



**Faculty of  
Chemical  
Sciences  
Bachelor of  
Science  
(Honours)  
Session 2019-20**



# Programme Objectives

Faculty of Chemical Sciences is developing talents for chemical industries and strengthens them to enable to venture into allied fields too.

To develop foundation and proficiency in the through sound knowledge in basics of Organic, Inorganic and physical Chemistry.

To compete and serve the recent advanced developments in the interdisciplinary science, the chemistry students are expected to have sound knowledge of mathematics and physical sciences too. This will help them to have a firm position in any team and lead it.

To integrate knowledge of Chemistry to make appropriate intellectual connections in other areas of Chemistry.

The aim underlying these courses is to develop basic awareness of computer applications required for applied chemistry. To enhance the IT skills and make aware its utility in chemistry.

# Programme Learning Outcomes

After doing Chemistry honor course, our student will be able to:

**PLO1** Demonstrate core competence in various areas of chemistry be it classical, modern or applied chemistry.

**PLO2** Apply chemistry skills and knowledge to the solution of theoretical and practical problems in chemistry.

**PLO3** Apply analytical, numerical, computational skill and subject knowledge to solve academic as well as in the problem at research level.

**PLO4** Demonstrate competence in different chemical laboratories.

**PLO5** Apply knowledge of chemistry with integrative approach in diverse fields.

**PLO6** Acquire the presentation skill ability to communicate scientific information effectively.

**PLO7** Apply their responsibilities in societal and environmental context.

**PLO8** Function individually and in teamwork.



## Programme Specific Objectives

The aim of the Faculty of Chemical Sciences through the courses is to offer a cut above the rest by training them as man-power to serve the ever growing demands of the industries and also prepare the students for higher education.

To develop familiarity with the current state of research/higher studies in one or more subfields of Chemistry.

To enhance the presentation skill and ability to communicate scientific information effectively.

To aware students regarding the technical advancements and industrial applications of chemistry.

To develop the experimental skills in students in terms of synthesis, purification and characterization of basic important compounds so that they can assimilate them in various organic, pharmaceutical and materials based industries.

## Programme Specific Outcomes

Upon completion of the B.Sc. (Hons.) Chemistry programme, students will be able to:

Gain the knowledge of Chemistry through theory and practical' s and Develop research oriented skills.

Use modern chemical tools, Models, Chem-draw, Charts and Equipments.

Achieve the skills required to succeed in graduate school, professional school and the chemical industry like cement industries, agro product, Paint industries, Rubber industries, Petrochemical industries, Food processing industries, Fertilizer industries



**STUDY & EVALUATION SCHEME (Session 2019-20)**

**Bachelor of Science (Hons.)**

**Chemistry**

**B.Sc.(Hons.): Chemistry with Mathematics I Year: I Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY1002	Physical Chemistry-I	3	1	-	40	60	100	4
2		BCY1003	Organic Chemistry-I	3	1	-	40	60	100	4
3		BCY1502	Chemistry Lab-I	-	-	4	80	20	100	2
	<b>GE</b>									
1		BMA1004	Modern Algebra	3	2	-	40	60	100	5
2		BMA1005	Calculus-I	3	2	-	40	60	100	5
	<b>AEC</b>									
1		BES1001	Environmental Studies	2	-	-	20	30	50	2
2		BHU1001	Functional English	3	-	-	40	60	100	3
3		BHU1501	English Language Lab	-	-	2	80	20	100	1
	<b>SEC</b>									
1										
			<b>Total</b>	<b>17</b>	<b>6</b>	<b>6</b>	<b>380</b>	<b>370</b>	<b>750</b>	<b>26</b>
<b>Library/Computer Center</b>				<b>3</b>						
<b>Games/Clubs</b>				<b>2</b>						



**B.Sc.(Hons.): Chemistry with Mathematics I Year: II Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C	
	<b>CORE</b>										
1		BCY2002	Inorganic Chemistry-I	3	1	-	40	60	100	4	
2		BCY2003	Organic Chemistry-II	3	1	-	40	60	100	4	
3		BCY2502	Chemistry Lab-II	-	-	4	80	20	100	2	
	<b>GE</b>										
1		BMA2004	Vector Calculus and Geometry	3	2	-	40	60	100	5	
2		BMA2005	Calculus-II	3	2	-	40	60	100	5	
	<b>AEC</b>										
1		BHU2001	Advanced Functional English	3	-	-	40	60	100	3	
	<b>SEC</b>										
1		BCS2009	Computer Fundamentals	2	-	-	20	30	50	2	
2		BCS2502	Computer Application Lab	-	-	2	80	20	100	1	
			<b>Total</b>	<b>17</b>	<b>6</b>	<b>6</b>	<b>380</b>	<b>370</b>	<b>750</b>	<b>26</b>	
<b>Library/Computer Center</b>				<b>3</b>							
<b>Games/Clubs</b>				<b>2</b>							



**B.Sc.(Hons.): Chemistry with Mathematics II Year: III Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY3002	Physical Chemistry-II	3	1	-	40	60	100	4
2		BCY3001	Inorganic Chemistry-II	3	1	-	40	60	100	4
3		BCY3501	Chemistry Lab-III	-	-	4	80	20	100	2
	<b>GE</b>									
1		BMA3002	Differential Equations	3	2	-	40	60	100	5
2		BMA3003	Statics and Dynamics	3	2	-	40	60	100	5
	<b>AEC</b>									
1		BHU3010	History and Philosophy of Science	3	-	-	40	60	100	3
	<b>SEC</b>									
1		BMA3008	Numerical Technique with C	3	-	-	40	60	100	3
2		BCS3511	C Programming Lab	-	-	4	80	20	100	2
			<b>Total</b>	<b>18</b>	<b>6</b>	<b>8</b>	<b>400</b>	<b>400</b>	<b>800</b>	<b>28</b>
<b>Library/Computer Center</b>				<b>2</b>						
<b>Games/Clubs</b>				<b>2</b>						



**B.Sc.(Hons.): Chemistry with Physics**

**I Year: I Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY1002	Physical Chemistry-I	3	1	-	40	60	100	4
2		BCY1003	Organic Chemistry-I	3	1	-	40	60	100	4
3		BCY1502	Chemistry Lab-I	-	-	4	80	20	100	2
	<b>GE</b>									
1		BPH1002	Mechanics and Waves	3	1	-	40	60	100	4
2		BPH1003	Optics	3	1	-	40	60	100	4
3		BPH1502	Physics Lab-I	-	-	4	80	20	100	2
	<b>AEC</b>									
1		BES1001	Environmental Studies	2	-	-	20	30	50	2
2		BHU1001	Functional English	3	-	-	40	60	100	3
3		BHU1501	English Language Lab	-	-	2	80	20	100	1
	<b>SEC</b>									
			<b>Total</b>	<b>17</b>	<b>4</b>	<b>10</b>	<b>460</b>	<b>390</b>	<b>850</b>	<b>26</b>
<b>Library/Computer Center</b>				<b>3</b>						
<b>Games/Clubs</b>				<b>2</b>						



**B.Sc.(Hons.): Chemistry with Physics**

**I Year: II Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C	
	<b>CORE</b>										
1		BCY2002	Inorganic Chemistry-I	3	1	-	40	60	100	4	
2		BCY2003	Organic Chemistry-II	3	1	-	40	60	100	4	
3		BCY2502	Chemistry Lab-II	-	-	4	80	20	100	2	
	<b>GE</b>										
1		BPH2002	Electricity & Magnetism	3	1	-	40	60	100	4	
2		BPH2003	Thermal Physics	3	1	-	40	60	100	4	
3		BPH2502	Physics Lab-II	-	-	4	80	20	100	2	
	<b>AEC</b>										
1		BHU2001	Advanced Functional English	3	-	-	40	60	100	3	
	<b>SEC</b>										
1		BCS2009	Computer Fundamentals	2	-	-	20	30	50	2	
2		BCS2502	Computer Application Lab	-	-	2	80	20	100	1	
			<b>Total</b>	<b>17</b>	<b>4</b>	<b>10</b>	<b>460</b>	<b>390</b>	<b>850</b>	<b>26</b>	
<b>Library/Computer Center</b>				<b>3</b>							
<b>Games/Clubs</b>				<b>2</b>							





