthesis Biopolymers: Carbohydrates, Proteins, Lipids, Nucleic acids; Types of biopolymers: Polynucleotide, Polysaccharides, Polypeptide; Natural synthesis of carbohydrates, Biomaterials: Science for the benefit of life, Required characteristics of a biomaterial; Types of Biomaterials: Natural, Synthetic, Biodegradable, Biocompatibility of biomaterials, Standardization of Biomaterials, Performance, Properties & application of biomaterials. Characterization of Polymers: Molecular weight, XRD, SEM, TGA-DSC, Mechanical characterization: Stress/Strain.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Learn polymer, their classification and different synthesis techniques.

CO2– Acquire knowledge about different class of rubbers, engineering plastics, and their applications.

CO3– Understand and learn the structure-property relationships in polymers.

CO4– Explain the process for the manufacturing of polymer in the petroleum industry.

CO5– Understand different kind of bio polymers and their applications.

CO6– Develop the knowledge on the synthesis, characterisation and use of biomaterials for different applications.

TEXT/REFERENCE BOOKS

1. Polymer Chemistry, S. Koltzenburg, M.Maskos, O. Nuyken, Springer
2. Introduction to Polymer Chemistry, 4th Edition, Charles E. Carraher Jr., CRC Press
3. A textbook of polymer chemistry, M.S. Bhatnagar, S Chand Publication
4. Polymer Chemistry, Alka L Gupta, Pragati Publication
5. Basic Principles of Polymer Chemistry, Archana Garg, Atlantic Publication
6. Wiley Engineering Chemistry, Second Edition, Wiley Indi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 5 Questions from each unit, each carrying 1 mark 20 Marks

Part B/Question: 2 Questions from each unit, each carrying 10 marks 80 Marks

17BSC403					Materials Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the knowledge about fundamental of materials.
- To provide the knowledge about the metallic and ceramic crystalline structure.
- To develop the knowledge about the phases of metallic alloy systems.
- To provide the knowledge about the different properties of materials.

UNIT 1 FUNDAMENTAL ABOUTMATERIALS **14 Hrs.**

Introduction of materials, classification of materials, atomic structure and interatomic bonding in materials, covalent, ionic and metallic bonding, bonding forces and energies, lattice energy and Madelung constant, metallic crystal structure and ceramic crystal structure, coordination number, factors affecting structure. different ionic structures according to anion packing: AX, AX2, A2X, AmEnXp structures; Rock salt, Rutile, Zinc blende, Antifluorite, Wurtzite, Corundum, CsCl, Perovskite, Spinel (normal-inverse), structure of silicates.

UNIT 2 DEFECTS, DISLOCATIONS AND DIFFUSION IN MATERIALS **14 Hrs.**

Defects in solids, point defects, extrinsic point defects, line defects, description of dislocations, elements of elastic theory, forces on dislocations, effect of dislocations on the materials behaviour, planar defects, stacking faults, grain boundaries, interface boundaries, volume defects, vacancies and voids, surface defects: description of surface structure, surface crystallography, surface relaxation and reconstruction, and crystal growth. diffusion in solids and types of diffusion, Diffusion equations; Fick's law of diffusion, mechanisms of diffusion, the Kirkendall Effect.

UNIT 3 PHASE DIAGRAM OF MATERIALS **14 Hrs.**

Phase rule, phase diagram, Gibbs's phase rule, interpretation of mass fractions using Lever's rule, Hume Rothery rules-binary iso- morphous system, binary eutectic alloy system (lead-tin System), binary peritectic alloy system (iron-nickel system).

UNIT 4 PROPERTIES OF MATERIALS **14 Hrs.**

Electronic properties of materials, insulator, semiconductor, conductor, band diagram, dielectrics; optical properties of materials, transparent, transluscent, opaque materials, luminescence; magnetic properties of materials, ferromagnetic, ferromagnetic, antiferromagnetic; mechanical behavior of materials.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the materials and their chemical bonding.

CO2– Acquire knowledge about the crystalline structure of materials.

CO3– Understand the defects and dislocations in materials.

CO4– Explain the diffusion phenomenon in solids.

CO5– Acquire knowledge about the phases of metallic alloy systems.

CO6– Develop the knowledge about the different properties of materials.

TEXT/REFERENCE BOOKS

1. W.D.Callister, An Introduction to Materials Science & Engineering, John Wiley & Sons (2007).
2. MW Barsoum, Fundamental of Ceramics, IOP publishing (2003).
3. V. Raghavan, Materials Science and Engineering, Prentice-Hall of India Private Limited (2003).
4. W.F. Smith, Principles of Materials Science and Engineering, McGraw Hill, New York (1994).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks

Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

17BSC401P					Analytical Chemistry-I Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- Care about safety precautions during work in the laboratory.
- Understand the scientific back ground of the practical's for industrial and domestic use.
- Comprehend the adsorption principle and its application.
- Experience with spectroscopic techniques to characterize the synthesized complex.
- Evaluating abilities in line with the modern trends in science and technology.

LIST OF EXPERIMENTS

1. To determine soil pH by using a pH-meter.
2. To determine the strength of given mixture of HCl and CH_3COOH by conductometric titration.
3. Gravimetric determination of Sulphate as Barium Sulphate.
4. Spectrophotometric determination of Iron by complexing with 1,10 –Phenanthroline .
5. Determination of hexavalent chromium by complexing with di-phenyl carbazide, using a spectrophotometer.
6. Estimation of oil and grease from a given sample after solvent extraction.
7. Determination of distribution coefficient of an organic acid between water and an organic solvent.
8. To determine the Chemical Oxygen demand (COD) in a given water sample.
9. Determination of elements (e.g., Cu) in aqueous solutions by Atomic absorption spectrometer.
10. Adsorption of Acetic acid on charcoal.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Capable of designing set of new experiment.

CO2– Comprehend conductometric titration to calculate the unknown concentration.

CO3– Understand the electrode functional and calculate the pH of any unknown solution.

CO4– Able to determine the amount of oxygen in different water sample and its significance.

CO5– Apply the atomic absorption spectroscopy to investigate the different industrial solution.

CO6– Create a new scientific method to be use in the domestic and industrial purpose.

TEXT/REFERENCE BOOKS

1. A. I. Vogel, A text book of quantitative Inorganic Analysis, ELBS.
2. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007. Vogel's Text Book of Practical Organic Chemistry (5th Edn).

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal maintain each 25 marks) 50 Marks

LE (Viva-voce plus Lab examination each 25 marks) 50 Marks

17BSC405E					ENVIRONMENTAL CHEMISTRY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals concepts of environmental chemistry.
- To know about the different kinds of pollutants present in the atmosphere, hydrosphere, and lithosphere.
- To provide understanding of chemistry of rock, soil, sediment, water, air and living organisms.
- Provide a sound scientific background for understanding environmental problems and for monitoring, controlling. managing and cleaning up pollution.

UNIT 1 ATMOSPHERIC COMPOSITION AND PRINCIPLES OF CONTAMINANT BEHAVIOR **12 Hrs.**

The atmosphere of Earth, Composition of air. Particles, ions and radicals in the atmosphere. Chemical speciation. Chemical processes in the formation of inorganic and organic particulate matters. Green House Effect-Global Temperature-Acid rain-Ozone layer Depletion**.** COformation in atmosphere, Organic Pollutants, Pollution from Combustion Systems, Coal Combustion, Photochemical Smog, Indoor Air Pollution Carcinogens in the air.

UNIT 2 AIR POLLUTION AND AIR POLLUTION CONTROL TECHNIQUES **10 Hrs.**

Factors responsible for air pollution. Types of air pollutants- CO, oxides of Nitrogen, Sulphur Dioxide. Instrumental Techniques to monitor Pollution. Air pollution control Techniques.

UNIT 3 WATER POLLUTION **14 Hrs**

Introduction: Ground and subsurface water contamination, Ground water pollution, Ocean pollution Major sources of water pollution: Eutrophication, Acid Mine Drains, Pesticides and Fertilizers, Dying and Tanning Water Pollution Treatment: Introduction, Technological Approach, Chemical degradation of wastes and chemicals, coagulation and flocculation, photocatalytic degradation of pollutants, Supercritical water oxidation Sewage treatment Trace Contaminants.

UNIT 4 SOIL POLLUTION **12 Hrs.**

Soil around us, Organic and Inorganic components of soil, Soil water characteristics, soil erosion, soil & pollution, Water resources: Irrigation and wetlands, Soil pollution management . Contaminants and their natural pathways of degradation and their abatement- Carbon Cycle, Nitrogen Cycle, Sulphur Cycle, Phosphorus Cycle. Nuclear waste management, solid waste management.

48 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Comprehend the basic concepts of environmental chemistry.
CO2– Understand the components of natural environment and their interaction within and between them.
CO3– To know about the different types of pollutants, their sources and sinks.
CO4– To know pollution enter the natural environment & are transferred from one component to the other.
CO5– To know about various pollution abatement technique and pollution control equipments.
CO6– To know about latest Environmental issues related to the above subjects.

TEXT/REFERENCE BOOKS

1. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press LLC,2001
2. Eugene R. Weiner Applications of Environmental Chemistry 2000 CRC Press, LLC

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

A408					STATISTICS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To enable a student in understanding how to make quantitative and qualitative data analysis.
- To introduce types of data, database, analysis of data by various statistical tools.
- To derive meaningful information from database by applying statistical analysis.
- To provide scientific basis for generating meaningful interpretation among variables.

UNIT 1 AN INTRODUCTION TO STATISTICS **10 Hrs.**

Meaning of Statistics - Origin of Statistics - Importance of Statistics- Classification and Tabulation of Data- Graphical Study of Statistical Data.

UNIT 2 MEASURES OF CENTRAL TENDENCY AND DISPERSION **15 Hrs.**

Measures of Central Tendency- Mean- Combined Mean- Median- Quartiles- Deciles- Percentiles- Mode- Geometric Mean- Measures of Dispersion- Standard Deviation- Coefficient of Standard Deviation- Coefficient of Variation- Quartile Deviation.

UNIT 3 INDEX NUMBERS, CORRELATION AND REGRESSION **10 Hrs.**

Index Number- Study of Correlation- Regression

UNIT 4 PROBABILITY AND PROBABILITY DISTRIBUTION **10 Hrs.**

Permutation & Combination- Probability- Probability Distribution.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– To get students acquainted with the different statistical concepts in statistics

CO2– Understand the basics of descriptive and inferential statistics like measures of central tendency, dispersion, probability, etc.

CO3– To enable use of statistical tools in data presentation

CO4– Develop linkages between statistical methods and usage in real world

CO5– To enhance analytical capabilities of students in data interpretation and analysis.

CO6– Apply concepts of correlation, regression and probability distribution for bivariate and multivariate analysis.

TEXT/REFERENCE BOOKS

1. Levin and Rubin, Statistics for Management, TataMcGraw Hill
2. S P. Gupta- Statistics, S. Chand Publications.
3. Michael Sullivan- Statistics : Informed Decisions Using Data 4th Edition, Pearson.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A: 5 Questions of 12 marks each 60 Marks

Part B: 4 Questions of 10 marks each 40 Marks

A409					Rural Development in India					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide an understanding of rural development and to enhance awareness about the complexities involved in defining and measuring rural development.
- To give a general view of the political-economic scenario in rural India in the post-independence period.
- To create awareness about the various development indicators.
- To orient the students about different trends of rural development.

UNIT 1 RURAL DEVELOPMENT **10 Hrs.**

a) Concepts and connotations b) Paradigms and determinants
b) Policies and strategies.

UNIT 2 RURAL DEVELOPMENT AND SECTORAL REFORMS **10 Hrs.**

a) Critical Analysis of the Development Interventions b) Financial Inclusion
b) Financial Sector Reforms & Institutions

UNIT 3 EMERGENCE OF THE AGRARIAN STRUCTURE **10 Hrs.**

a) Land Reforms in India b) Caste, Class and Power

UNIT 4 RURAL DEVELOPMENT TRENDS, CHALLENGES & SUCCESS STORIES **15 Hrs.**

a) Food Security b) Income Generating c) Wage Employment Programmes
b) Poverty, Hunger, Health, Education, e) Green Revolution, PURA, Bharat Nirman

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Acquire basic knowledge about the concept and determinants of rural development.
CO2– Illustrate an overview on policies and strategies adopted for rural development.
CO3– Interpret the developmental interventions through programmes and institutional support mechanism.
CO4– Assess the sector specific reforms and interventions made through financial inclusion.
CO5– Understand the agrarian structure and the caste, class complexities.
CO6– Analyse various success stories of rural development and poverty alleviation.