**B.Sc.(Hons.): Chemistry with Physics**

**II Year: III Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C	
	<b>CORE</b>										
1		BCY3002	Physical Chemistry-II	3	1	-	40	60	100	4	
2		BCY3001	Inorganic Chemistry-II	3	1	-	40	60	100	4	
3		BCY3501	Chemistry Lab-III	-	-	4	80	20	100	2	
	<b>GE</b>										
1		BPH3003	Basic Electronics	3	1	-	40	60	100	4	
2		BPH3002	Modern Physics	3	1	-	40	60	100	4	
3		BPH3501	Physics Lab-III	-	-	4	80	20	100	2	
	<b>AEC</b>										
1		BHU3010	History and Philosophy of Science	3	-	-	40	60	100	3	
	<b>SEC</b>										
1		BMA3008	Numerical Technique with C	3	-	-	40	60	100	3	
2		BCS3511	C Programming Lab	-	-	4	80	20	100	2	
			<b>Total</b>	<b>18</b>	<b>4</b>	<b>12</b>	<b>480</b>	<b>420</b>	<b>900</b>	<b>28</b>	
<b>Library/Computer Center</b>				<b>2</b>							
<b>Games/Clubs</b>				<b>2</b>							



**B.Sc.(Hons.): Chemistry**

**II Year: IV Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY4001	Inorganic Chemistry-III	4	1	-	40	60	100	5
2		BCY4002	Organic Chemistry-III	4	1	-	40	60	100	5
3		BCY4003	Physical Chemistry-III	4	1	-	40	60	100	5
4		----	Elective-I	3	1	-	40	60	100	4
5		BCY4501	Chemistry Lab-IV	-	-	6	80	20	100	3
	<b>GE</b>									
1										
	<b>AEC</b>									
1										
	<b>SEC</b>									
1		BSS4501	Soft Skill	-	-	2	100	-	100	1
2		BCY4004	Fuel Chemistry	2	-	-	20	30	50	2
3		BCY4005	Pesticide Chemistry	2	-	-	20	30	50	2
			<b>Total</b>	<b>19</b>	<b>4</b>	<b>8</b>	<b>380</b>	<b>320</b>	<b>700</b>	<b>27</b>
<b>Library/Computer Center</b>				<b>2</b>						
<b>Games/Clubs</b>				<b>2</b>						



**B.Sc.(Hons.): Chemistry III Year: V Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY5001	Inorganic Chemistry-IV	4	1	-	40	60	100	5
2		BCY5002	Organic Chemistry-IV	4	1	-	40	60	100	5
3		BCY5003	Physical Chemistry-IV	4	1	-	40	60	100	5
4		----	Elective-II	3	1	-	40	60	100	4
5		BCY5501	Chemistry Lab-V	-	-	6	80	20	100	3
6		BCY5503	Term Paper-I	-	-	2	50	-	50	1
7		BCY5502	Seminar	-	-	2	50	-	50	1
	<b>GE</b>									
1										
	<b>AEC</b>									
1										
	<b>SEC</b>									
1		BAP5501	Aptitude Reasoning & Online Test	-	-	2	100	-	100	1
			<b>Total</b>	<b>15</b>	<b>4</b>	<b>12</b>	<b>440</b>	<b>260</b>	<b>700</b>	<b>25</b>
<b>Library/Computer Center</b>				<b>2</b>						
<b>Competitive Examination Guidance</b>				<b>2</b>						



**B.Sc.(Hons.): Chemistry**

**III Year: VI Semester**

S.No.		Sub. Code	Subject	L	T	P	CIE	ESE	Total	C
	<b>CORE</b>									
1		BCY6001	Inorganic Chemistry-V	4	1	-	40	60	100	5
2		BCY6002	Organic Chemistry-V	4	1	-	40	60	100	5
3		BCY6003	Physical Chemistry-V	4	1	-	40	60	100	5
4		----	Elective-III	3	1	-	40	60	100	4
5		BCY6501	Chemistry Lab VI	-	-	6	80	20	100	3
6		BCY6503	Term Paper II	-	-	2	50	-	50	2
7										
	<b>GE</b>									
	<b>AEC</b>									
	<b>SEC</b>									
1		BCY6004	Introduction to Spectroscopy	2	-	-	20	30	50	2
2		BCY6005	Chemical Technology and Society	2	-	-	20	30	50	2
			<b>Total</b>	<b>19</b>	<b>4</b>	<b>8</b>	<b>330</b>	<b>320</b>	<b>650</b>	<b>28</b>
<b>Library/Computer Center</b>				<b>2</b>						
<b>Competitive Examination Guidance</b>				<b>4</b>						



## List of Electives

### **Elective-I ( Semester-IV)**

BCY4101 - Polymer Chemistry

BCY4102 - Industrial Chemicals and Environment

### **Elective-II ( Semester-V)**

BCY5101 - Analytical Chemistry

BCY5102 - Green Chemistry

### **Elective-III ( Semester-VI)**

BCY6103 - Pharmaceutical Chemistry

BCY6104 - Molecules of Life

## List of Ability Enhancement Courses

### **Semester -I**

BES1001- Environmental Studies

BHU1001- Functional English

BHU1501- English Language Lab

### **Semester -II**

BHU2001- Advanced Functional English

### **Semester -III**

BHU3010- History and Philosophy of Science

## List of Skill Enhancement Courses

### **Semester -I**

-

### **Semester -II**

BCS2009- Computer Fundamental

BCS2508- Computer Lab



**Semester -III**

BMA3008- Numerical Technique with C

BCS3511- C Programming Lab

**Semester-IV**

BSS4501- Soft Skill

BCY4004- Fuel Chemistry

BCY4005-Pesticide Chemistry

**Semester-V**

BAP5501- Aptitude & Reasoning and Online Test

**Semester-VI**

BCY6004- Introduction to Spectroscopy

BCY6005- Chemical Technology and Society



**B. Sc. (Hons): Chemistry**  
**I Year, I Semester**  
**Physical Chemistry-I**  
**BCY1002**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

- CO1** To **tell** students about the rate constant, various factors affecting rate of chemical reaction.  
**CO2** To **explain** students about the order and molecularity of reactions and how are they calculated.  
**CO3** To **describe** theories and their development to **interpret** the rate of a chemical reaction.  
**CO4** To **illustrate** the behaviour of liquids and gases at STP and various parameters that alters their physical properties.  
**CO5** To build **understanding** among the students about the crystalline and amorphous nature of materials and also how to **compare** the physical behavior of the three states of matter.

**UNIT I- Chemical Kinetics-I**

**[8 L]**

Introduction of reaction rate: rate constants, effect of temperature, pressure, catalyst and other factors on reaction rates, order and molecularity of reactions, reactions of zero, first, second, fractional and pseudo first order, derivation of integrated rate equations for zero, first and second order reactions.

**UNIT II- Chemical Kinetics-II**

**[6 L]**

General methods for determination of order of a reaction, concept of activation energy and its calculation from Arrhenius equation, theories of reaction rates: collision theory and activated complex theory of bimolecular reactions, comparison of the two theories (qualitative treatment only)

**UNIT III- Gaseous State**

**[9 L]**

Kinetic molecular theory of gases, derivation of the kinetic gas equation, collision frequency; collision diameter, mean free path, transport phenomena in gases, degree of freedom of a gaseous molecule, deviations of gases from ideal behavior, equation of state for real gases- the van der Waal's equation, brief mention of other equations of state.

**UNIT IV- Liquid State**

**[8 L]**

Qualitative treatment of the structure of the liquid state, physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination, effect of addition of various solutes on surface tension and viscosity, temperature variation of viscosity of liquids and comparison with that of gases.

**UNIT V- Solid State**

**[9 L]**

Properties of solids, symmetry elements in crystal systems, space lattice and unit cells, crystal systems, bravais lattice types and identification of lattice planes, laws of crystallography - law of constancy of interfacial angles, law of rational indices, miller indices , X-ray diffraction by crystals, Bragg's law, defects in crystals.

**Total lectures: 40**



**TEXT BOOKS:**

- T1.** *Essentials of Physical Chemistry*, A. Bahl and B. S. Bahl, G. D. Tuli, 27th Edition (2014), S. Chand & Company Ltd., New Delhi.
- T2.** *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
- T3.** *Physical Chemistry*, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.

**REFERENCE BOOKS:**

- R1.** *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
- R2.** *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.
- R3.** *Physical Chemistry*, I. N. Levine, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Define</b> rate constant and <b>select</b> the better experimental conditions for optimizing reaction rates.	1, 3 Remembering, Applying
CLO2	<b>Understand</b> the mechanism of chemical reactions and <b>calculate</b> order of a chemical reaction experimentally as well as from theoretical data.	2, 3 Understanding, applying
CLO3	<b>Explain</b> the behaviour of gases under given conditions of thermodynamic parameters and can <b>compare</b> between ideal and real gases.	2, 4 Understanding, Analyzing
CLO4	<b>Predict</b> the behaviour of liquids under given conditions of pressure, temperature and interface and <b>determine</b> experimentally the physical properties like surface tension and viscosity.	3, 5 Applying, Evaluating
CLO5	<b>Examine</b> crystalline nature of a material and the crystal system of a crystal with known lattice parameters and also explain the <b>importance</b> of crystal defects.	3, 5 Applying and Evaluating





Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	M	L	L	L	-	-	L	L	M	L
CLO2	M	H	M	M	M	-	L	L	M	M	M
CLO3	M	H	M	-	M	L	L	L	L	M	M
CLO4	L	M	M	M	-	-	M	M	M	M	M
CLO5	M	M	M	H	M	-	M	M	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, I Semester**  
**Organic Chemistry-I**  
**BCY 1003**

L T P C  
3 1 0 4

**Course Objectives:**

**CO1** To **explain** student about the shape of atomic orbitals, and **how** to **identify** the type of hybridization and **show** the orbital representation of hydrocarbons.

**CO2** To build **understanding** about the basic concepts of organic reaction mechanisms and what are the factors that **determine** the reactivity of molecules and mechanisms of reactions.

**CO3** To **demonstrate** the conformations of alkanes and cycloalkanes and **discuss** with students about the synthesis, stability and reactivity of alkanes, alkenes and alkynes.

**CO4** To **illustrate** importance of alkenes and alkynes in synthetic organic chemistry.

**UNIT I- Structure and Reactivity of Organic Molecules**

[8 L]

Atomic orbitals, hybridization and orbital representation of different examples of alkanes, alkenes, alkynes and benzene. Delocalized and localized bonds, Inductive effect, Electromeric effect, Resonance, Hyperconjugation and their influence on acidity, basicity and reactivity of organic compounds, Inclusion compounds.

**UNIT II- Organic Reaction Mechanisms**

[12 L]

Different types of bond cleavage: Homolytic and Heterolytic cleavage, Nucleophiles and Electrophiles, Reactive intermediates: carbocations, carbanions, carbon free radicals, carbenes, nitrenes, benzenes: their structure using orbital picture, behavior, stability and generation.

General overview of different types of organic reactions: nucleophilic addition and Substitution reactions, Elimination reactions and Basic approach of their reaction mechanisms.

**UNIT III- Alkanes and Cycloalkanes**

[6 L]

Corey Synthesis and chemical reactivity of alkanes, mechanism of free-radical halogenation, conformations of ethane and n-Butane. Cycloalkanes: General syntheses, Angle strain Theory.

**UNIT IV- Alkenes and Dienes**

[8 L]

General methods of synthesis of alkenes, electrophilic addition reaction, mechanism of bromination, hydration, hydroxylation, hydroboration, epoxidation hydrohalogenation, ozonide formation, Markownikoff's addition, peroxide effect, polymerization

**Dienes:** Introduction and stability of Conjugated and isolated Dienes, 1,2- versus 1,4-addition. Diels - Alder reaction, Ene reaction.

**UNIT V- Alkynes**

[6 L]

General methods of synthesis of alkynes, their acidity; *reactions*: addition reactions (addition of water, hydrogen halide and hydrogen), hydroboration and its application, polymerization.

**Total Lectures: 40**



### TEXT BOOKS:

- T1. Organic Chemistry, Paula Y. Bruice, 2<sup>nd</sup> Edition, Prentice-Hall, International Edition (1998).
- T2. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6<sup>th</sup> Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
- T3. Solomons & Fryhle's Organic Chemistry, T.W. Graham Solomons, C. B. Fryhle, 10<sup>th</sup> edition, 2014, Wiley.
- T4. Organic Chemistry, S.M. Mukherjee, S.P. Singh and R.P. Kapoor, New Age International (P) Ltd. New Delhi.
- T5. Reactions, Rearrangements and Reagents, S.N. Sanyal, 2<sup>nd</sup> revised edition (2001), Bharati Bhawan publishers.
- T6. Arun Bahl and B. S. Bahl, Advanced Organic Chemistry, First multicolor revised edition, S. Chand and company Ltd. New Delhi.

### REFERENCE BOOKS:

- R1. M.B. Smith & Jerry March, March's Advanced Organic Chemistry, 5<sup>th</sup> Edition (2001), John Wiley & Sons, New York.
- R2. Peter Sykes, A Guide book to Mechanism in Organic Chemistry, 6<sup>th</sup> Edition (1997), Orient Longman Ltd., New Delhi.
- R3. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, Oxford University Press, Oxford (2001).
- R4. P.S. Kalsi, Organic Reactions and their Mechanisms, 1<sup>st</sup> Edition (1996), New Age International Publication, New Delhi.
- R5. I.L. Finar, Organic Chemistry, Vol. I, 5<sup>th</sup> Edition (1975) Reprinted in 2004, Pearson Education Pvt. Ltd., New Delhi.

### **Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Identify</b> the type of hybridization and <b>compare</b> the acidic strength and reactivity of alkane, alkene and alkynes.	1, 2 Remembering, Understanding
CLO2	<b>Explain</b> the mechanisms of important organic reactions and can <b>predict</b> which molecule will follow type of mechanism under given set of conditions.	2, 3 Understanding, Applying
CLO3	<b>Illustrate</b> the conformations/Configuration of molecules and <b>predict</b> the most stable one.	3, 6 Analyzing, Creating



CLO4	<b>Interpret</b> and <b>design</b> the important synthetic routes for preparation of synthetically useful hydrocarbons and their derivatives.	5, 6 Evaluating, Creating
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Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	M	L	L	L	-	-	L	L	M	L
CLO2	M	M	M	M	M	L	L	M	M	M	M
CLO3	M	M	H	L	L	-	-	M	M	H	L
CLO4	H	H	M	M	M	L	M	M	H	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, I Semester**  
**Chemistry Lab-I**  
**BCY1502**

**L T P C**  
**0 0 4 2**

**Course Objectives:**

**CO1** To **illustrate** students about the preliminary analysis of organic compounds.

**CO2** To **explain** students **how** to **identify** few important functional groups.

**CO3** To **build understanding** among students about the **estimation** of some important water quality parameters.

**CO4** To **develop** experimental knowledge of **calculating** molecular weight of polymers.

**CO5** To **develop** an **understanding** among students for **identifying** equivalence point in titrations.

**LIST OF EXPERIMENTS**

1. Identification of acidic, basic, neutral and phenolic organic compounds.
2. (i) Test for aliphatic and aromatic nature of compounds.  
(ii) Test for saturation and unsaturation of organic compounds.
3. Detection of additional elements (N, S) by Lassaigne's test in given organic compounds.
4. Detection of carboxylic (-COOH) functional group by systematic chemical methods.
5. Detection of alcoholic functional group by systematic chemical methods.
6. Detection of amide functional group by systematic chemical methods.
7. Determination of the alkalinity in the given water sample.
8. Determination of molecular weight of a polystyrene sample by viscometric method.
9. To determine the strength and percentage composition of sodium carbonate and sodium hydroxide in a given mixture.
10. To determine the strength in gm/lit. of given  $K_2Cr_2O_7$  solution being provided with approx N/30 hypo solution.



**TEXT BOOKS:**

- T1.** O. P. Pandey, D. N. Bajpai and S. Giri. "Practical Chemistry", S. Chand & Co., 2012.  
**T2.** Arun Sethi "Systematic Experiments in Chemistry", New Age International (P) Limited, Publishers, 1<sup>st</sup> edition, 2009.  
**T2.** Arun Sethi, "Systematic Lab Experiments in Organic Chemistry", New Age International (P) Limited, Publishers, 1<sup>st</sup> edition, 2003.