TEXT/REFERENCE BOOKS

1. Desai, A. R., Rural Sociology in India
2. Dreze J. and Amartya Sen (ed.) (1990): The Political Economy of Hunger, Vol. I, Clarendon Press, Oxford
3. Kothari, Rajni, Politics in India
4. Sainath, P., (1996): Everybody Loves a Good Drought, Penguin, New Delhi
5. Sen, Amartya, (1999): Development as Freedom, OUP, New Delhi
6. Singh, Katar, (1999): Rural Development: Principles, Policies and Management, II Edition, Sage, New Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks 100 **Exam Duration: 3 Hours**

Part A: Short Questions with choice, each question carries 10 marks 40 Marks
Part B: Long Questions with choice, each question carries 15 marks 60 Marks

A410					COGNITIVE PSYCHOLOGY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide in-depth understanding about domains of Cognitive Psychology.
- To be able to identify underlying theoretical considerations in the field of cognitive psychology.
- To learn the manner in which the brain acquires, digests and processes information.
- To acquire an understanding of research methods in cognitive psychology and the ability to critically evaluate research in this area.
- To be able to apply research findings in cognitive psychology to everyday events and challenges.

UNIT 1 **6 Hrs.**

a. Introduction to Cognitive Psychology

b. Cognitive Neuroscience **8 Hrs.**

UNIT 2

a. Attention & Perception **6 Hrs.**

b. Learning & Memory **5 Hrs.**

UNIT 3

a. Problem Solving & Creativity **6 Hrs.**

b. Reasoning and Decision Making **6 Hrs.**

UNIT 4

a. New Areas of Cognitive Psychology **8 Hrs.**

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Analyse the information processing systems of mind and behaviour.

CO2–Discuss causal factors and functioning of the human mental processes.

CO3– Apply the basic knowledge of core concepts in human cognition.

CO4– Apply the knowledge of cognitive processes to one's own personal life and to real life issues.

CO5– Analyse the role of individual differences, and sociocultural factors in cognitive functioning.

CO6– Build knowledgebase onemerging trends, complexity, challenges and choices related to cognitive psychology.

TEXT / REFERENCE BOOKS

1. Sternberg, Robert J., Cognitive Psychology, 6th Edition, Cengage Learning, 2011.
2. Goldstein, Bruce E., Cognitive Psychology Connecting Mind, Research and Everyday Experience, Cengage Learning, 2018
3. Dawn M. McBride, J. Cooper Cutting, Cognitive Psychology - Theory, Process, and Methodology, Sage Publications, Inc., 2018
4. Riegler, G. R., &Riegler, B. R. Cognitive Psychology: Applying the Science of the Mind, Pearson (South Asia Edition), 2008

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Durations: 3 Hours**

Part A: 10 questions of 2 Marks each-No Choice 20 Marks

Part B: 2 questions from each unit of internal choice, each carrying 20 marks 80 Marks

A411					Educational Psychology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	3	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To discuss nature and scope of Educational Psychology.
- To explain role of Learning environment, Teacher and teaching- Significance of Educational Psychology to the teacher.
- To discuss various intelligence and creativity models.
- Identify and discuss the major components and techniques of classroom planning, management and instruction and how these components and techniques address individual differences.
- Describe how teachers, parents, and students all contribute to a productive learning environment.

Unit 1 NATURE OF EDUCATIONAL PSYCHOLOGY	**05 Hrs.**
UNIT 2 NATURE AND IMPORTANCE OF LEARNING	**10 Hrs.**
UNIT 3 GUIDANCE AND COUNSELLING	**10 Hrs.**
UNIT 4	
a. Growth and Development	**10 Hrs.**
b. Intelligence and Creativity	**10 Hrs.**
	45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understanding the meaning and processes of education at individual and social plains in the Indian context.

CO2 – Demonstrating an appreciation of various theoretical perspectives on cognition and learning in educational contexts.

CO3 – Developing insights into the facilitators of learning such as intelligence, emotion, imagination, creativity and self-processes.

CO4 – Understanding the social processes within the classroom and broader societal contexts that shape student's learning outcomes.

CO5 – Learning and applicability of Counselling in education sector.

CO6 – Build knowledgebase on emerging trends, complexity, challenges and choices related to educational psychology.

TEXT / REFERENCE BOOKS

1. Lahey R.B. Graham J. E., & others (2000) An Introduction to Educational Psychology, 6th Ed., Tata McGraw Hill Publishers, New Delhi.
2. Sharma R.N. & Sharma R.K. (2003) Advanced Educational Psychology, Atlantic Publishers and Distributors, New Delhi.
3. Sharma, P.N. & R. K. Sharma (1996) Advanced Educational Psychology, Surjeet Publications,
4. Santrock John W. (2010) Educational Psychology, Inwin Professional Publishers, Delhi.
5. Walia J.S. Foundations of Educational Psychology, Paul Publishers, Jalandhar.

END SEMESTER EXAM QUESTION PAPER PATTERN

Total. Marks: 100	**Exam Durations: 3 Hours**
Part A: 10 questions of 2 Marks each-No Choice	20 Marks
Part B: 2 questions from each unit of internal choice, each carrying 20 marks	80 Marks

A412					Soft Skills					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop competencies and capabilities in students to handle tasks effectively and efficiently.
- To bring behavioral changes among students in order to develop skills related to interpersonal communication, team building and leadership.
- To equip students with functional skills and communication skills.
- To build the EQ along with their IQ to make them sensible sensitive citizens.

UNIT 1 TEAM BUILDING AND ART OF NEGOTIATION **10 Hrs.**

Nature of the team, team through building relation and interpersonal communication, understand what is negotiation, Ways of negotiating, To understand the power of language and non-verbal communication.

UNIT 2 DRESS FOR SUCCESS, TABLE MANNERS AND TELEPHONE ETIQUETTES **10 Hrs.**

To learn selection of proper attire as per the situation, How to carry one' self, the telephonic etiquettes; tone and pitch of the voice, send a voice mail, manners during professional meetings over lunch/dinner, Basics of the table manners and netiquettes.

UNIT 3 ORGANIZING MEETINGS, TIME AND STRESS MANAGEMENT **10 Hrs.**

How to call the meeting, design the agenda and prepare minutes of the meeting, Goal setting, time management, To learn kinds of stress, How to handle the pressure and perform efficiently in such situations.

UNIT 4 MULTI-TASKING, ORGANIZATIONAL SKILLS **15 Hrs.**

How to prioritize the work, Importance of multi-tasking and concerns related to multi-tasking, To identify what to multi-task, To understand the nature of the organization, To understand the structure and communication channel of the organization, Clarity about the roles and responsibilities in an organization, How to be a team member, How to draft reports.

45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Acquire employability skills.
CO2 – Communicate with others effectively and create an impact and be a team player.
CO3 – Demonstrate critical thinking and lateral faculties o solve problems.
CO4 – Enhance productivity and performance at the workplace.
CO5 – Demonstrate understanding of diversity.
CO6 – Cope with pressure and yet produce results.

TEXT/REFERENCE BOOKS

1. Bhatnagar, N & Bhatnagar, M. Effective Communication and Soft Skills. New Delhi: Pearson Education India, 2011.
2. Mitra, K Barun. Personality Development and Soft Skills. New Delhi: OUP, 2012.
3. P**eggy Klaus, T**he Hard Truth about Soft Skills. NYC: Harper Collins, 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part-A 4 questions 10 marks each with choice: 40 Marks
Part-B 4 questions 15 marks each with choice: 60 Marks

A414					An advance course in Atmospheric Science					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know about the fundamentals of Paleoclimatology.
- To learn various proxies used for paleoclimatology along with their use.
- To learn basic mechanism used for various meteorological instruments.
- To get a basic idea of satellite meteorology.

UNIT 1 BASICS OF PALEOCLIMATOLOGY **12 Hrs.**

Basic principles of Paleoclimatology, sampling and dating techniques, radioactivity, isotopic fractionation, mass spectrometry, Rayleigh equation, use of stable isotopes as tracers.

UNIT 2 PROXIES FOR PALEOCLIMATOLOGY **10 Hrs.**

Various proxies used for paleoclimatology (such as ice cores, ocean sediment cores, cave deposits), data interpretation, orbital scale climate change and Last Glacial Maxima.

UNIT 3 METEOROLOGICAL INSTRUMENTS **08 Hrs.**

Principles and protocols of measurement, measurement of atmospheric temperature, humidity, pressure, wind, radiation, precipitation and aerosols, upper air observations, radiosonde techniques.

UNIT 4 SATELLITE METEOROLOGY **12 Hrs.**

Electromagnetic spectrum, solar, terrestrial, blackbody radiation, emissivity, radiative properties of the atmosphere, thermal, infrared and microwave techniques for measurement of temperature, humidity and cloud height, some important results from satellite observations, sustainable development.

42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand basic concepts of paleoclimatology and measurements in meteorology.
CO2– Develop basic understanding of various proxies and dating techniques.
CO3– Analyse effect of modern measurement techniques to improve scientific understanding.
CO4– Evaluate human contribution to climate change.
CO5– Understand role of satellites in meteorology.
CO6– Apply knowledge of past to understand present and future

TEXT/REFERENCE BOOKS

1. Thomas M. Cronin, Principles of Paleoclimatology, Columbia University press, New York.
2. Raymonds S. Bradley, Paleoclimatology: Reconstructing Climates of the Quaternary,Elsevier
3. John Imbrie and Katherine Palmer Imbrie, Ice Ages: Solving the Mystery, Harvard University Press.
4. Fred Hoyle, Ice: The Ultimate Human Catastrophe, Continuum Intl Pub Group.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part-A 4 questions 10 marks each with choice: 40 Marks
Part-B 4 questions 15 marks each with choice: 60 Marks

A420					Principles of Financial Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVE

- To develop a foundation of financial management concepts.
- To deeply understand the functions of financial management and its importance.
- To acquaint with techniques of financial statements analysis.
- Gain the practical knowledge of various financial decisions of the organisation with the help of selected numerical problems available in various suggested text books.

UNIT 1 INTRODUCTION **11 Hrs.**

Meaning of Financial Management – Definitions, Scope and content of financial management, Evolution of Corporate Finance, Relation of financial management with other disciplines of business, Fundamental Principles of Financial Management.

UNIT 2 OBJECTIVES & FUNCTIONS **11 Hrs.**

Profit maximization, Shareholder's Wealth Maximisation, Economic Value Added and Market Value Added, Functions of Finance Manager, Financial Management Process and organisation of finance function.

UNIT 3 UNDERSTANDING AND ANALYSIS OF FINANCIAL STATEMENTS **12 Hrs.**

Meaning and Nature of Financial statements, Objectives of Financial Statements, Form and Contents of Income Statement, Balance Sheet and Cash Flow Statement, Statutory Provisions pertaining to Financial Statements, Limitations of Financial Statements, Importance of Financial analysis, Types of Financial analysis, Comparative Statements, Ratio Analysis, Du Pont Identity.

34 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Define various theoretical concepts of financial management.
CO2– Understand functions and importance of financial management.
CO– Understand various financial statements.
CO4– Analyze and interpret financial statements.
CO5– Understand the mathematics of Time Value of Money.
CO6– Explain the concepts of compounding and discounting and utilize these tools to calculate the future value and present value of lump sums.

TEXT/REFERENCE BOOKS

1. Financial Management – Theory and Practice Author: Prof. Prasanna Chandra Publisher: TATA McGraw Hill
2. Fundamentals of Financial management Author: Prof. Sheeba Kapil, Publisher: Pearson
3. Financial Management – Theory and Practice Author: Prof. Shashi K Gupta and R.K. Sharma Publisher: Kalyani Publishers

END SEMESTER EXAM QUESTION PAPER PATTERN

Max Marks : 100 **Exam Duration : 3 Hours**

Part A/Question: Concept based questions 50 Marks
Part B/Question: Application based questions 50 Marks

18BSC501					Chemical Kinetics & Catalysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concepts of Chemical Kinetics.
- To learn the theory of reaction rates.
- To learn the basic concepts of homogeneous and heterogeneous catalysis.
- To understand the basic concepts of different methods of catalyst characterization.

UNIT 1 CHEMICAL KIETICS **12 Hrs.**

Rate of reactions, rate law, order, molecularity, Integrated rate laws: zero order reactions, First order reactions, Second order reactions, Third order reactions, Rate law for nth order reaction, Pseudo-unimolecular reactions, Half life time: for zero order, 1st order, 2nd order, third order, nth order reactions, Methods of determination of order of a reaction, Factors affecting the rate of a reaction.

UNIT 2 CHEMICAL REACTIONS AND COLLISION THEORY **14 Hrs.**

Types of Chemical Reactions, Collision theory, collision requirements, Energy of Activation, Factors that cause more collisions, Collision frequency, Transition state theory, Potential-Energy Diagrams for Reactions, Collision Theory and the Arrhenius Equation, Reaction Mechanisms, Elementary Reactions, Rate determining step.

UNIT 3 CATALYSIS – FUNDAMENTAL **13 Hrs.**

Theory of catalysis, Acid base catalysis, Homogeneous and Heterogeneous Catalysis, Biocatalysis, Positive catalyst, Negative catalyst, Catalyst promoters, Catalyst poisons, Auto Catalyst.

UNIT 4 CATALYSIS – INDUSTRIAL APPLICATION **13 Hrs.**

Catalyst Characterization - Surface area measurements, BET Theory, Pore size distribution, Porosimetry Chemisorption techniques, Crystallography and surface analysis techniques, XRD, XPS, NMR, Surface acidity and Activity, Life time, Bulk density, Thermal stability. Industrial applications of catalyst, Catalysts in Petroleum Refining, Catalytic converter

52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand chemical kinetics and its application to find rate, order and molecularity.

CO2– Interpret half-life and correlates with reactions of different order.

CO3– Conceptualize the basic need of homogeneous and heterogeneous catalysis.

CO4– Analyse the interaction of radiation with matter in catalysis in real world.

CO6– Elucidate the mechanism of catalysis with the help of knowledge of characterization techniques.

TEXT/REFERENCE BOOKS

1. Chemical Kinetics, 3rd edition, K. J. Laidler, Pearson India
2. Physical Chemistry, 9th edition, Peter Atkins, Julio De Paula, Oxford University Press
3. Essentials of Physical Chemistry, A. Bahl, B.S. Bahl, G.D. Tuli, S Chand Publication

18BSC502					Liquid State and Ionic Equilibrium					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding on properties of liquid
- To provide the knowledge about reaction equilibrium
- To develop the knowledge on ionisation of electrolytes in solution
- To provide the knowledge about salt hydrolysis

UNIT 1 LIQUID STATE **14 Hrs.**

Physical properties of liquid; structure of the liquid state; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes and temperature on surface tension and viscosity. Structure of water.

UNIT 2 EQUILIBRIUM **14 Hrs.**

Reactions at equilibrium, significance of equilibrium constant and the composition at equilibrium. Response of equilibria to the conditions: catalyst, temperature and pressure. Reaction equilibrium in electrolyte and nonelectrolyte solutions. Standard States and Gibbs energy change for a reaction.

UNIT 3 IONIZATION **14 Hrs.**

Ionization and degree of ionization. Ionization constant and ionic product. Strong, moderate and weak electrolytes.Ionization of weak acids and bases. pH of weak acids and bases.Dissociation constants of mono-, di- and triprotic acids (exact treatment).

UNIT 4 HYDROLYSIS OF SALTS **14 Hrs.**

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. Common ion effect.Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

56 Hrs.

COURSE COUCOMES

On completion of the course, student will be able to

CO1– Understand the liquid state and it's importance in solution chemistry
CO2– Understand the solution equilibrium and its dependence on different thermodynamic parameters
CO3– Understand and learn the significance of ionisation of electrolytes and extraction of pH
CO4– Explain the process of salt hydrolysis and its application
CO5– Acquire the knowledge about buffer and its application on analytical chemistry
CO6– Develop the knowledge on the use of buffer in biological processe

TEXT/REFERENCE BOOKS

1. A Text Book of Physical Chemistry, Vol I, States of Matter and Ions in Solution, 5e, K. L. Kapoor, McGraw Hill
2. Physical Chemistry (6thEdn), (SIE), Ira N. Levine,Tata McGraw-Hill Education Pvt. Ltd., 2013; ISBN 10: 0071321217 / ISBN 13: 9780071321211
3. Physical Chemistry for the Life Sciences (2nd Edn.), Peter Atkins & Julio de Paula, Oxford University Press, 2011; ISBN 978-0-19-956428-6

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100. **Exam Duration: 3 Hrs**

Part A/Question: 5Questions from each unit, each carrying 1 mark. 20 Marks
Part B/Question: 2 Questions from each unit, each carrying 10 marks 80 Marks

18BSC 501P					Inorganic Chemistry Lab – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To apply the theoretical knowledge of Inorganic chemistry into practical application.
- To demonstrate the skill for quantitative estimation of inorganic compounds.
- To develop the skills for synthesis of pure inorganic complexes and their crystals.
- To learn good and safe laboratory practices.

LIST OF EXPERIMENTS

1. Quantitative estimation of Ni^{2+} as Ni-dimethyl glyoxime.
2. Preparation of cuprous chloride.
3. To prepare pure crystals of Tetra amine copper (II) sulphate.
4. Determination of amount of Ferrous iron in Mohr's salt by titration against standard $KMNO_4$ solution.
5. Estimation of copper in a given solution.
6. Preparation of Prussian blue from iron fillings.
7. To prepare pure crystals of chrome alum.
8. Estimation of Barium in a salt solution.
9. To determine the percentage purity of the given sample of $MgSO_4.7H_2O$ and also determine the percentage of magnesium in it by provided N/20 EDTA solution.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Apply the theoretical knowledge of Inorganic Chemistry in quantification & synthesis of inorganic compounds.

CO2– Demonstrate the skills for quantitative estimation of ions *viz.* Ni^{2+}, Cu^{2+}, Ba^{2+}, Fe^{2+} in salt or solution.

CO3– Prepare metal salts and complexes.

CO4– Learn to prepare pure crystals of inorganic compounds.

CO5– Determine the percentage purity and percentage of Mg in a given unknown sample.

CO6– Develop the aptitude for research & development in analytical and synthetic Inorganic Chemistry.

TEXT/REFERENCE BOOKS

1. Mendham, J., Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala, G. and Sivasankar, B., Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.
3. Marr, G. and Rockett, B. W., Practical Inorganic Chemistry. John Wiley & Sons 1972.

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal) 50 Marks

LE (Viva-voce plus Lab examination) 50 Marks

18BSC 502P					Organic Chemistry Lab – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To translate the theoretical knowledge of Organic Chemistry into practical application.
- To develop the skills for identifying the presence of different functional groups.
- To classify different types of organic compounds.
- To learn good and safe laboratory practices.

LIST OF EXPERIMENTS

1. Alkaline Hydrolysis tests for the presence of amides and esters.
2. Benedict's Test for the presence of aldehydes.
3. Chromic Acid tests for the presence of primary alcohols, secondary alcohols, and aldehydes.
4. 2,4-Dinitrophenylhydrazine tests for the presence of aldehydes and ketones.
5. Ferric Hydroxamate test for the presence of esters.
6. Hinsberg's test for classifying amines as primary, secondary or tertiary.
7. Iodoform test to determine the establishment of alcohol or a ketone.
8. Lucas's test for classifying alcohols as primary, secondary, or tertiary.
9. Neutralization Equivalent test for the determination of the molecular weight of your unknown and the number of carboxylic acids present in the unknown.
10. Tollen's test for the presence of aldehyde.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply the theoretical knowledge of Organic Chemistry in identifying different functional groups (aldehyde, ketone, amide, ester, alcohol etc.)

CO2 – Critically evaluate the choice of reagents and reactions for qualitative analysis of organic compounds.

CO3 – Distinguish between three types of amines by using suitable reagents.

CO4 – Classify different types of alcohols with the help of chemical reactions.

CO5 – Determine the molecular weight of an unknown carboxylic acid (by neutralization equivalent test).

CO6 – Develop the skills for studying unknown organic compounds.

TEXT/REFERENCE BOOKS

1. Mann, F.G. and 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. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).
4. Ahluwalia, V.K. and Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal) 50 Marks

LE (Viva-voce plus Lab examination) 50 Marks

18BSC503 T					Oxygen Containing Functional Groups					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To remember the definition, history, importance and modern developments in oxygen containing functional group.
- Be able to understand basic concepts like pH, pKa, Kw and chemical bonding in perspective of oxygen containing functional group and able to get clear view about origin and evolution of life.
- Students should understand the importance of oxygen containing functional group. They should learn about structure, classification, properties and role of Aldehyde, Alcohol, ethers, Ketones and carboxylic acid. They should understand the function of some important.
- To understand the structure, classification and physiological importance of various carbohydrates and should learn about Aldehyde. Alcohol, ethers, Ketones and carboxylic acid.

UNIT 1 ALCOHOLS, POLYHYDRIC ALCOHOLS AND PHENOLS

Preparation, Identification of primary, secondary and tertiary alcohols; properties of alcohols, glycols and phenols mechanism manufacture of alcohol, polyhydric alcohols. **8 Hrs.**

UNIT 2 PHENOLS

Acidic nature, electrophilic substitution reactions halogenation, nitration and sulphonation, Reimer – Tiemann reaction. **12 Hrs.**

UNIT 3 ETHERS AND EPOXIDE

Structure, nomenclature, preparation of Ethers and epoxide, physical and chemical properties of ethers, diethyl ether and crown ether, reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4. **10 Hrs.**

UNIT 4 CARBOXYLIC ACIDS AND THEIR DERIVATIVES

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typ dicarboxylic acids, hydroxyl acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comp nucleophilicsustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reform Hofmann- bromamide degradation and Curtius rearrangement. **15 Hrs.**

UNIT 5 ALDEHYDE AND KETONES **15 Hrs.**

Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones; Important reactions such addition reactions (addition of HCN, NH_3 and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen hydrogen, aldol condensation, Cannizzaro reaction, Hatoform reaction; Chemical tests to distinguish between aldehydes and Ketones.

60 Hrs.

COURSE OUTCOMES

CO1– Understand the definition, history, importance and modern developments in oxygen containing functional group.
CO2. – Analyse basic concepts like pH, pKa, Kw and chemical bonding in perspective of oxygen containing functional group and able to get clear view about origin and evolution of life
CO3– Be able understand the importance of oxygen containing functional group. They should learn about structure, classification, properties and role of Aldehyde, Alcohol, ethers, Ketones and carboxylic acid. They should understand the function of some important.
CO4– Illustrate the structure, classification and physiological importance of various carbohydrates and should learn about Aldehyde, Alcohol, ethers, Ketones and carboxylic acid.
CO5– Be able to understand the basic oxygen containing named reaction and their application.
CO6– Analyse the importance and application of oxygen containing functional groups.

TEXT/REFERENCE BOOKS

1. Morrison, R. T. & 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. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice > 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

18BSC504					Coordination Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concepts of coordination compounds and their properties.
- To relate isomerism, reactivity and stability of coordination compounds to their structure.
- To assimilate the concepts of structure and bonding in coordination compounds.
- To predict variation in properties in the coordination compounds and realize applications.

UNIT 1 INTRODUCTION TO COORDINATION CHEMISTRY 12 Hrs.

Double salts and coordination compounds, Werner's theory, more recent methods of studying complex, Effective atomic number, Shape of d-orbital, nomenclature of coordination compounds.

UNIT 2 ISOMERISM, REACTIVITY AND STABILITY 14 Hrs.

Determination of configuration of cis- and trans- isomers by chemical methods; Labile and inert complexes, substitution reaction on square planar complexes, trans effect (examples and applications); Stability constants of coordination compounds and their importance in inorganic analysis.

UNIT 3 STRUCTURE AND BONDING 14 Hrs.

VB description and its limitation; elementary crystal field theory; splitting if d^n configuration in octahedral, square planar and tetrahedral fields; Crystal field stabilization energy in weak and strong fields; pairing energy; Jahn-Tellar distortion; Metal-ligand bonding (MO concept-elementary idea), sigma- and pi- bonding in octahedral complexes (qualitative pictorial approach) and their effect on the oxidation states of transitional metals (examples).

UNIT 4 MAGNETISM AND COLOR 16 Hrs.

Orbital and spin magnetic moments, spin only moments of d^n ions and their correlation with effective magnetic moments, including orbital contribution; quenching of magnetic moments; super-exchange and anti-ferromagnetic interactions (elementary idea with examples only); d-d transitions; L-S coupling; qualitative Orgel diagrams for $3d^1$ -$3d^9$ ions and their spectroscopic ground states; selection rules for electronic spectral transitions; spectrochemical series of ligands, charge transfer complex (elementary idea).

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the basic concepts in coordination chemistry.
CO2 – Apply theories such as CFT and MOT to predict molecular structure and properties.
CO3 – Analyze spectroscopy, color and magnetism of coordination compounds.
CO4 – Elucidate the chemistry of coordination compounds and infer their relevance in industry.
CO5 – Appreciate the importance of imagination in scientific discovery.
CO6 – Appreciate the importance of coordination compounds and their uses in chemical industry.

TEXT/REFERENCE BOOKS

1. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Oxford University Press, 1999.
2. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity.
3. D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, Oxford University Press, New York.
4. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

18BSC505					Green Chemistry (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the definition, basic concepts, importance of Green Chemistry.
- To provide knowledge about the Green synthesis, properties and application.
- To develop skills for various prevention of waste, safety, green solvents, green reagents and green synthesis.
- To provide knowledge about biocatalyst, enzymatic reactions, prevention of chemical waste, electrochemical reactions, combinatorial chemistry and future of green chemistry.
- To understand the importance of various microwave technology
- To evaluate the synthesis, properties and application of Sonochemistry.

UNIT 1 INTRODUCTION TO GREEN CHEMISTRY **10 Hrs.**

History, definition, aims and sustainability, need, limitations and advantage of green chemistry, pollution, hazard/waste substance, classification of hazard, Basic principles of green chemistry and their detailed explanation with examples, designing of green synthesis, Alternate energy sources. Hazard assessment in chemical industry.

UNIT 2 **10 Hrs.**

Green synthesis: Prevention of waste, safety, green solvents, green reagents, catalysis, Green synthesis examples: Ibuprofen, adipic acid, Ammonia, Sulfuric acid and others, Ionic liquids, water as solvent, solvent less reactions, examples.