**REFERENCE BOOKS:**

- R1.** S. S. Dara. "Text book on Experiment and calculation in Engg. Chemistry", S. Chand & Co.  
**R2.** G. H. Affery, J. Bassett, J. Mendham and R. C. Denney, "Vogel's textbook of quantities chemical analysis 5<sup>th</sup> edition", John Willy and Sons.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Interpret</b> and <b>predict</b> important characteristic structural features including functional group present in an unknown organic compounds and also <b>how</b> to <b>distinguish</b> functional groups.	1, 2, 3, 4 Remembering, Understanding, Applying Analyzing
CLO2	<b>Estimate</b> some quality parameters of water like alkalinity and <b>show</b> the ions responsible for it.	3, 5 Applying Evaluating
CLO3	<b>Calculate</b> experimentally molecular weight of polymers in laboratory.	3 Applying
CLO4	<b>Understand</b> the <b>determination</b> of equivalence point in titration and its importance.	2, 5 Evaluating, Creating



Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	M	L	L	L	-	-	L	L	M	L
CLO2	M	M	M	M	M	L	L	M	M	M	M
CLO3	M	M	H	L	L	-	-	M	M	H	L
CLO4	H	H	M	M	M	L	M	M	H	H	M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Mechanics and Waves**  
**BPH1002**

L T P C  
3 1 0 4

**Course Objectives (CO):**

**CO1** To introduce with the fundamental concepts and basic laws of physics, conservative and nonconservative forces along with collision in one and two dimensions.

**CO2** To introduce the dynamics of simple and circular motion and the knowledge of hollow and solid cylinder.

**CO3** To introduce the knowledge of properties of matter and torsion of cylinder.

**CO4** To describe the concept of motion under central forces and dynamics of planets and satellites.

**CO5** To develop a better understanding about free damped and forced oscillation in one dimension.

**UNIT-I**

**(09 Hours)**

Inertial reference frame, Newton's laws of motion, Dynamics of particle in rectilinear and circular motion, Conservative and Non-conservative forces, Conservation of energy, linear momentum and angular momentum, Collision in one and two dimensions, cross section.

**UNIT-II**

**(09 Hours)**

Rotational energy and rotational inertia for simple bodies, the combined translation and rotational motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top, Relations between elastic constants, bending of beams and torsion of cylinder.

**UNIT-III**

**(10 Hours)**

Central forces, Two particle central force problem, reduced mass, relative and centre of mass motion, Law of gravitation, Kepler's laws, Motions of planets and satellites, geo-stationary satellites. Kinematics of Moving Fluids:- Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

**UNIT-IV**

**(12 Hours)**

Simple harmonic motion, differential equation of S. H. M. and its solution, uses of complex notation, Free, damped and forced Oscillations, composition of simple harmonic motion. Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves, pressure and energy distribution, phase and group velocity.

**Total Lectures: 40**





## REFERENCE BOOKS:

**R1:** An introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)

**R2:** The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988)

## Course Learning Outcomes:

After completing this course, our student will be able to

**CLO1** **Recall, understand and explain** the laws/forces help in their daily life, **recall** the basic or classical laws of physics to also **apply** in the concept of collision.

**CLO2** **Define, analyze, explain** and **demonstrate** the rotational and simple motion dynamics and **apply** formulae to solve problems.

**CLO3** **Understand** and **explain** the concept of elasticity and **apply** it to **compare** the various physical properties of hollow and solid objects.

**CLO4** **Describe and explain** the concept of central forces and **apply** it to reduce the two body problem in to one body problem.

**CLO5** **Recall, explain** and **describe** the mechanics of simple harmonic motion and **understand** the difference between free, damped and forced oscillator.

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	L	H	M	L	M	L	M	L
CLO2	H	H	H	H	H	M	L	M	M	M	M
CLO3	H	M	M	H	H	M	M	H	M	H	L
CLO4	H	L	H	L	H	M	H	M	H	H	M
CLO5	M	L	L	H	H	M	L	M	L	L	L



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Optics**  
**BPH1003**

L T P C  
3 1 0 4

**Course Objectives (CO):**

- CO1** To introduce basic concepts of geometrical optics and their applications to physical problems.
- CO2** To provide understanding of phenomenon of interference and its application to real world problem.
- CO3** To gain insight about diffraction phenomenon and its uses to solve observed physical events.
- CO4** To explore idea about phenomenon of polarization and its application to resolve real world puzzles.

**UNIT-I**

**(8 Hours)**

Fermat's Principle and its Examples Reflection and Refraction, Lenses - Transverse Magnification of a Spherically Refracting Surface, Cardinal Points of a Coaxial Optical System, Graphical Construction of Image using Cardinal Points. Equivalent Focal Length of Two Thin Lenses separated by a distance, Cardinal Points of a Coaxial System of Two Thin Lenses, Thick Lenses, Focal Length of a Thick Lens, Variation of Focal Length of a Convex Lens with Thickness, Cardinal Points of a Thick Lens.

**UNIT-II**

**(10 Hours)**

Condition for interference, classification of Interference, Coherence and theory of Interference of light, Interference with Bi-prism, Thin films (parallel and wedge), Newton's Rings, Michelson's and Fabry Perot Interferometers

**UNIT-III**

**(10 Hours)**

Fresnel's diffraction, Fresnel's zones and propagation of light, Zone plate, Fresnel's diffraction at straight edge and narrow wire, Fraunhofer diffraction at multiple slits, limiting cases - single and double slits, Resolving power - criterion, expressions for resolving powers of telescope, grating.



**UNIT-IV**

**(12 Hours)**

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator. Analysis of polarised light, Optical activity and Fresnel's explanation, Half shade and Biquartz polarimeters, Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems.

**Total Lectures: 40**

**TEXT BOOKS:**

**T1:** Text Book of Optics by BrijLal, Subramaniam & Avadhanulu (S. Chand)

**T2:** Optics by Ajoy Ghatak (Tata McGraw Hill, 2008)

**T3:** Optics by Eugene Hecht and A R Ganesan (Pearson Education, 2002)

**REFERENCE BOOKS:**

**R1:** Fundamentals of Optics by Francis Arthur Jenkins and Harvey Elliott White (McGraw-Hill, 1976)

**R2:** Light and Optics: Principles and Practices by Abdul Al-Azzawi (CRC Press, 2007)

**R3:** Contemporary Optics by A. K. Ghatak & K. Thyagarajan (Plenum Press, 1978)

**Course Learning Outcomes:**

After completion of this course, the students will be able to

- CLO1** state and apply Fermat's Principle to ray optics, understand and apply the properties of thin and thick lenses to various devices.
- CLO2** explain various aspect of phenomenon of interference and apply these aspect to fabricate and tailor the optical devices to solve day to day life unsolved problems.
- CLO3** understand different classes of diffraction phenomena and their features, apply these features to make and modify optical devices to resolve general as well as specific real word problems.
- CLO4** illustrate various types of polarization phenomena, analyze and apply these phenomena to achieve solutions of various puzzles of the daily life.



Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO 2	PSO3
CLO1	H	L	H	M	H	H	H	M	L	M	L
CLO2	H	L	H	M	H	H	H	M	M	M	M
CLO3	H	L	H	M	H	H	H	M	M	H	L
CLO4	H	L	H	M	H	H	H	M	H	H	M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Physics Lab-I**  
**BPH1502**

**L T P C**  
**0 0 4 2**

**Course Objectives (CO):**

**CO1:** To find the value of wavelength of light wave by using optical instrument like grating and plano-convex lens.

**CO2:** To understand the working of lens arrangement and rotatory polarization properties of sugar solution.

**CO3:** To identify the ultrasonic wave velocity and calculate value of alongwith the verification of parallelogram law.

**CO4:** To determine the moment of inertia, modulus of rigidity and young modulus of different objects.

**NAME OF THE EXPERIMENTS**

1. To determine the wavelength of the monochromatic light by Newton's Ring
2. To determine the specific rotation of the cane sugar solution using bi-quartz polarimeter
3. To determine the wavelengths of any three spectral lines using plane transmission diffraction grating
4. To determine the focal length of two lenses by nodal slide and to verify the Newton's formula
5. To determine the (a) Velocity of Ultrasonic Waves in and (b) Compressibility of the given experimental liquid (non-electrolytic) using ultrasonic interferometer
6. To determine the acceleration due to gravity using compound pendulum
7. To verify the law of parallelogram of forces
8. To determine the moment of inertia of a fly-wheel
9. To find the Young's modulus of the material by deflection of beam
10. To determine the modulus of rigidity by horizontal torsion of a rod



**REFERENCE BOOKS:**

- |   |   |
|---|---|
| [1] Practical Physics                             | G. L. Squires<br>Cambridge University Press                                 |
| [2] Numerical Methods for Engineers               | Steven Chapra & R.P. Canale, Tata McGraw- Hill<br>(3 <sup>rd</sup> Edition) |
| [3] Numerical Methods in<br>Engineering & Science | B. S. Grewal<br>Khanna Publishers (7 <sup>th</sup> Edition)                 |
| [4] Fundamentals of Mathematical<br>Statistics    | S. C. Gupta<br>Sultan Chand & Sons (10 <sup>th</sup> Edition)               |
| [5] Fundamental of Optics                         | Jenkins and White<br>McGraw-Hill International Ed.                          |
| [6] Optics  | Brij Lal and Subramaniam, S. Chand and Co.                                  |
| [7] Optics  | Ghatak, Tata-McGraw-Hill  |
| [8] Engg. Physics Practical                       | S. K. Gupta, Krishna Prakashan Media  |
| [9] B. Sc. Practical Physics                      | C. L. Arora, S. Chand and Co.   |

**Course Learning Outcome:**

After completion of this course student will be able to

CLO1: perform the experiments on different optical devices to calculate the wavelength of give light wave

CLO2: Comment on the relation for focal length of lens arrangement and understand the rotatory polarization process in optical active medium.