UNIT 3 **10 Hrs.**

Biocatalyst, enzymatic reactions, prevention of chemical waste, electrochemical reactions, combinatorial chemistry, AI powered synthesis, Green chemistry for sustainable development, new generation methods in green synthesis, future of green chemistry.

UNIT 4 Hours:- **10 Hrs.**

Microwave technology: Definition, principle, working mechanism, advantage and limitations, examples of synthesis, industrial prospective. Sonochemistry: Definition, principle, working mechanism, advantage and limitations, examples of synthesis, industrial prospective. **40 Hrs.**

COURSE OUTCOME

CO1– Understand the basic concepts, importance of Green Chemistry.
CO2– Enable to illustrate and appraise about the Green synthesis, properties and application.
CO3– Illustrate the importance of various prevention of waste, safety, green solvents, green en reagents and green synthesis.
CO4– Enable to know about Biocatalyst, enzymatic reactions, prevention of chemical waste, electrochemical reactions, combinatorial chemistry and future of green chemistry
CO5– Understand the importance of various importance of various Microwave technology.
CO6– Evaluate the synthesis, properties and application of various Green synthesis, properties and application.

TEXT/REFERENCE BOOKS

1. Green Chemistry: Theory and Practice. P.T. Anastas and J.C. Warner. Oxford University Press.
2. Green Chemistry: Introductory Text. M. Lancaster Royal Society of Chemistry (London)
3. Introduction to Green Chemistry. M.A. Ryan and M.Tinnesand, American Chemical Society (Washington).
4. Real world cases in Green Chemistry, M.C. Cann and M.E. Connelly. American Chemical Society (Washington).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

18BSC506				Fundamentals of Biotechnology (Elective)						
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concepts of animal and plant biotechnology
- To provide knowledge about the molecular genetics.
- To understand the importance of biotechnology and its applications
- To evaluate the role of biotechnology towards commercial applications

Unit I:- **Hours:- 10**

Introduction to Biotechnology

History of Earth, Theories of origin of life, Millers experiment, Cell Theory, Cell differentiation, Levels of organization, Nature of the earliest organisms, Evolution of Prokaryotes, Eukaryotes, Mitochondria and Chloroplast Quest for extra-terrestrial life Whittaker's five-kingdom classification.

Unit II:- **Hours:- 10**

Animal & Plant Biotechnology

Plant tissue culture techniques, in vitro pollination and fertilization, embryo culture and its applications.
Basic techniques in animal cell culture and organ culture, cell lineand isolation of cell line, culture media, contaminations and their laboratory management, cell fusion, cell differentiation and growth of cultured cells, bioreactors for large scale culture of cells.

Unit III:- **Hours:- 10**

Molecular Genetics

Isolation and Purification of DNA, Chemical synthesis of DNA and Sequencing, Recombinant DNA techniques, Types of vectors, Gene cloning, Restrictions enzymes, Introduction of DNA/Gene into living cell, PCR system and gene amplification, Blotting techniques, RFLP and DNA fingerprinting, Applications in present perspective, Human genome Project, Gene therapy, Microarrays.

Unit IV:- **Hours:- 10**

Commercial Applications of Biotechnology

Moving Science from the Laboratory into Society-Risks and Regulations -Health Care Applications -Medical Biotechnology in Society - Biotechnology in the Food Industry-Ecology and Evolution in Agriculture-Biotechnology and Sustainable Agriculture-Environmental Sustainability and Biotechnology

Total Hours:- 40

COURSE OUTCOME

CO1– Understand the basic concepts, importance of animal and plant biotechnology.
CO2– Enable to illustrate and appraise about the molecular genetics.
CO3– Illustrate the importance of Basic techniques in animal cell culture and organ culture, cell lineand isolation of cell line.
CO4– Enable to know about contaminations and their laboratory management, cell fusion, cell differentiation and growth of cultured cells
CO5– To understand the importance of biotechnology and its applications
CO6– To evaluate the role of biotechnology towards commercial applications.

Reference Books:

1. Biology and Biotechnology: Science, Applications, and Issues, Helen Kreuzer and Adrianne Massey, ASM Press, 2005.
2. The Cell: A molecular approach by Geoffrey M.Cooper.ASM Press, 2007.
3.Cowan K and KP Talaro (2009) Microbiology: A Systems Approach, (2nd Edn), McGraw-Hill

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

18BSC601					Spectroscopy & Photochemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To interpret what happens when electromagnetic radiation interacts with molecules.
- To understand how molecular spectroscopy is used as a tool for molecular structure studies.
- To determine size, shape, flexibility and electronic arrangement of a molecule.
- To estimate how light can induce a chemical reaction and apply this to real world applications.

12 Hrs.

UNIT 1 GENERAL FEATURES OF SPECTROSCOPY

Introduction to molecular spectroscopy; Emission, Absorption and Raman Spectroscopy; Intensities of transition: theoretical aspects, transition of dipole moment, stimulated and spontaneous transition, population and intensities, spectral line widths, Doppler broadening; Beer-Lambert's law.

UNIT 2 ROTATIONAL AND VIBRATIONAL SPECTROSCOPY **17 Hrs.**

Molecular rotation, classical and quantum mechanical descriptions; Rotational energy levels; Rigid rotors; Stark effect in molecular rotation, selection rules. Rotational spectra of linear molecules, determination of the bond length from rotational constants, non-rigid rotor, centrifugal distortion, degeneracies and intensities. Harmonic oscillators, classical and quantum mechanical descriptions; Potential energy and the Morse curve; Vibrational selection rules; Anharmonicity- convergence of energy level, Birge-Sponer plots. Calculation of force constants from vibrational spectrum. Vibration of polyatomic molecules, normal modes of vibration. Rotation-vibration spectra; Vibrational stretching and vibrational satellites; Selection rules and spectral branches (P,Q,R).Vibrational Raman Spectra, depolarization, and resonance. Coherent anti-Stokes Raman spectroscopy.

UNIT 3 ELECTRONIC SPECTROSCOPY **15 Hrs.**

Electronic transition; Electronic spectra of diatomic molecules; Term symbols; Selection rules; Vibrational structure in electronic spectra; Frank Condon principle; Rotational structure in electronic spectra; Polyatomic molecules; d- Metal complexes; Circular dichroism. Decay of excited states- Radiative and non-radiative decay; Fluorescence and Phosphorescence; dissociation and predissociation; Chromophores and Optical Activity.

UNIT 4 Photochemistry **12 Hrs.**

Laws of photochemistry; Jablosnski diagram; Photochemical processes- dissociation, ionization, isomerization, intramolecular rearrangements and photosensitized reactions. A few photochemical reactions-vision, photosynthesis, synthesis of vitamin-D; Introduction to photodynamic therapy.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Interpret Microwave, IR and UV-Vis Spectra

CO2– Apply vibrational, rotational spectroscopy in molecular structure determination

CO3– Understand application of electronic spectroscopy in molecular structure determination

CO4– Elucidate chemistry of photochemical reactions such as synthesis of Vitamin D

CO5– Conceptualize interaction of light with rhodopsin

CO6– Appreciate the importance of learning basics of several spectral techniques

TEXT/REFERENCE BOOKS

1. Peter Atkins, Julio de Paula, Physical Chemistry - Thermodynamics, Structure, and Change, 2014
2. C. N.Banwell, E. M.McCash; Fundamentals of Molecular Spectroscopy,5th ed., Tata McGraw Hill.
3. Principles of Instrumental Analysis, Douglas A. Skoog, Donald M.West, 6th Edition, Cengage, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks

18BSC601P					Physical Chemistry Lab – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- To understand the working principle of pH meter, conductivity meter and potentiometer
- To learn titrimetric method for chemical analysis
- To learn the basic concepts of buffer solution and pKa
- To understand the basic concepts adsorption and chemical kinetics.
- To know the significance of analytical chemistry in qualitative and quantitative analysis

LIST OF EXPERIMENTS

1. Determine experimentally the partition coefficient of I_2 in CCl_4 and water.
2. Determine solubility of benzoic acid at different temperatures and calculate ΔH of dissolution.
3. To determine the composition of mixture of acids by Conductometrically.
4. Determination of pKa values of orthophosphoric acid using pH meter.
5. Determination of rate constant of decomposition of Hydrogen peroxide by acidified potassium iodide.
6. Investigation of the reaction between Acetone and Iodine.
7. Volumetric analysis of given sample of brass alloy.
8. To estimate amount of ferrous ion present in the solution by $K_2Cr_20_7$.
9. Determination of pH of a buffer solution by colour matching of indicator.
10. Determination of the concentration of Iodide, Bromide and chloride in the mixture by potentiometric titration with $AgNO_3$.
11. Potentiometric titration of a standard solution of KCl against $AgNO_3$ solution.
12. To study the adsorption of acetic acid on charcoal and to verify Freundlich isotherm.
13. Study of chemical kinetics of Methyl acetate ester (acid) hydrolysis.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the use of different instrumental techniques such as pH, conductivity & potentiometers.
CO2– Interpret the results obtained from the instrumental techniques.
CO3– Conceptualize the analytical methods for chemical applications.
CO4– Analyse the interaction of materials present in ionic medium.
CO5– Analyse and demonstrate the applications of analytical tools in chemical industry.
CO6– Elucidate the ionic behaviour of different solutions with the knowledge of physico-analytical methods.

TEXT/REFERENCE BOOKS

1. Practicals in Physical Chemistry, P S Sindhu, Macmillan, 2005.
2. Experiments in Physical Chemistry 2nd Edition, J. M. Wilson, R. J. Newcombe, A. R. Denaro, Pergamon Press.

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal) 50 Marks
LE (Viva-voce plus Lab examination) 50 Marks

18BSC602					Heterocyclic and Stereo chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the definition, basic concepts, importance of stereo chemistry.
- To provide knowledge about the structure, classification, nomenclature and designating the chiral compounds.
- To develop skills for various isomerism and stereo selective, specific synthesis and its application in organic chemistry.
- To provide knowledge about hetero cyclic compounds, properties, design and chemical reactions.
- To evaluate the synthesis, properties and application of various industrial heterocyclic compound.

UNIT 1 STEREO CHEMISTRY-I **10 Hrs.**

Introduction to the concepts of stereo chemistry, importance and history and applications. Configurations and conformations, Conformational isomerism: conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds,Fischer Projection, Newman projection and Sawhorse formulae and its interconversion. Difference between configuration and conformation. Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

UNIT 2 STEREO CHEMISTRY-II **10 Hrs.**

Optical isomerism: concepts, optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centers, Distereoisomers, Relative and absolute configuration: D/L and R/S designations. Threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention, and racemization. Stereo selective and stereo specific synthesis. Enantiomeric and diastereomeric excess: definition, determination, and control. Examples of selected stereo chemical named reactions and mechanisms.

UNIT 3 HETEROCYCLIC CHEMISTRY-I **10 Hrs.**

Introduction to hetero cyclic compounds, structural features, and stability, nomenclature, basicity, Hückel's rule, aromaticity of hetero cyclic compounds. Preparation, properties and chemical reactions of 3, 4 membered heterocyclic compounds (Aziridines, Epoxides, Azetidine, oxetanes).

UNIT 4 HETEROCYCLIC CHEMISTRY-II **10 Hrs.**

Preparation, properties and chemical reactions of five membered hetero cyclic compounds (Pyrrole, Furan, Thiophenes). Preparation, properties and chemical reactions of six membered hetero cyclic compounds (Pyridines, Pyrylium salt), Introduction to fused, other heterocyclics: nomenclature, types, reactions and properties of selected heterocyclics (Indoles, benzofurans, pyrazines, quinolines)

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the basic concepts, and importance of stereo chemistry.
CO2– Enable to illustrate and appraise about the structure, classification, nomenclature and designating the chiral compounds.
CO3– Illustrate the importance of various isomerism and stereoselective, specific synthesis and its application in organic chemistry.
CO4– Enable to know about heterocyclic compounds, properties, design and chemical reactions.
CO5– Understand the importance of various heterocyclic compounds and able to design or understand site-specific synthesis.
CO6– Evaluate the synthesis, properties, and application of various industrial heterocyclic compounds.

TEXT/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 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
4. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.
5. Bahl, A. (2005). A text book of organic chemistry. S. Chand.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

18BSC602P					Organic Chemistry Lab -II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week				Practical		Total Marks
								LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- Concern about safety precautions in laboratory while handling glassware, equipment, and chemical.
- Comprehend the scientific methodology for need and importance of chemistry in pharmaceutical industry.
- Understand the theoretical back ground of each practical.
- Realize the principle of chromatography, separation and purification techniques.
- Ability to characterize the synthesized organic molecule by melting point, IR and UV.

LIST OF EXPERIMENTS

1. Detection of Functional Groups or Class Determination (eight different functional groups) (4 slot)
2. Qualitative single detection of some common organic compounds by chemical methods (10 different) (4 slot)
3. Thin layer chromatography of plant pigments (spinach extraction and identification of component mixture by TLC) (1 slot)
4. Separation, purification and identification (by m.p, IR and UV) of the components of a binary mixture (2 slot)
5. Organic synthesis/derivative and identification by spectroscopy technique (2 slot)

COURSE OUTCOMES

On completion of the course, students will be able to

CO1– Summarize in findings the writing in a clear and concise manner.

CO2– Able to identify the several functional groups through chemical test reaction.

CO3– Capable to predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.

CO4– Knowledge to carry out work up and separation procedures.

CO5– Critically evaluate data collected to determine the identity, purity, and yield of products.

CO6– Assess scientific method to create, tests, and evaluate a hypothesis.

TEXT/REFERENCE BOOKS

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. 1. A. I. Vogel, A text book of quantitative Inorganic Analysis, ELBS.
3. 2. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007. Vogel's Text Book of Practical Organic Chemistry (5th Edn).
4. Finar, I. L. Organic Chemistry (volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Nutritionand Cancer, 46(2), 222–231

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal write up maintain each 25 marks) 50 Marks

LE (Viva-voce plus Lab examination each 25 marks) 50 Marks

18BSC603T					Electrochemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the knowledge about fundamentals of electrolytic conduction.
- To provide the concept of how conductance measurements can be used to measure parameters such as solubility product, ionic product, dissociation constants. Etc.
- To understand conceptally the different theories/models of electrolytic conductance.
- To provide the knowledge about the electrode potential and electrode kinetics.
- To understand the application of the above in electrochemical energy devices.

UNIT 1 ELECTROLYTIC CONDUCTION-I **14 Hrs.**

Electrolytic conduction: Arrhenius theory of electrolytic dissociation; Ion conductance; conductance and measurement of conductance, cell constant, specific, molar and equivalent conductance; variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and determination for strong and weak electrolytes; Application of conductance measurements (degree of dissociation and dissociation constants of weak electrolytes, determination of solubility product, ionic product of water; conductometric titrations-acid base titration and precipitation titrations.

UNIT 2 ELECTROLYTIC CONDUCTION-II **14Hrs.**

Migration of ions: Transference number; Principle and experimental determination of transport number by Hittorf's and moving boundary methods; transference number and ionic mobility; Debye-Huckel theory of Ion atmosphere (qualitative)-Walden rule, asymmetric effect and electrophoretic effect; Wien effect, Debye-Falkenhagen effect; activities in electrolytic solutions, ionic strength; Debye-Huckel theory of dilute solutions and of concentrated solution.

UNIT 3 ELECTRODE POTENTIAL AND ELECTRODE KINETICS **14Hrs.**

Reversible and irreversible cells; measurements of EMF of cells, Electrode potential Nernst equation; applications of Nernst equation in estimating thermodynamic properties, spontaneity of cell reaction; Electrochemical series – Latimer and Frost diagrams, Types of single electrodes; EMF and electrode potentials, Liquid Junction Potentials and concentration cells; some applications of EMF measurements, Significance of Overpotential— Activation, Ohmic and diffusion overpotentials, Hydrogen evolution reaction.

UNIT 4 ELECTROCHEMICAL ENERGY SYSTEMS AND INTERFACES **14Hrs.**

Energy storage devices – batteries and fuel cells, Electrochemical Supercapacitors, electrical double layer –Lippmann equation and modern electrical double layer theory, Adsorption of ions and dipoles.

56 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1– Apply knowledge of electrolytic conductance to quantify/measure equivalent conductance.

CO2– Translate theoretical knowledge to measure chemical parameters such as solubility product, ionic product and dissociation constants.

CO3– Apply theoretical knowledge to quantify the migration of ions in electrolytes.

CO4– Calculate thermodynamic parameters such as enthalpy, entropy etc. from electrode potential values.

CO5– Set up experiments to apply EMF measurements for determining activity coefficient, conduct potentiometric titration and, understand complexation processes.

CO6– Conceptualize the role of electrode potential and electrode kinetics in energy storage devices.

TEXT/REFERENCE BOOKS

1. Rakshit, P.C., Physical Chemistry, Sarat Book House.
2. Atkins, P. W. and Paula J de Atkins, Physical chemistry, Oxford University Press.
3. Castellan, G. W. Physical Chemistry, Narosa.
4. Maron, S. and Prutton, Physical Chemistry.
5. Glasstone, S. and Lewis, G. N. Elements of Physical Chemistry.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks

Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

18BSC604					Group Chemistry and Organometallic Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand the concept of hybridization, bonding interaction of various group compounds
- Knowledge on the different group compound and their importance in our real life
- Appraise the concept, terms, and important events in the development of organometallic Chemistry
- Analyze spectroscopic data to elucidate structure and reaction mechanism of organometallic compounds
- Appreciation for the scope, diversity, and application of organometallic chemistry

UNIT 1 GROUP CHEMISTRY **14 Hrs.**

Group-I & II: Hydrogen, main group elements and their compounds like oxide, peroxide, superoxide, carbonates, hydroxide, coordination chemistry of s-block elements, bonding in metals. Group-III: borane, carborane, borazine, boron nitride, halides, boric acid, borax, aluminium chloride, synthesis, structure bonding, properties and uses, industrial importance of the these compounds. Group-IV: allotropy of carbon and their conductivity, catenation and condition for catenation, different type of silicones: synthesis and properties, Freons and depletion of ozone layer by Freon, synthesis of hydrides, carbides synthesis and reactivity.

UNIT 2 GROUP CHEMISTRY **18 Hrs.**

Group-V: Synthesis and reactivity of hydrides, halides of this group, nylon-6, nylon-66, phophazenes: preparation, properties, structure and bonding, different oxides of nitrogen, acid strength of different phosphorous acid. Group-VI: reactivity and properties of the different compounds belong in this group, different kind of silicate structure, variety of sulphur acid, acid rain, tetrasulphurtetranitride, polythiazyl preparation structure and properties. Group-VII: Interhalogen compounds, hepervalent iodine compounds and their reactivity etc. Group-VIII: noble gases elements and their compounds occurrence, synthesis, properties, structure and bonding, clatharates, industrial application of the noble gas.

UNIT 3 ORGANOMETALLIC CHEMISTRY **12 Hrs.**

Different types of organometallic compounds, classification of ligands and their uses, 18 electron rule and its application, effective atomic number, metal carbonyl compounds: discrete, dimeric, trimeric, tetrameric, reactivity, synthesis, properties.

UNIT 4 ORGANOMETALLIC CHEMISTRY **12 Hrs.**

Ferrocene: synthesis, properties, reaction and application; Reaction: oxidative addition, reductive elimination, Insertion, reaction, several example in each case and their explanation.

56 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1– Capability of understand the fundamental principles on how the properties are dictated by ligand and metal ions

CO2– Able to predict geometries of simple molecules

CO3– Apply basic concept of organometallic chemistry for synthesize new organometallic compound in facile manner

CO4– Analysis and characterize the organometallic compound data by using modern instrumental methods CO5–

Estimate reaction types and mechanism and imply these two to comprehend the catalytic process

CO6– Evaluate the efficacy of homogeneous organometallic catalysis in the production of smaller-scale (fine chemicals) and large-scale desired product

TEXT/REFERENCE BOOKS

1. Greenwood, N.N & Earnshaw, A. Chemistry of the Elements
2. Lee, J.D. Concise Inorganic Chemistry
3. Sarkar, R. General and Inorganic Chemistry Part-II
4. Crabtree, H. R. The Organometallic Chemistry of the Transition Metals

END-SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks

Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

18BSC605E					Petroleum Chemistry (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concepts of hydrocarbon chemistry.
- To learn the importance of crude oil and natural gas.
- To learn the basic concepts of physico-chemical properties of crude oil.
- To understand the basic concepts of different methods of crude oil characterization.

UNIT 1 INTRODICTION **08 Hrs.**

Introduction –Origin of crude oil, basic building blocks, Major petrochemical processes & catalysts, Overview of refining process, Properties and General Characteristics of Hydrocarbon, Composition, Molecular types in Petroleum.

UNIT 2 CHARACTERIZATION **12 Hrs.**

Characterization and Analytical Techniques for Crude Oil: Physical properties, Thermal properties, Electrical properties, Optical properties, Chromatographic techniques, Spectroscopic methods (Principles and Applications of UV Visible, IR, and NMR Spectroscopy), Characterization of formation water. SARA Separation methods, Metals and Heteroatoms in Heavy crude oil.

UNIT 3 PHYSICAL PROCESSES **10 Hrs.**

Processing and Refining of crude oil: Physical Processes Desalting/dehydration, Crude distillation, Propane deasphalting, Solvent extraction and dewaxing, Blending.

UNIT 4 CATALYTIC PROCESSES **10 Hrs.**

Fluidized Catalytic Cracking (FCC), Hydrocracking, Reforming, Alkylation Polymerization processes, Solvent process, Knocking, Octane number and Cetane number, Additives to improve the quality of Diesel and Petrol, Catalysis and Applications of Catalysts (like Zeolite and other catalysts) in separation processes and also in petroleum industries Treatment of refinery gases.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand hydrocarbon chemistry.

CO2– Interpret physico-chemical properties of crude oil.

CO3– Conceptualize the basic need of petroleum refining.

CO4– Analyse the physico-chemical properties of crude oil fractions.

CO6– Elucidate the industrial application of petroleum refining with the help of knowledge of characterization techniques.

TEXT/REFERENCE BOOKS

1. The Chemistry and Technology of Petroleum, J.G. Speight, 2014 CRC Press.
2. Hydrocarbon Chemistry, George A. Olah& Arpad Molnar, Wiley-Interscience, 2nd Edition May 2008.
3. Handbook of Petroleum Product Analysis, J.G. Speight, , 2nd Edition 2015.
4. The Properties of Petroleum Fluids, William D. McCain Penn Well Publication, 3rd Edition 2017.

END-SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks

Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

18BSC606E					Chemistry of Paints and Dyes (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Students should able to understand the definition, basic concepts, importance, chemistry of dyes and paints.
- Students should understand the structure, classification, nomenclature of dyes.
- Students should understand various aspects, theories involved in designing of suitable dyes and paints.

Unit I:- **Hours:- 10**

Dyes and Pigments-II

Introduction, nomenclature and classification of synthetic dyes. History of dyes and natural pigments. Colour and constitution - chromospheres and auxochromes with suitable examples. Bathochromic and hypsochromic effects. Colour, the relation between colour and chemical constitution: Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory. Classification of dyes based on chemical constitution and method of applications and examples.

Unit II:- **Hours:- 10**

Dyes and Pigments-II

Introduction to pigments, history, natural pigments, extraction. Synthesis properties and applications of Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane
Dyes - Malachite Green, Rosaniline and Crystal Violet; Phthalein
Natural dyes: haemoglobin, chlorophyll, bilirubin.

Unit III:- **Hours:- 10**

Dyes and Paints-III

Fluorescent Dyes – the concept of fluorescence and phosphorescence. Interaction of organic molecules with electromagnetic radiation. Energy diagram. Activation and deactivation of organic molecules by light. Synthesis, properties and application of Phenolphthalein and Fluorescein. Introduction to paints, surface coating compounds. 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).

Unit IV:- **Hours:- 10**

Dyes and paints-IV

Introduction to laser dyes. Synthesis of Oligophenylenes. Oxazoles and benzoxazoles. Stilbenoid compounds, Coumarin laser dyes, Rhodamine laser dyes. Analytical tools to evaluate characterise dyes and paints. Quality control parameters. Application of dyes and paints in various industries. Formulation of paints.

Total Hours:- 40

Reference Books:

1. The Chemistry of Synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
2. Dyes and their intermediates by E. N. Abrahart.
3. Handbook of Synthetic Dyes and Pigments, Vol. I & II by K. M. Shah.
4. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH

END-SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

18BSC608E					Chemistry of Cosmetics and Perfumes (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concepts of perfumes and perfume chemistry.
- To learn the basics of cosmetics, cosmeceuticals and insight into hair-care products.
- To learn the basic concepts skin care cosmetics.
  To understand the basic concepts involving the characterization techniques used for cosmetics and perfumes

UNIT 1 PERFUMES **10 Hrs.**

Introduction to perfumes, history, classification of perfumes, the concept of aroma, types and physiological effects. Composition, formulation and working mechanism of perfume. Antiperspirants and deodorants: definition, working mechanism, composition, formulation chemistry and comparison. Introduction to perfumery chemicals: Natural sources, natural identical and synthetic compounds. Extraction methods of perfumery chemicals. Examples of some important perfumery chemicals (synthesis, properties and chemistry)

UNIT 2 CHEMISTRY OF COSMETICS-I **10 Hrs.**

Introduction to cosmetics: Definition, history and application. Cosmetology, Introduction to cosmeceuticals. Anatomy of skin and hair with respective to cosmetology. Classification of cosmetics. Physiological effects of cosmetics. Cosmeceuticals: definition, classification, chemicals, mechanism of action. Induction to oral care products. Examples chemistry of materials used in skin, nail care productsand their function. Chemistry of materials used in cosmeceuticals.