CLO3: Understand the behaviour of ultrasound is liquid medium of different properties and also the principle of parallelogram law.

CLO4: Analyze and identify different elastic properties of the materials.



Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	L	M	H	M	M	L	H	L	M	L
CLO2	H	L	M	M	M	H	L	M	M	M	M
CLO3	H	L	M	H	M	M	L	H	M	H	L
CLO4	H	L	M	L	M	H	M	H	H	H	M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Modern Algebra**  
**BMA1004**

L T P C

3 2 0 5

**Course Objectives (CO):**

**CO1:** To introduce fundamental ideas about relation, function, number theory and matrices.

**CO2:** To provide understanding of binary operations, group, subgroup and its properties.

**CO3:** To aim at understanding of trigonometry and relation between roots and coefficients for general polynomial equations

**CO4:** To explore the connection between theory and current fields of applications of the subject.

**UNIT-I: FUNCTIONS & NUMBER THEORY**

**(08 Hours)**

Sets, relations, equivalence relations, congruence relation between integers, functions, bijective functions, invertible functions, composition of functions, principle of mathematical induction, division algorithm, statement of fundamental theorem of arithmetic.

**UNIT-II: MATRIX THEORY-I**

**(08 Hours)**

Real and Complex matrices, elementary operations on matrices, normal form, Echelon form, inverse of matrices, rank of matrix, linear dependent and independent vectors, solution of systems of linear equations.

**UNIT-III: MATRIX THEORY-II**

**(08 Hours)**

Eigen values, Eigen vectors, Cayley- Hamilton Theorem, inverse of the matrix by Cayley- Hamilton Theorem, Diagonalizations.

**UNIT-IV: GROUP THEORY**

**(08 Hours)**

Group and its properties, Subgroup, Generators of a group, Cyclic groups, Coset decomposition, Permutation groups, Lagrange's theorem and its consequences, Fermat and Euler theorem.

**UNIT-V: TRIGONOMETRY**

**(08 Hours)**

De Moivre's theorem for rational indices and its applications, Gregory's series, Summation of series complex roots of unity, Descartes's rule of signs, relation between roots and coefficients for general polynomial equations, solution of cubic equation (Cardan method), Biquadratic equations.

**Total Lectures: 40**





### TEXT BOOKS

- T1. Fraleigh, John B., *Abstract Algebra*, Seventh Edition, Addison, Wesley, 2003
- T2. Joseph A. Gallian, "Contemporary", Narosa Publishing House, 1999.
- T3. Chandrika Prasad, Text-Book on algebra and Theory of Equations, Pothishala Private Ltd., Allahabad.
- T4. S.L. Loney, Plane Trigonometry Part II, Macmillan and Company, London.
- T5. Shanti Narayan, A Text Book of Matrices, S. Chand & Company, New Delhi.

### REFERENCES BOOKS

- R1. I.N. Herstien, Topics in Algebra, Wiely Eastern Ltd., New Delhi, 1975.
- R2. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
- R3. P.B. Bhattacharya, S.K. Jain And S.R. Nagpaul, BASIC Abstract Algebra (2<sup>nd</sup> Edition), Cambridge University Press, Indian Edition, 1997.
- R4. S.K. Jain A. Gunawardena and P.B. Bhattacharya, basic Linear Algebra with MATLAB, Key college Publishing (Springer-Verlag), 2001.
- R5. H.S. Hall and S.R. Knight, Higher Algebra, H.M. Publications, 1994.
- R6. R.S. Verma and K.S. Shukla, Text Book on Trigonometry, Pothishala Private Ltd., Allahabad.
- R7. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

### **Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to

**CLO1:** Recall, comprehend, apply and analyse the basic properties of relation, function, mathematical induction and division algorithm.

**CLO2:** Recall, understand, use and analyse and communicate is to impart student's fundamental concepts of matrices.

**CLO3:** Understand, apply, analyse and communicate to impart student's, fundamental concepts of algebra which include different type of binary operation, basic properties of group and subgroup.

**CLO4:** Remember, comprehend, apply and analyse the concept of De Moiver's theorem, Gregory's series, Descarte's rule of signs, and finding the solution of cubic equation (cardon method), Biquadratic equations.



Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CL O1	H	H	H	H	H	M	L	M	L	M	L
CL O2	H	H	H	H	H	M	M	M	M	M	M
CL O3	H	H	H	M	H	M	M	M	M	H	L
CL O4	H	M	M	L	H	M	L	M	H	H	M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**CALCULUS-I**  
**BMA1005**

L T P C

3 2 0 5

**Course Objectives (CO):**

**CO1:** To introduce concept of limit, continuity and differentiability of the functions.

**CO2:** To provide some understanding of the basic concept and theories of monotonic functions, uniform continuity and mean values theorems.

**CO3:** To aim that understanding the importance of functions of two variables and their properties.

**CO4:** To introduce some fundamental concepts about Tangents, Normals, Asymptotes and Curvature.

**UNIT-I: LIMIT, CONTINUITY & DIFFERENTIABILITY OF FUNCTIONS**

**(08 Hours)**

Limit of a function, Continuity and Discontinuity of functions, classification of discontinuities, Differentiability, Chain rule of differentiability, Indeterminate forms.

**UNIT-II: FUNCTIONS OF ONE VARIABLE**

**(08 Hours)**

Monotonic functions, uniform continuity, Rolle's Theorem, First and second mean value theorems, Maclaurin and Taylor series, Taylor's theorems with Lagrange's and Cauchy's forms of remainder.

**UNIT-III: FUNCTIONS OF TWO VARIABLES**

**(08 Hours)**

Functions of two variables, Limit, Continuity and Differentiability, Directional Derivative, Taylor's theorems for two variables, Maxima and Minima, Lagrange's method of multipliers and its applications.

**UNIT-IV: SUCCESSIVE DIFFERENTIATION**

**(07 Hours)**

Successive differentiation and Leibnitz's theorem, Partial differentiation, Change of variables, Euler's theorem on homogeneous functions.

**UNIT-V: TANGENTS AND NORMALS**

**(09 Hours)**

Tangents and Normals, Asymptotes, Curvature: Radius of Curvature - Cartesian equation, Centre of Curvature, Chord of Curvature, Envelopes and evolutes.

**Total Lectures: 40**



**TEXT BOOKS**

- T6. Gorakh Prasad, Differential Calculus, Pothishala Private Ltd. Allahabad.
- T7. Murray R. Spiegel, Theory and Problems of Advanced Calculus, Schaum’s outline series, Schaum Publishing Co. New York.
- T3. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.

**REFERENCE BOOKS**

- R1. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
- R2. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.
- R3. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S.Chand & Co. New Delhi, 2000.
- R4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiely and Sons, 1999

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

**CLO1:** Recall, comprehend, apply and analyze the basic properties of functions like limit, continuity, discontinuity and differentiability.

**CLO2:** Recall, understand, use and analyze the basic concept of uniform continuity and mean value theorems

**CLO3:** Understand, apply, analyze and communicate the importance of functions of two variables and their properties

**CLO4:** Remember, comprehend, apply and analyze some fundamental concepts about Tangents.

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	M	L	M	L	M	L
CLO2	H	H	H	H	H	M	M	M	M	M	M
CLO3	H	H	H	M	H	M	M	M	M	H	L
CLO4	H	M	M	L	H	M	L	M	H	H	M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Functional English**  
**BHU-1001**

**L T P C**  
**3 0 0 3**

**Course Learning Objectives:**

**CO1** To improve students' written and oral communication skills in English.

**CO2** To help them acquire professional and interpersonal skills to attain both their career and organization needs.

**CO3** To make the students apply effective communication skills in a variety of public and interpersonal settings.

**CO4** To help the students to develop reasoning, analytical and research skills.

**UNIT-I (13 HOURS)**

**COMMON ERRORS**

Noun, Pronoun, Verb, Adjective, Adverbs, Preposition, Conjunction, Articles, Tense, Direct and Indirect Narration, Active and Passive voice.

**UNIT-II (7 HOURS)**

**COMMUNICATION AND ITS ASPECTS**

Communication—definition, cycle, types and features; Flows of communication; Levels of communication; Barriers to communication.

**UNIT-III (8 HOURS)**

**LISTENING AND SPEAKING SKILLS**

Listening as a process and its types; Developing effective listening; Conversational ability; Situational conversation: at inquiry desk, at complaint desk, in hospital, at tourist place, with fellow travellers, etc; Organization and delivery of public speech.

**UNIT-IV (12 HOURS)**

**READING AND WRITING COMPREHENSION**

Reading skills and its types, Reading strategies, Reading comprehension; Note Making and Note Taking, Précis Writing and Paraphrasing, Writing skills and its types, Paragraph writing, Expansion, Essay writing, Article writing, Press Notes.

**Prescribed Texts for Reading Comprehension:**



*The Effect of Scientific Temper on Man* by Bertrand Russell

*The Aims of Science and the Humanities* by Moody E. Prior

*Mass Media and Society* by Gerald Barry *et. al.*

*The Mother of the Sciences* by A. J. Bahm

### Text Books

- T1.** Sinha, R.P. “Current English Grammar and Usage with Composition” Oxford University Press, New Delhi.
- T2.** Raman, M. and Sharma, S. “Technical Communication: Principles and Practice” Oxford University Press.
- T3.** Arora, V.N. and Chandra, Lakshmi. “Improve Your Writing” Oxford University Press, New Delhi.
- T4.** Kaul, A. “Business Communication” (2<sup>nd</sup> Edition) PHI Learning Pvt. Ltd. New Delhi.

### Reference Books:

- R1.** Lesiker, R.V. et al., “Business Communication”, Tata Mc-Graw Hill.
- R2.** Brians, P. “Common Errors in English Usage”, Franklin, Beedle& Associates, 2003.
- R3.** Nitin, B. “Communicative English for Engineers and Professionals”, Pearson Education India, 2010.
- R4.** Bakshi, R.N. “A Course in English Grammar”, Orient Longman.

### **Course Learning Outcomes (CLO)**

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

<b>CLO</b>	<b>Description</b>	<b>Bloom’s Taxonomy Level</b>
CLO1	<b>Recall</b> the basics of grammar without error. The students will <b>list</b> the usage of parts of speech and avoid the common errors in spoken and written communication. The students will <b>summarize</b> and <b>develop</b> the appropriateness of grammar in speech and writing and use English language correctly and effectively.	1,1,2,3 Remembering, Understanding, Apply
CLO2	<b>Develop</b> information learnt about communication to become a good communicator. The students will <b>examine</b> the types, flows and levels of communication and effectively <b>judge</b> an	3,4,5 Applying,



	appropriate level of communication developing interpersonal skills. The students will be acquainted with LSRW (Listening, Speaking, Reading and Writing) skills as well.	Analyzing, Evaluating
CLO3	<b>Apply</b> the knowledge to differentiate between the process of listening and hearing. The students will <b>examine</b> accurate way of communicating effectively by becoming an effective listener as well. The students will <b>evaluate</b> a well equipped communication channel by not only becoming a good speaker but also a good listener and will be well acquainted with LSRW (Listening, Speaking, Reading and Writing) skills.	3,4,5 Applying, Analyzing, Evaluating
CLO4	<b>Apply</b> the usage of reading and writing skills and <b>analyze</b> the importance of both the skills to make process of communication successful to improve language comprehension ability. The students will <b>determine</b> an accurate way to share their views and ideas in a professional and competent manner by acquainting themselves with LSRW (Listening, Speaking, Reading and Writing) skills.	3,4,5 Applying, Analyzing, Evaluating

Course Learning Outcomes	Program Learning Outcomes (PLO's)										
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	L	M	M			M		H	M	M
CLO2	M		M	M	M	M	H	H		M	
CLO3	H	H	H	H	M	M	H	H		M	
CLO4	H	H	H	H	M	M	H	H			M



**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**ENGLISH LANGUAGE LAB**  
**BHU1501**

L T P C  
0 0 2 1

**Course Objectives (CO):**

**CO1** To develop effective communication skills, team spirit, leadership quality, presentation skills, interpersonal skills and professional etiquette.

**CO2** To improve accent, intonation, pronunciation and overall language skills.

**CO3** To organize language workshops or activities to enhance confidence in group discussion, debate, speaking, public speaking, situational conversation, mock interviews, etc.

**CO4** To design suitable activities and create environment to boost up confidence and effective communication skills.

**LIST OF ACTIVITIES**

**1. PRONUNCIATION PRACTICE** (2 lab days)

- i. Sounds of English
- ii. Syllable
- iii. Accent
- iv. Intonation
- v. Common Errors in Pronunciation
- vi. Pronunciation Practice

**2. SPEAKING PRACTICE** (2 lab days)

- i. Phenomenon Description
- ii. Live commentary
- iii. Process Description
- iv. Routine and Properties
- v. Future Plans
- vi. Story Telling

**3. PRESENTATION** (2 lab days)

- i. Use of Power Point Presentation
- ii. Salient Features of Effective PPT
- iii. Slide Making
- iv. Delivery
- v. Practice





- 4. PUBLIC SPEECH** (1 lab day)
- i. Use of Public Speech
  - ii. Salient Features of an Effective Speech
  - iii. General Challenges
  - iv. Audience Analysis
  - v. Persuasion Techniques: Ethos, Pathos, Logos
  - vi. Body Language, Tone, and Delivery
  - vii. Speech Practice
- 5. INTERVIEW** (1 lab day)
- i. Making an Effective CV
  - ii. Preparation for an Interview
  - iii. Interview Etiquettes
  - iv. Most Common Interview Questions
  - v. Mock Interview
- 6. GROUP DISCUSSION** (2 lab days)
- i. Purpose
  - ii. GD Etiquettes
  - iii. Rules and Techniques
  - iv. GD Practice
- 7. DEBATE** (1 lab day)
- i. Purpose
  - ii. Rules and Techniques
  - iii. Debate Practice
- 8. SITUATIONAL CONVERSATION** (2 lab days)
- i. At Hotel
  - ii. At the Air-Port
  - iii. At Bank
  - iv. At Shop
  - v. At Workplace



**TEXT BOOKS:**

- T1: Beebe, S.A.*et al.* “Communication: Principles for Lifetime”(3rd edition), Pearson.
- T2: Raman, M. and Sharma, S. “Technical Communication: Principles and Practice” Oxford University Press.
- T3: Sethi, J. and Dhamija, P.V. “A Course in Phonetics and Spoken English”(2<sup>nd</sup> Ed.),PHI Learning Pvt. Ltd.

**REFERENCE BOOKS:**

- R1: Hencock, M. “English Pronunciation in Use”, Cambridge University Press.
- R2: Carter, R. “Seeing Through Language: A Guide to Styles of English Writing”, Blackwell Publications.
- R3: Balasubramanian, T. “A Textbook of Phonetics for Indian Students”, Macmillan.
- R4: Humes, J.C. “Speak Like Churchill, Stand Like Lincoln: 21 Powerful Secrets of History's Greatest Speakers”, Three Rivers Press.