UNIT 3 CHEMISTRY OF COSMETICS-II **10 Hrs.**

Introduction to skin care cosmetics: classification, chemicals, properties, physiological effects. Study chemistry of some skin care products (creams, foundation, primer, lotions). Chemistry of nail polish and paints. Hair care products: Properties, classification, working mechanism, formulation, safety and chemistry of hair care products (shampoo, conditioner, gels, colouring agents etc.)

UNIT 4 CATALYTIC PROCESSES **10 Hrs.**

Introduction to herbal cosmetics. Characterisation of cosmetics and perfumes (Chromatography, physical methods, spectroscopy). Safety and testing of cosmetics and perfumes. Regulatory and quality control of cosmetics. Modern developments in cosmetic chemistry. Cosmetic surgery and related studies

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Understanding the basics of perfumes and perfume industry.
CO2– Insight into the cosmetics and hair and nail care products.
CO3– Understanding the cosmetics for the skin care products.
CO4– Providing a deep insight into the chemistry of perfumery chemicals
CO5- Attaining a deep insight into the chemistry of cosmeceuticals
CO6– Providing a better knowledge of the characterization techniques for perfumes and cosmetics.

TEXT/REFERENCE BOOKS

5. Hilda Butler (editor), Poucher's Perfumes, Cosmetics, and Soaps 10th edition, Dordrecht: Kluwer Academic Publishers © 2010.
6. "Chemistry and Technology of the Cosmetics and Toiletries Industries", by D.F. Williams, Springer International Edition.
7. Anthony J. O'Lenick Jr.; Thomas G. O'Lenick, Organic chemistry for cosmetic chemists, Carol Stream, IL: Allured Publishing, © 2008
8. Beginning Cosmetic Chemistry by Schueller and Romanowsk, Allured Pub Corp; 3rd edition, 20089
9. Barel AO, Paye M, Maibach HI. Handbook of cosmetic science and technology. CRC Press; 2014

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

19BSC609E					Introduction to Fuel Cell Science and Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding on hydrogen as fuel.
- To provide the basic knowledge on electrochemistry, performance and efficiency in fuel cell.
- To provide the knowledge on different kinds on fuel cell operated at low temperature and the effect of different parameters on performance of the fuel cell.
- To provide the knowledge on different kinds on fuel cell operated at high temperature and the effect of different. parameters on performance of the fuel cell.

UNIT 1 **10 Hrs.**

Introduction of hydrogen energy systems, Properties of hydrogen as fuel, current uses of hydrogen, general introduction to infrastructure requirement for hydrogen production, storage, dispensing and utilization, and hydrogen production plants.

UNIT 2 **10 Hrs.**

Definition, History of fuel cell, Basic working principle, thermodynamics and kinetics of fuel cell process, Electrochemistry and performance evaluation of fuel cell, comparison with battery, Types and Applications of Fuel Cell Systems, Efficiency and Open Circuit Voltages, Fuel reformation.

UNIT 3 **10 Hrs.**

Alkaline Fuel Cells, PEM Fuel Cells, Direct Methanol Fuel Cell, Phosphoric Acid Fuel Cell: State-of-the-Art Components, Materials, Performance, Effect of pressure, temperature, impurities, current densities and cell life on performance.

UNIT 4 **10 Hrs.**

High Temperature Fuel Cells (MCFC and SOFC), Microbial fuel cell, and other fuel cells: State-of-the-Art Components, Materials, Performance, Effect of pressure, temperature, impurities, current densities and cell life on performance.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand hydrogen as a fuel and its use in fuel cell technology.

CO2– Acquire knowledge about different kind of fuel cells and their performance.

CO3– Understand and learn the working principles of low temperature operated fuel cells.

CO4– Explain the process for the manufacturing of low temperature operated fuel cells.

CO5– Understand and learn the working principles of high temperature operated fuel cells CO6 – Explain the process for the manufacturing of high temperature operated fuel cell.

TEXT BOOK

Fuel Cell Handbook, (Seventh Edition), By EG&G Technical Services, Inc. U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory, Morgantown, West Virginia, USA.

TEXT/REFERENCE BOOKS

1. Fuel Cell Systems Explained, J. Larminie and A. Dicks (John Wiley & Sons, 2003, USA)
2. Fuel Cell Fundamentals, R. O'Hayre, S-W. Cha, W. Colella, F. B. Prinz (John Wiley and Sons, 2005, USA)
3. Fuel Cell Engines, M. M. Mench (John Wiley and Sons, 2008, USA)
4. Fuel Cells: Principles and Applications, B. Viswanathan and M. A. Scibioh (Universities Press, 2006, India)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100. **Exam Duration: 3 Hrs**

Part A/Question: 5 Questions from each unit, each carrying 1 mark. 20 Marks

Part B/Question: 2 Questions from each unit, each carrying 10 marks 80 Marks

19BSC701					Nanochemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop the fundamental understanding about nano materials.
- To provide the knowledge about the strategies for the synthesis of nano materials.
- To develop the skills for phase, micro structural and elemental characterisation of nano materials
- To provide the knowledge about the applications of nano materials.

UNIT 1 INTRODUCTION TO NANO CHEMISTRY **14 Hrs.**

Nano chemistry, nano materials and nanotechnology, Introduction to surface area to volume ratio and aspect ratio. Quantum confinement. Classification of nano materials in accordance to dimension (0, 1, 2, 3D), Examples, and properties and use of carbonaceous (e.g. carbon nano tubes (CNT), graphenes, fullerenes), metallic, ceramic (oxide/ non oxide), polymer, bio, composite nano materials.

UNIT 2 STRATEGIES FOR THE SYNTHESIS OF NANOMATERIALS **14 Hrs.**

Topdown and bottom up chemical/ physical approaches for the synthesis of nanomaterials, coprecipitation, autocombustion, sol-gel synthesis, microemulsions synthesis, hydrothermal, solvothermal, self assembly, metal nanocrystals by reduction methods, nano- structure formation using template method. Physical processes for preparation of nanomaterials,chemical vapour deposition (CVD), molecular beam epitaxy (MBE), plasma arc technique, laser ablation, lithography,biological methods of synthesis, processing of nanomaterials through compaction, thin film (dip coating, spin coating, Langmuir blodget film), thick film (casting, doctor blading, electrochemical deposition) technique.

UNIT 3 CHARACTERISATION OF NANOMATERIALS **14 Hrs.**

Characterization of nanomaterials using X-ray diffraction (XRD), electron microscopes (SEM, TEM), elemental mapping (EDAX), atomic force microscope (AFM), scanning tunneling microscope (STM), surface profilometer, Thermal Analysis (TGA-DTA-DSC), N2 adsorption desorption isotherm, X-ray photoelectron spectroscopy (XPS), FTIR, UV-vis spectrometer.

UNIT 4 APPLICATIONS OF NANOMATERIALS **14 Hrs.**

Nanomaterials for photo-voltaic (solar cell) application, Nanomaterials for alternative source and storage of energy (supercapacitor, fuel cell, battery), nanomaterials for water purification application, nanomaterials for toxic and hazardous chemical sensing, nanomaterials for biomedical application, nanomaterials for mechanical and lubrication applications.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the nanomaterials and their importance as compared to bulk materials.
CO2 – Acquire knowledge about different nanomaterials and their dimensional impact over properties.
CO3 – Understand and learn the strategies for the synthesis of nanomaterials.
CO4 – Explain the process for the fabrication of devices using nanomaterials.
CO5 – Develop the skill for phase, microstructural and elemental characterisation of nanomaterials.
CO6 – Develop the knowledge on the use of nanomaterials for different applications.

TEXT/REFERENCE BOOKS

1. Text book of Nanoscience and Nanotechnology, T. Pradeep, Mc. Graw Hill Education (2003).
2. Textbook of Nanoscience and Nanotechnology, Murty, Shankar, B Raj, Rath, Murday, Springer (2013).
3. Chemistry of nanomaterial : Synthesis, properties&applications by CNR Rao et.al. John Wiley & Sons (2004).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks 36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks 64 Marks

19BSC702					Advance Spectroscopy					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- 1 To understand advanced spectroscopy as a tool for molecular structure determination
- 2 Acquiring basic principles applied for mass spectrometry measurements.
- 3 To estimate how chemical reactions like fragmentation in mass assist in spectral analysis
- 4 Learning the fundamental principal of photoelectron spectroscopy
- 5 Acquiring the knowledge of basic theory of nuclear magnetic resonance spectroscopy and able to interpret basic NMR spectra
- 6 To be acquainted with electron spin spectroscopy as a spectroscopic tool for structure elucidation.

UNIT 1 Mass spectrometry **16 Hrs.**

Some Fundamentals of Mass Spectrometry

Introduction of mass spectrometry- The Mass Spectrometer, The Mass Spectrum- Ion Fragments, The Base Peak, The Molecular or Parent Ion (M+), The (M + 1)+ Ion , Isotopic Fragments , High-Resolution Mass Spectrometry; Depicting Mass Spectral Data; The Molecular or Parent Ion; Predicting the Formation of M+; The Nitrogen Rule ; Metastable Ions; Doubly Charged Ions; The General Fragmentation Process; The Fragmentation of a Hypothetical Molecule; Identifying the Molecular Ion; Chemical Ionization; The Fragmentation of M+; Determining the Molecular Ion from the Fragments; General Rearrangement; Skeletal Rearrangement; The McLafferty Rearrangement; The Loss of Neutral Fragments; Atomic Weight Determinations; The Isotopes of Carbon; Calculating Relative Intensities; The Experimental Determination of the Carbon Number; Compounds Containing Bromine and/or Chlorine; Compounds Containing Sulfur, The Analysis of Mass Spectra: The Fragmentation Patterns of- Straight-Chain Alkanes, Branched Alkanes, Cycloalkanes, Unsaturated Hydrocarbons, Alkyl Halides, Phenyl Halides, Benzyl Halides, Alcohols and Phenols, Problems in Mass Spectrometry: Introduction: Some General Suggestions for Interpreting Mass Spectra

UNIT 2 Photoelectron spectroscopy **12 Hrs.**

Photoelectron spectroscopy-Introduction: The photoelectric effect, Origin of X-ray spectra, Energy levels in atom, electron binding (ionization) energy, UV photoelectron spectroscopy, X-ray photoelectron spectroscopy: Chemical shifts in XPS, Chemical shifts and oxidation states, Analytical applications of XPS, Auger electron spectroscopy: Auger process, mechanism of emission of an Auger electron, Auger Transitions: ionization, relaxation and emission, nomenclature for Auger transitions: ABB transitions, AAB transitions, Coster-Kronig transitions, Examples of Auger Processes, Kinetic Energies of Auger Electrons.

UNIT 3 Proton Nuclear magnetic resonance spectroscopy **16 Hrs.**

Introduction, Theory: Nuclear spin quantum number, properties of the nuclei, Magnetic moment of a nucleus, Fundamental NMR equation, Larmor precession, spin-spin and spin lattice relaxations, Instrumentation, Sample Handling, Shielding, Deshielding and Chemical Shift, Standard for proton NMR, Tetramethylsilane (TMS) as reference compound, Advantages of TMS as a reference compound, Measurement of Chemical Shift: NMR Scale, δ(or ppm) and τ scale, Factors Affecting chemical Shift: Electronegativity-inductive effect, Anisotropic effects, Hydrogen bonding, van der Waals deshielding Number of PMR Signals: Equivalent and Non-equivalent Protons, Peak Area and Proton counting, Spin-Spin Splitting: Spin-Spin coupling, Multiplicity-Number of Component Peaks (Lines) in Multiplet, Relative Intensities of Component Peaks (Lines) of a Multiplet, Analysis (Interpretation) of NMR Spectra, Applications of PMR Spectroscopy.

UNIT 4 Electron paramagnetic resonance (EPR) spectroscopy **12 Hrs.**

Introduction, Theory, ESR Absorption Positions: The g Factor, Instrumentation, Working of an ESR Spectrometer, Sample Handling, Sensitivity of an ESR Spectrometer, Multiplet Structures in ESR Spectroscopy, Interpretation of ESR Spectra, Double Resonance (or Double Irradiation) in ESR, Spectroscopy, Applications of ESR Spectroscopy, Comparison Between NMR and ESR Spectroscopy.

COURSE OUTCOMES **Max. 56 Hrs**

On completion of the course, student will be able to

CO1- Estimate molecular weight by using mass spectra and able to understand various mass spectrometric parameters

CO2- understand and differentiate between XPS, UPS and Auger spectroscopy and can demonstrate their practical application

CO3- Interpret the basic H^1NMR spectra, differentiate equivalent and non-equivalent protons and identify the splitting of NMR peak by analysing the chemical formulae.

CO4- Elucidate chemistry of fragmentation reactions in mass spectroscopy

CO5- Conceptualize the role of electron, proton and atomic mass, in magnetic resonance spectroscopy, photoelectron spectroscopy and mass spectrometry

CO6- differentiate between ESR and NMR spectroscopy

TEXT/REFERENCE BOOKS

1. Donald L. Pavia, Gary M. Lampman, George S. Kriz, Introduction to Spectroscopy
2. Yadav, L. D. S. (2013). *Organic spectroscopy*. Springer Science & Business Media.
3. C. N. Banwell, E. M. McCash, Fundamentals of molecular spectroscopy
4. Peter Atkins, Julio de Paula, Physical Chemistry
5. William Kemp, Organic Spectroscopy
6. D. A. Skoog, D. M. West, Principles of Instrumental Analysis

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 3 Questions from each unit, each carrying 3 marks	36 marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 marks

19BSC703					Reagents & Name Reaction					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To remember and understand the basic named reaction.
- To Know and appraise modern named reaction.
- To understand the importance of basic named reaction their synthesis, mechanism and application.
- To understand the intra and intermolecular rearrangements.
- To able to know synthesis and apply different types of reagents.
- To evaluate current industrial reagents over regular reagents.

UNIT 1 NAME REACTIONS OF CARBONYL COMPOUNDS **15Hrs.**

Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Ponndorf-Verley reduction, Aldol condensation, Perkin reaction, Benzoin condensation, Benzil-Benzilic acid rearrangement, Mannich reaction, Michael addition, Darzens glycidic ester synthesis, Wittig reaction, Reformatsky, Baeyer-Villiger oxidation, Claisen condensation, Stobbe condensation, Dickmann condensation, Knoevenagel, Pinacol, Favorskii, Dienone-phenol rearrangement, Beckmann rearrangement, Wolff, Hofmann, Curtius, Schmidt, Lossen, Fries.

UNIT 2 NAME REACTIONS **13 Hrs.**

Claisen rearrangement, Cope rearrangement, Chugaev reaction, Demjanov rearrangement, Wagner-Meerwein rearrangement, Reimer-Tiemann reaction, Jones oxidation, Swern oxidation, Birch reduction, Vilsmayer-Haack reaction, Grignard reaction, Friedel-Crafts, Diels-Alder reaction, Mitsunobu reaction, Suzuki reaction, Buchwald Hartwing reaction, Sonogashira coupling.

UNIT3 REARRANGEMENTS **13 Hrs.**

General mechanistic considerations, nature of migration, migratory aptitude, and memory effects in respect of following. (1) Carbon to Carbon migration of R, H and Ar (i) Pinacol- Pinacolone rearrangement (ii) Favorskii rearrangement (2) Carbon to Nitrogen migrations: (i) Curtius rearrangement (ii) Schmidt rearrangement (3) Carbon to oxygen migration of and Ar (i) Baeyer- Villiger rearrangement (ii) Rearrangement of hydroperoxide.

UNIT 4 REAGENTS **15 Hrs.**

Oxidizing & Reducing agents, organometallic reagents, ylides of sulfur, phosphorous and nitrogen, Tebbe's reagent. complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium diisopropylamide (LDA), dicyclohexylcarbodiimide, 1,3-dithiane (reactivity Umpoloung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, Phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker's Yeast.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will

CO1– Understand the basic named reaction and their synthesis, mechanism and application.

CO2– Enable to illustrate and appraise modern named reaction.

CO3– Illustrate the importance of named reaction their synthesis, mechanism and application.

CO4– Enable to classify the intra and intermolecular rearrangements.

CO5– Understand the synthesis and application of different types of reagents.

CO6– Evaluate current industrial reagents over regular reagents.

TEXT/REFERENCE BOOKS

1. J. March, Advanced Organic Chemistry: Reactions Mechanism and Structure, 4th Ed., John-Wiley and Sons, 1999.
2. J. Wade and S Singh, Organic Chemistry, 6th Ed, Pearson Edu. (LPE), 2006.
3. Clayden, Greeves, Warren and Wothers, Organic Chemistry; Oxford, 2001.
4. J. M. Coxan, Principles of Organic Synthesis, 3rd Ed. Thomson Science, 1998.
5. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd ed., 1995.
6. Ernest L. Eliel, Stereochemistry of Organic Compounds

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 10 marks 80 Marks

19BSC701P					Organic chemistry lab-III				
Teaching Scheme					Examination Scheme				
L	T	P	C	Hrs/Week	Theory	Tutorial	Term Work	Practical/Viva	Total Marks
0	0	2	1	2			50	50	100

COURSE OBJECTIVES

- To translate the theoretical knowledge of Organic Chemistry into practical application.
- To develop the skills for separation techniques
- To prepare different types of organic compounds in the form of simple drugs
- To learn good and safe laboratory practices.

LIST OF EXPERIMENTS

1. Introduction to the laboratory techniques: Fractional distillation (conventional and using rotary evaporator), Recrystallization, Drying of organic solvents
2. Chromatography: Thin layer chromatography, Column chromatography
3. Determination of melting point using visual melting point apparatus
4. Estimation of functional groups: Alcohol, carbonyl, Amide, Sugar and Amino acids
5. Simple organic preparations and Name reactions: Aldol condensation, Sandmeyer reaction, Cannizzaro reaction, Aromatic, Perkin's reaction, Knoevenagel condensation, Nitration, Coupling reactions etc.
6. Synthesis of Dyes: Azo dyes, Triphenylamine dyes, Fluorescein, eosin etc.
7. Synthesis of simple drugs: Paracitamol, Aspirin, Sulphanilamide etc.
8. Introduction to GLP and safety: Basics of Good laboratory practices and safety concepts.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Apply the theoretical knowledge of separation techniques to perform organic separation
CO2– Perform thin layer and column chromatographic separation
CO3– Distinguish and estimate different oxygen containing function groups.
CO4– Perform the classical name reactions.
CO5– Prepare the simple analgesic and paracitamol type of drugs.
CO6– Prepare simple types of dyes of industrial application.

TEXT/REFERENCE BOOKS

1. A text book of practical organic chemistry- A. I. Vogel.
2. Practical organic chemistry- Mann and Saunders.
3. A handbook of quantitative and qualitative analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal) 50 Marks
LE (Viva-voce plus Lab examination) 50 Marks

19BSC702P					Inorganic Chemistry Lab-2					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week				Practical		Total Marks
								LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

- Knowledge on safety rule while working in the laboratory
- Developed scientific methodology for industrial and domestic use
- Apply the knowledge for the solutions of a problems encountered in an experiment
- Experience for the synthesis of the different inorganic complexes

LIST OF EXPERIMENTS

1. Potassium tris-oxalatoferrate(III): synthesis and spectral analysis.
2. Paper chromatographic separation of Cu^{2+}, Fe^{3+} and Ni^{2+}
3. Spectrophotometric determination of phosphate: estimation of phosphate in cola drinks.
4. Preparation of $K_2[Cu(C_2O_4)_2].2H_2O$:Synthesis and spectral analysis
5. Preparation of hexamminenickel(II) chloride: estimation of ammonia and nickel by titrimetric and gravimetric methods Determination of complex composition using simple techniques.
6. Preparation of $K_3[Cr(C_2O_4)_3].3H_2O$:Synthesis and spectral analysis
7. Synthesis and characterization of ferrocene and acetylferrocene.
8. Estimation of Zinc in brass by complexometric titration.
9. Estimation of Iron(III) and Zinc(II) in a mixture by dichromatometry.
10. Estimation of Iron(III) and Cu(II) in a mixture by titration procedure (dichromatometry and iodometry).

COURSE OUTCOMES

On completion of the course, students will be able to

CO1– Capable of designing new sets of experiment.

CO2– Summarize findings in writing in a clear and concise manner.

CO3– Critically evaluate data collected to determine the identity, purity, and yield of products.

CO4– Evaluate scientific method to create, tests, and evaluate a hypothesis.

CO5– Apply the column chromatography technique to separate inorganic compounds.

CO6– Create a new scientific method to be use in the industrial purpose.

TEXT/REFERENCE BOOKS

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. 1. A. I. Vogel, A text book of quantitative Inorganic Analysis, ELBS.
3. 2. A. K. Nad, B. Mahapatra & A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007. Vogel's Text Book of Practical Organic Chemistry (5th Edn).
4. Finar, I. L. Organic Chemistry (volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

SEMESTER EXAMINATION PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

LW(Daily lab performance plus journal write up maintain each 25 marks) 50 Marks

LE (Viva-voce plus Lab examination each 25 marks) 50 Marks

19BSC705E					Computer Applications in Chemistry (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

To provide an in-depth understand of the role of computers in chemistry.
Introduce the fundamentals of theories of computational chemistry.
Provide the overview of various softwares packages and their applications.
Provide hands-on use of software to elucidate various structural parameters.

UNIT 1 INTRODUCTION **04 Hrs.**

Role of computers in chemistry, field of computer applications; computational chemistry, chemometrics, chemoinformatics, introduction and uses of computational chemistry, a brief idea about the types of computers and operating systems.

UNIT 2 THEORY OF COMPUTATIONAL CHEMISTRY **12 Hrs.**

The Schrödinger equation, Born-Oppenheimer approximation, various theoretical approaches (density functional theory, Hartree-Fock and force field methods), a short description of density of states, energy dispersion, vibrational frequency, Basis set, and Dirac equation.

UNIT 3 COMPUTATIONAL TOOLS AND USES **12 Hrs.**

Introduction and uses of different computational softwares; VESTA, Chemcraft, Chemdraw, Gauss view, Mercury. Brief introduction of various software package; VASP, SIESTA and Gaussian.

UNIT 4 Modelling and Application **12 Hrs.**

Modelling of molecular system, identification of different structural parameters, steps of geometry optimization, HOMO-LUMO identification. Brief introduction of solid systems, dimensionality of the system, structure modelling, steps of geometry optimization of solids, electronic properties analysis.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the types of operating systems.
CO2 – Understand the basic computer vocabulary.
CO3 – Describe the role of computers in chemistry.
CO4 – Explain the theories of the computational chemistry.
CO5 – Describe the use of different computational softwares.
CO6 – Utilize the softwares to evaluate the structural parameters.

TEXT/REFERENCE BOOKS

1. Frank Jensen Introduction to Computational Chemistry, 2nd edition (Wiley)
2. Christopher Cramer, Essentials of Computational Chemistry, 2nd edition (Wiley)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

19BSC706E					Heterogeneous Catalysis (Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concepts of catalysis.
- To learn the importance of solid catalysts.
- To learn the basic concepts of heterogeneous catalysis.
- To understand the basic concepts of different methods of catalyst characterization.

UNIT 1 INTRODICTION **08 Hrs.**

Introduction - Types of Catalysis, Industrial Importance of Catalysis, History of Catalysis; Principles and Concepts - Sabatier's Principle, Active Sites, Surface Coordination Chemistry, Modifiers and Promoters, Active Phase - Support Interactions, Spillover Phenomena, Shape-Selectivity Concept, Catalytic Cycle.

UNIT 2 SOLID CATALYSTS **12 Hrs.**

Development of Solid Catalysts, Classification of Solid Catalysts Unsupported (Bulk) Catalysts - Metal Oxides, Metals and Metal Alloys, Carbides and Nitrides, Carbons, Ion-Exchange Resins and Molecularly Imprinted Catalysts, Metal – Organic Frameworks Metal Salts. Supported Catalysts - Supports, Metal Oxide Catalysts, Surface-Modified Oxides, Metal Catalysts, Sulfide Catalysts, Hybrid Catalysts, Ship- in-a-Bottle Catalysts, Polymerization Catalysts Zeolitic Materials – Composition, Synthesis, Zeolite catalysis, Isomorphously substituted zeolites, Mesoporous molecular sieves.

UNIT 3 CHARACTERIZATION **10 Hrs.**

Physical Properties - Surface Area and Particle Size and Dispersion, Structure and Morphology, Chemical Properties – Surface Chemical Composition, Valence States and Redox Properties, Acidity and Basicity Mechanical Properties – Bulk density, Crush Strength, Abrasion and Attrition Resistance, etc.

UNIT 4 APPLICATION **10 Hrs.**

Catalytic Reactors - Classification of Reactors, Laboratory Reactors, Industrial Reactors, Reactor Types and Processes. Catalyst Deactivation and Regeneration. Industrial Application of Catalysis - Synthesis Gas and Hydrogen, Ammonia Synthesis, Fischer-Tropsch Synthesis, Petroleum and related Hydrocarbon Transformations, Environmental Catalysis - Catalytic Reduction of Nitrogen Oxides from stationary Sources, Automotive Exhaust Catalysis, Catalytic application of zeolites and related materials.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1– Understand heterogeneous catalysis and its application.
CO2– Interpret different types of catalysis and their mechanism.
CO3– Conceptualize the basic need of heterogeneous catalysis.
CO4– Analyse the physico-chemical properties of solid catalysts.
CO6– Elucidate the industrial application of solid catalysts.

TEXT/REFERENCE BOOKS

1. Heterogeneous Catalysis, DK Chakrabarty& B Viswanathan, New Age International Publishers.
2. Heterogeneous Catalysis in Industrial Practice, 2nd ed Charles N. Satterfield, McGraw-Hill Book Company.
3. Applied Industrial Catalysis, Volume 1, Edited by Bruce E Leach, Academic Press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

19BSC707E					Supramolecular Chemistry(Elective)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart the knowledge about types of supramolecules and structure.
- Analyse the different weak interactions that are exist within the framework.
- Understand the structural feature dictate different properties i.e. devices developed.
- Comprehend the supramolecular in biological aspects.