**Course Learning Outcomes (CLO):** On completion of this course, the students will be able to:

CLOs	Description	Bloom’s Taxonomy Level
CLO1	<b>Show</b> confidence in group discussion, debate, speaking, public speech, situational conversation, etc.	2 Understanding
CLO2	<b>Identify and demonstrate</b> effective communication skills, team spirit, leadership quality, presentation skills, interpersonal skills and professional etiquette.	2, 3 Understanding, Applying
CLO3	<b>Take part in</b> group discussion, debate and interviews comfortably and confidently; <b>influence</b> the public with professional competence.	4, 5 Analysing, Evaluating
CLO4	<b>Improve</b> accent, intonation, diction and overall communication and presentation skills; <b>adapt</b> themselves to new situations or as per the need of organization.	6 Creating



**Mapping of CLOs with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs):**

CLOs	PLOs												PSOs		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PSO1	PSO2	PSO3
<b>CLO1</b>	M	L	M	M			M		H	M	M	M	L	M	M
<b>CLO2</b>	M		M	M	M	M	H	H		M		M		M	M
<b>CLO3</b>	H	H	H	H	M	M	H	H		M		H	H	H	H
<b>CLO4</b>	H	H	H	H	M	M	H	H			M	H	H	H	H

**B. Sc.(Hons): Chemistry**  
**I Year, I Semester**  
**Environmental Studies**  
**BES 1001**

L T P C  
2 0 0 2

**Course Objectives (CO):**

CO1 To **tell** some introductory knowledge on concepts and general principles regarding environment.

CO2 To **illustrate** role of education, religions, cultures, movements and sustainable developmental activities in ecological preservation.

CO3 To aim at **understanding** the sources, effects and control measures of pollution of air, water, land, noise, solid wastes and also creating awareness on globally recognized environmental challenges.

CO4 To **examine** the role of ways, legal methods and accountabilities in safeguarding environment.

**Unit I: Basics of Environment and Natural Resources**

**(08 Hours)**

Components of the environment (atmosphere, hydrosphere, lithosphere and biosphere), types of environment (micro-level, macro-level, natural and man-made), concept of ecology.

□ Importance and multidisciplinary nature of environmental studies.

□ Ecosystem; Structure and functions (energy flow, food chains and food webs).

□ Land resources: Land use change; land degradation, soil erosion and desertification.

Deforestation: Causes (mining, dam construction and urbanization) and impacts on environment.

□ Water resources: Use and over-exploitation of surface and ground water, conflicts over water (international & inter-state).

Energy resources: Renewable and non renewable, alternate resources, growing energy needs.

**Unit II: Ecological Behavior and Knowledge Management**

**(07 Hours)**

Ethics and ecological wisdom: Role of Indian and other religions and cultures in environmental conservation, ecological world view.

Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi), energy and water conservation, consumerism, commitment to environmental organizations.

T1. Pollution case studies.

T2. Resettlement and rehabilitation of project affected persons; case studies.

T3. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan etc.

Sustainable Development and Agenda 21.



Biodiversity: Importance, threats and conservation.  
Managing Environmental challenges for future.

**Unit III: Environmental Pollution and Remediation**

**(06 Hours)**

Environmental pollution: Air, water, land, noise, and nuclear hazards.

Solid waste management (municipal, industrial, commercial and hazardous).

An understanding of environmental issues: Climate change, global warming, ozone layer depletion, acid rain, natural disasters and human population growth.

**Unit IV: Environmental Laws and Regulations**

**(04 Hours)**

Policy consideration: Environmental (Protection), Act, 1986; Hazardous Wastes (Management and Handling) Rules, 1989; Noise Pollution (Regulation and Control) Rules, 2000; Bio-Medical Waste (Management and Handling) Rules, 1998.

Role of different agencies in promoting environmental protection: Role of magistracy, higher courts and police.

International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Corporate Social responsibility (CSR).

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Recall, analyze</b> and respond on the basic understanding of their environmental complexes.	1, 4 Remembering, Analyzing
CLO2	<b>Understand</b> and <b>analyze</b> the ways education, social movements and fair developmental practices help in maintaining ecological balance.	2, 4 Understanding, Analyzing
CLO3	<b>Understand</b> and <b>analyze</b> various aspects of deteriorating environmental components and also prevailing environmental threats.	2, 4 Understanding, Analyzing
CLO4	<b>Interpret</b> and <b>elaborate</b> various tools viz. policies, rules/acts, mechanisms, compliances, institutions/agencies in securing the planet.	5, 6 Evaluating, Create



**Matching of PLOs and CLOs:**

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)												Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PSO 1	PSO2	PSO3
	CLO1	M	M		M	L	M		M	-	M	-	M	M	-
CLO2	M	H		M	L		H	L		M	M	-	-	H	M
CLO3	M		H	-	-	H		L	M			M	M	H	M
CLO4	-	-	L		H	-	H	-	M	H	M		-	-	H

**TEXT BOOKS:**

1. Environmental Science and Engineering by Benny Joseph (Tata Mc Graw Hill Publishing Company, New Delhi).
2. Environmental Studies by R.C. Sharma and D. Gurbir Sangha (Kalyani Publishers, New Delhi).
3. Introduction to Environmental Science by Anjaneyalu, Y. (B.S. Publications, Hyderabad).
4. Environmental Pollution Control Engineering by C.S. Rao (New Age International Pub.).

**REFERENCE BOOKS:**

- T4. Text book of Environmental Studies for undergraduate courses by E. Bharucha (University Press Publication).
- T5. Environmental Studies: From Crisis to Cure by R. Rajagopalan (Oxford University Press).
- T6. Environmental Science by S.C. Santra (New Central Book Agency (P) Ltd., Kolkata).

**OTHER REFERENCES:**

- R1. <http://nptel.ac.in/courses/122102006/>
- R2. <https://www.youtube.com/watch?v=jXAIlwKkzhk>
- R3. [https://www.youtube.com/watch?v=2OIRyx\\_f0\\_g](https://www.youtube.com/watch?v=2OIRyx_f0_g)
- R4. <https://www.youtube.com/watch?v=1izVLnqOm4A>
- R5. <https://www.youtube.com/watch?v=IDrIGTnTuBI>



**B. Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Inorganic Chemistry-I**  
**BCY2002**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1 State and explain** students about the fundamental concepts of structure of atom and theories governing them.

**CO2 Describe** the arrangement of elements on the basis of electronic configuration and **explain** the periodicity.

**CO3 Compare** among the elements of different groups in periodic table on the basis of periodic properties.

**CO4 To illustrate** bonding and **classification** of ionic solids and **demonstrate** crystal defects.

**Unit I- Atomic Structure-I**

**[6 L]**

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance.

**Unit II- Atomic Structure-II**

**[7 L]**

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations. Schrödinger's wave equation, significance of  $\psi$  and  $\psi^2$ , Quantum numbers and their significance, Shapes of *s*, *p* and *d* orbitals.

**Unit III- Periodicity of Elements-I**

**[10 L]**

Definition and discussion of the following properties of the elements, with reference to *s* & *p*-block and the trends shown:

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic and ionic radii

(c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization enthalpy and trends in groups and periods.

**Unit IV- Periodicity of Elements-II**

**[8 L]**

Definition and discussion of the following properties of the elements, with reference to *s* & *p*-block and the trends shown:

(d) Electron gain enthalpy and trends in groups and periods.

(e) Electronegativity, Pauling's/ Allred Rochow's scales, Mulliken's scale, Variation of electronegativity with bond order, partial charge.

**UNIT –V Chemical Bonding-I**

**[9 L]**

Definition and explanation, Energy changes in the formation of ionic bond, Lattice energy and Born-Haber cycle, radius ratio rule, Calculation of radius ratio (For Coordination No-3,4 and 6 only), Limitation of radius ratio rule, Close packing in ionic structures, Classification of ionic structures into group AX (ZnS, NaCl and CsCl) and AX<sub>2</sub>(CaF<sub>2</sub>, TiO<sub>2</sub>, SiO<sub>2</sub>), Defects in solids.

**Total Lectures: 40**



**TEXT BOOKS:**

- T1.** J. D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup>, Blackwell Science, London, 1996.  
**T2.** Wahid U. Malik, G. D. Tuli, R. D. Madan Inorganic chemistry, 7<sup>th</sup>, S. Chand Publication, 2001.  
**T3.** B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 1<sup>st</sup>, Shobhan Lal Nagin Chand & Co., 1996.