UNIT 1 CONCEPTS OF SUPRAMOLECULAR CHEMISTRY **06 Hrs.**

Definition, nature of supramolecular interactions, host-guest interaction, molecular recognition, types of recognition, receptor design, principles of assembly, porphyrin and other tetrapyrrollic macrocycles, coenzymes, neurotransmitters, DNA and biochemical self-assembly.

UNIT 2 SUPRAMOLECULAR INTERACTIONS **14 Hrs.**

Concepts, ion-ion interactions; ion-dipole interactions; dipole-dipole interactions; hydrogen bonding; cation-π-interactions; π-π-interactions; van derwaals interactions; hydrophobic effect; metal-coordination bonds, cation receptors, crown ethers, cryptands, spherands, calixarens, siderophores, cyclophanes, cyclodextrins, catenanes and rotaxanes, selectivity of cation complexation, macrocyclic and template effects.

UNIT 3 APPLICATIONS OF SUPRAMOLECULAR CHEMISTRY **12 Hrs.**

Rational Design, molecular maneling, supramolecular reactivity and catalysis, nanoscience applications. crystal engineering of hydrogen bonded and metal-organic framework solids, molecular electronic devices, molecular wires, molecular rectifiers, molecular switches and molecular logic gates, examples of recent developments in supramolecular chemistry from current literature.

UNIT 4 SUPRAMOLECULAR CHEMISTRY IN BIOLOGY **08 Hrs.**

Membranes, macrocyclic systems, photosynthesis, oxygen transport, biological mimics, enzymes, metallobiosites, heme analogues, transportation of anions and cations across transmembrane channels.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Understand the basic concept of supramolecular chemistry.

CO2– Comprehand the structural property relationship i.e. molecular recognition, molecular separation etc.

CO3– Analysis the supramolecular structure in solid and solution by using modern spectroscopic techniques.

CO4– Molecular recognition and nature of bindings involved in biological systems.

CO5– Applications of supramolecules in miniaturization of molecular devices.

CO6– Create a new molecular architecture on the basis of basic supramolecular polymer.

TEXT/REFERENCE BOOKS

1. J. M. Lehn, Supramolecular Chemistry, Concepts and Perspectives, VCH, 1995.
2. H. Dodziuk, Introduction to Supramolecular Chemistry, Kluwer Academic, 2002.
3. F. Vogtle, Supramolecular Chemistry, An Introduction, John Wiley & Sons, 1991.
4. J. W. Steed, J. L. Atwood, Supramolecular Chemistry, A Concise Introduction, John Wiley, 2000.
5. A. Bianchi, K. B. James, E. G. Espana, Supramolecular Chemistry of Anions, Wiley-VCH, 1997.
6. M. Fujita, Molecular Self-assembly, Organic Versus Inorganic Approaches, Springer, 2000..

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration:3 Hrs**

Part A/Question: 10 questions of 2 marks each with internal choice 20 Marks

Part B/Question: 8 questions of 10 marks each with internal choice 80 Marks

19BSC801					Natural Products					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the basic concepts of natural product chemistry and its importance.
- To identify different types of natural products based on their structure and predict their utility.
- To understand the chemistry of amino acids, peptides, proteins, enzymes and antibiotics.
- To comprehend the chemistry and stereochemistry of carbohydrates.
- To know the physiological significance and chemistry of alkaloids, terpenes, steroids, polyketides and fatty acids.

UNIT 1 INTRODUCTION TO NATURAL PRODUCTS **07 Hrs.**

Natural Products: Definition, Properties and Function; Classification; Introduction to important secondary metabolites (polyketides, fatty acids, terpenes, steroids, phenyl propanoids and alkaloids) and their roles in different sectors of life; Structure elucidation process by derivation, chemical degradation and spectroscopic techniques.

UNIT 2 AMINO ACIDS, PEPTIDES, PROTEINS, ENZYMES AND BETA-LACTAM ANTIBIOTICS **21 Hrs.**

Classification of Amino acids; Zwitter ion structure and Isoelectric point; Overview of Primary, Secondary, Tertiary and Quaternary structure of Proteins; Determination of Primary structure of peptides; Synthesis of simple peptides by N-protection and C-activating groups; Merrifield solid phase synthesis; Overview of enzyme action, coenzymes and cofactors and their role in biochemical reactions; The beta-lactam antibiotics: Penicillins, and other beta-lactams, Antibiotic Resistance.

UNIT 3 CARBOHYDRATES **12Hrs.**

Classification and General Properties; Reducing and Non-reducing sugars; Glucose and Fructose (open chain and cyclic structure), Projection formula; Determination of configuration of monosaccharides; Absolute configuration of Glucose and Fructose; Mutarotation and Anomerism; Reactions of carbohydrates; Structure of disaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen and Cellulose) excluding their structure elucidation.

UNIT 4 ALKALOIDS, TERPENES, STEROIDS, POLYKETIDES AND FATTY ACIDS **16 Hrs.**

Natural occurrence; General structural features and properties; Uses; Classification; Isolation; Hofmann's exhaustive methylation, Emde's modification; Structure elucidation and synthesis of Nicotine; Isoprene rule; Elucidation of structure and synthesis of Citral; Medicinal importance of Nicotine, Atropine, Quinine, Morphine, Reserpine and Taxol; Steroids; Cholesterol; Polyketides and Fatty Acids; Prostaglandins.

56 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1– Define the basic concepts of natural product chemistry.

CO2– Understand the structural and functional aspects of amino acids, peptides, proteins, enzymes, and antibiotics.

CO3– Develop knowledge on the structure, stereochemistry and reactions of carbohydrates.

CO4– Implement the knowledge of alkaloids, terpenes, steroids, fatty acids etc. to predict their physiological importance.

CO5– Analyse the spectroscopic data and inferences drawn from chemical procedures to determine the molecular structure of natural products.

CO6– Evaluate and apply the concepts of natural product chemistry in real life.

TEXT/REFERENCE BOOKS

1. Finar, I. L. Organic Chemistry (volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Hanson, J. R. Natural Products: The Secondary Metabolites. The Royal Society of Chemistry, 2003.
4. Graham Solomons, T. W. and Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
5. Singh, J.; Ali, S. M. and Singh, J. Natural Product Chemistry, Prajati Prakashan (2018).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 questions, each carrying 2 marks	20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice	80 Marks

19BSC802					Analytical Methods and Equipments					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Gaining the factual knowledge of surface analysis techniques
- Acquiring basic principles applied for spectroscopic measurements.
- Learning the fundamental principal of various thermal techniques
- Attaining necessary basic knowledge of chromatographic separation and difference in various kind of chromatographic techniques

10 Hrs.

UNIT 1 SURFACE ANALYSIS

Optical Microscopy, Electron Microscopy-Principles of electron microscopy, instrumentation, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy.

BET surface area technique- Brunauer-Emmett-Teller (BET) theory, the physical adsorption of gas molecules on a solid surface, measurement of the specific surface area of materials.

UNIT 2 OPTICAL AND DIFFRACTION TECHNIQUES **16 Hrs.**

Principles of Diffraction- Origin of X-Ray Spectra, Energy Levels in Atoms, Moseley's Law, X-Ray Methods, X-Ray Absorption Process, X-Ray Fluorescence Process, X-Ray Diffraction Process. X-Ray Diffraction- Single-Crystal X-Ray Diffractometry, Crystal Structure Determination, Powder X-Ray Diffractometry, Applications of XRD, Analytical Limitations of XRD X-Ray Photoelectron Spectroscopy- Basics principles of XPS, application of XPS Infra-red Spectroscopy- Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Raman Spectroscopy- Principles of Raman Scattering, Raman Instrumentation, Applications of Raman Spectroscopy Ultra-violet and Visible Spectroscopy- Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis. Application of UV in various industries.

UNIT 3 THERMAL TECHNIQUES **14 Hrs.**

Thermogravimetry- TGA Instrumentation, Analytical Applications of Thermogravimetry, Derivative Thermogravimetry, Sources of Error in Thermogravimetry Differential Thermal Analysis- DTA Instrumentation, Analytical Applications of DTA

Differential Scanning Calorimetry- Basics principles of DSC, Difference between DSC and DTA, DSC Instrumentation, Applications of DSC.

UNIT 4 CHROMATOGRAPHIC TECHNIQUES **16 Hrs.**

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. Instrumentation and applications of GC, GPC, HPLC, TLC.

56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - understand the basic principal of microscopy and surface analysis and will be able to explain the working mechanism of electron microscopy.

CO2 - Student will learn the theoretical aspects of X-ray and can differentiate various X-ray instrumentation techniques for material characterization.

CO3 - Student will acquire the knowledge of advance instrumentation techniques based on various electromagnetic radiations.

CO4 – Students can describe the technique to analyse surface area and can differentiate between topographic techniques and surface area analysis

CO5 - Students will be able to explain the working principal of thermal analysis.

CO6 - Learn various type of chromatographic techniques and will acquire the basic knowledge of the instrumentation involved in these techniques.

TEXT/REFERENCE BOOKS

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Robinson, James W., Eileen Skelly Frame, and George M. Frame II. Undergraduate instrumental analysis. CRC press, 2014.
6. Srivastava. A.K. and. Jain, P.C, "Instrumental Approach to Chemical Analysis", 4th Edition, S Chand and Company Ltd, New Delhi, 2012.2.
7. Chatwal. G. R., Anand, Sham K., "Instrumental Methods of Chemical Analysis" 5th Edition, Himalaya Publishing House, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A/Question: 10 multiple choice questions 1 mark each	10 Marks
Part B/Question: 10 Questions of 2 marks each with internal choice	20 Marks
Part C/Question: 4 Questions of 15 marks each with internal choice	60 Marks
Part D/Question: 1 Questions of 10 marks comprising a figure of an instrument for labelling and identifying its various parts	10 Marks

Pandit Deendayal Petroleum University School of Energy Technology

21BSC805					Quantum & Computational Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- The objective of unit I is to ensure that students learns the basic of quantum chemistry.
- The objective of unit II is to familiarize the students with the postulates and applications of quantum mechanics.
- The objective of unit III is to ensure that students learn about the different quantum mechanical operators and their properties.
- The objective of unit IV is to make students learn the theoretical background of principles of computational techniques in molecular modelling.

UNIT I ELEMENTARY QUANTUM MECHANICS-I **10 hours**

Black body radiation, Planck's radiation law, Photo electric effect, heat capacity of solids, Bohr's model of hydrogen atom and its defects. De Broglie hypothesis, Heisenberg's Uncertainty principle, Hamiltonian operator.

UNIT 2 ELEMENTARY QUANTUM MECHANICS-II **10 hours**

Schrödinger wave equation and its importance, physical interpretation of wave function, postulates of quantum mechanics, and its application to particle in one dimensional box, the harmonic oscillator, the rigid rotor, the hydrogen atom, concept of degeneracy.

UNIT 3 QUANTUM MECHANICS FORMALISM **10 hours**

Quantum mechanical operators, Algebra of operator: Addition and Subtraction, Multiplication, Commutative rule, Commutator operator, Linear operator, The operator ∇ and ∇^2.

Eigen value and eigen function, Hermation property of operator, Momentum operator, Hamiltonian operator, Angular momentum operator.

UNIT 4 QUANTUM MECHANICS IN COMPUTATIONAL CHEMISTRY **10 hours**

Quantum mechanical models, Comparison to classical models, Quantum theory and Born Oppenheimer approximation, Properties calculation by electronic wave function

Electronic structure methods, Hartree Fock method, Slater determinants, Semi-empirical methods, Electron correlation methods, Perturbation theory, Configuration Interaction, Density functional theory, Comparing the vibration and electronic spectra of known molecules with the theoretical study (Asprin).

COURSE OUTCOMES

Upon completion of the course, student will be able to
CO1 – Gain an understanding of the basic principles and concepts of quantum mechanics.
CO2 – Will know the basic information of uncertainty principal.
CO3 – Understand the Schrödinger equation for model systems of relevance.
CO4 – Develop an understanding of quantum mechanical operators.
CO5 – Describe the use of computational techniques and selective application to various molecular systems.
CO6 – Utilize the softwares to evaluate the structural parameters related to small organic compounds and compare computational and experimental results.

REFERENCE BOOKS:

1. House, J.E. (2004), Fundamentals of Quantum Chemistry, 2nd Edition, Elsevier.
2. McQuarrie, D.A. (2016), Quantum Chemistry, Viva Books.
3. Chandra, A. K. (2001), Introductory Quantum Chemistry, Tata McGraw-Hill.
4. Quantum Chemistry: I.N. Levine (2007) 5th edition, Pearson Education.

5. Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory: A. Szabo and N. Ostlund (1996) New edition, Dover Publications.

SEMESTER EXAMINATION PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A/Question: 10 questions of 2 marks each with internal choice	20 Marks
Part B/Question: 8 questions of 10 marks each with internal choice	80 Marks