**REFERENCE BOOKS:**

- R1.** D.F. Shriver, P.W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>, Oxford University Press, 2010.  
**R2.** F.A. Cotton, G. Wilkinson, P.L. Gaus, Basic Inorganic Chemistry, 3<sup>rd</sup>, Wiley India, 2004.  
**R3.** G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3<sup>rd</sup>, Pearson Education Ltd, 2014.  
**R4.** J. Huysse, E. A. Keiter, R. L. Keiter, Okhil K. Medhi, Inorganic chemistry, 4<sup>th</sup>, Pearson Education Ltd., 2013.  
**R5.** Dr. Sathya Prakash, S.K. Basu, R.D. Madan, G.D. Tuli. Advanced Inorganic Chemistry 4<sup>th</sup> reprint, 1999.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Describe</b> the structure of atom (classical as well as quantum mechanical approach) and understand <b>how</b> to draw shapes of s, p and d-orbitals.	1, 2 Remembering, Understanding
CLO2	<b>Explain</b> the arrangement of elements in the periodic table on the basis of electronic configuration and <b>illustrate</b> their bonding and properties.	2, 3 Understanding, Applying
CLO3	<b>Understand</b> and <b>compare</b> the changes in periodic properties across the group and period and their <b>influence</b> on chemical and physical properties.	2, 5 Analyzing, Evaluating
CLO4	<b>Show</b> the energy changes in the formation of bonds in ionic solids and <b>understand</b> their <b>importance</b> in solid state chemistry.	2, 3, 5 Understanding, Applying Evaluating,





Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	H	M	M	-	-	L	H	M	M
CLO2	M	M	M	M	M	-	L	L	M	M	L
CLO3	M	M	M	L	L	L	-	M	M	M	M
CLO4	M	H	H	L	M	L	L	M	H	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Organic Chemistry-II**  
**BCY2003**

L T P C  
3 1 0 4

**Course Objectives:**

- CO1** To teach student how to name organic molecules, and draw structures given names.  
**CO2** To teach student about the synthesis and applications of Alkyl, Aryl halides, carbonyl containing compounds and active methylene compounds, and closely related species and Grignard reagents.  
**CO3** To acquire knowledge about various physical properties of different functional groups and also how different subclasses of a particular functional group react with different rates and give different products.  
**CO4** To understand how a particular group can be converted into the desired group as well as compounds.  
**CO5** To provide some understanding of stereochemistry of organic molecules.

**Unit I- Alkyl and Aryl Halides**

**[8 L]**

Classification and nomenclature of alkyl halides, methods of preparation, Chemical reactions, Saytzeff rule. Polyhalogen compounds: Chloroform, Carbon Tetrachloride. Methods of formation of aryl halides, Nucleophilic aromatic substitution, Reactivity and orientation in nucleophilic aromatic substitution. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and applications of DDT and BHC. Grignard reagents-preparation and synthetic applications.

**Unit II- Alcohols**

**[8 L]**

Preparation, properties and relative reactivity of 1° 2° and 3° alcohols. Chemical tests to distinguish 1° 2° and 3° alcohols. Comparative study of dehydration, oxidation, substitution and esterification of 1° 2° and 3° alcohols. Formation of alkyl sulphonates. Bouveault-Blanc Reduction. Preparation and properties of glycols. Pinacole pinacolone reaction.

**Unit III- Aldehyde and Ketones**

**[10 L]**

Structure and reactivity of carbonyl compounds, Keto-enol Tautomerism, methods of preparation, Nucleophilic addition reactions-reactions with carbon nucleophiles (reaction with Grignard reagent, Acetylide ions, hydrogen cyanide) reaction with hydride ion-  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$  Reaction with nitrogen nucleophiles- formation of Schiff base, enamines. Addition of sodium bisulphate and alcohol. Reactions involving alkyl groups- Aldol condensation and mixed Aldol condensation. Reduction- Rosenmund reduction, Clemensen reductions, Wolf-Kishner reduction, Some important reactions- Haloform reaction, Reformatsky reaction, Wittig reaction, Claisen condensation.

**Unit IV- Stereochemistry**

**[7 L]**

Fischer, saw-horse and Newman projection. Chirality-optical activity, enantiomerism and diastereoisomerism involving one and two chiral centers, meso compounds and racemic mixtures. Enantiotopic and diastereotopic hydrogens and prochiral carbons. geometrical isomerism- cis-trans, E-Z and syn-anti. Absolute configuration, R/S nomenclature, conformational analysis of cyclohexane.



**Unit V- Aliphatic Carboxylic Acid and Active Methylene Compounds**

[7 L]

General preparation and reaction of mono- and di-carboxylic acids. Malonic ester synthesis. Acidity of carboxylic acid, effect of substituent on acidity, reduction reactions, decarboxylation of 3-oxocarboxylic acid. Esterification, Hell-Volhard-Zelinsky reaction. Electrolysis. Preparation and synthetic applications of ethyl acetoacetate.

**Total Lectures: 40**

**TEXT BOOKS:**

- T1.** "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6<sup>th</sup> Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
- T2.** Solomons & Fryhle's Organic Chemistry, T.W. Graham Solomons, C. B. Fryhle, 10<sup>th</sup> edition, 2014, Wiley
- T3.** "Organic Chemistry", S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1<sup>st</sup> Edition (1985), 5<sup>th</sup> Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
- T4.** Basic stereochemistry of Organic Molecules, Subrata Sen Gupta, 1<sup>st</sup> edition, Oxford University press, 2014.

**REFERENCE BOOKS:**

- R1.** "Organic Chemistry", Paula Y Bruice, 2<sup>nd</sup> Edition, Prentice-Hall International, Inc, New Jersey, International Edition (1988).
- R2.** B. M. Smith and Jerry March, March's Advanced Organic Chemistry, 5<sup>th</sup> Edition (2000), John Wiley & Sons, New York.
- R3.** Peter Sykes, "A Guide book to mechanism in Organic Chemistry" 6<sup>th</sup> Edition (1997), Orient Longman Ltd., New Delhi.
- R4.** D. Nasipuri, Stereochemistry of Organic Compounds, 2<sup>nd</sup> Edition (1994), Wiley Eastern Ltd., New Delhi.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Recall, comprehend, apply</b> and <b>analyze</b> the basic properties and stereochemistry of organic halides, alcohols, aldehydes and ketones, active methylene compounds and closely related species.	1, 2, 3, 4 Remembering, Understanding Applying, Analyzing
CLO2	<b>Recall, understand, use, classify, explain</b> and <b>apply</b> concepts associated with understand fundamental organic reactions ( $S_N^1$ , $S_N^2$ , $E_1$ , $E_2$ , addition, elimination, ring opening, etc.) to product prediction, synthesis design, and reaction mechanism.	1, 2, 3, 4 Remembering, Understanding, Applying, Analyzing
CLO3	<b>Understand, remember,</b> and <b>analyze</b> the major product, including stereochemistry by <b>explaining</b> the driving force for the reaction.	1, 2, 4, 5 Remembering, Understanding, Analyzing,



		Evaluating
CLO4	<b>Remember, comprehend</b> and <b>classify</b> organic molecules by their functional groups, and <b>identify</b> fundamental properties associates with those functional groups.	1, 2, 3, 4 Remembering, Understanding, Applying Analyzing

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	M	H	L	-	L	M	M	H	M
CLO2	M	L	L	M	L	-	M	M	L	M	M
CLO3	M	M	L	M	L	-	L	M	L	M	L
CLO4	M	M	M	H	M	L	M	M	H	M	M



**B.Sc. (Hons): Chemistry**  
**I Year, I Semester**  
**Chemistry Lab-II**  
**BCY2502**

**L T P C**  
**0 0 4 2**

**Course Objectives:**

**CO1** To **show** students **how** to **predict** the presence of halogens in an organic compound.

**CO2** To **demonstrate** students **how** to **identify** carbonyl and phenolic organic compounds. students

**CO3** To **build** practical skills of students in **identifying** anions and cations in inorganic mixture through analysis.

**CO4** To **develop** practical skills in **calculating** strength of solutions through some important titrations of analytical chemistry.

**LIST OF EXPERIMENTS**

1. Detection of halogens (Cl, Br, I) by Lassaigne's test in given Organic compounds.
2. Detection of aldehyde by systematic chemical tests.
3. Detection of ketone by systematic chemical tests.
4. Detection of esters by systematic chemical tests.
5. Detection of compound 1 (phenol) by systematic chemical tests.
6. Detection of compound 2 (phenol) by systematic chemical tests.
7. Semi-micro qualitative analysis of inorganic mixture containing one acidic and one basic radical (mixture 1.)
8. Semi-micro qualitative analysis of inorganic mixture containing one acidic and one basic radical (mixture 2.)
9. Determination of the strength of given  $\text{CuSO}_4$  solution using thiosulphate as intermediate and starch as internal indicator.
10. Determination of the strength of Ferrous ammonium sulphate (Mohr's salt) Solution using  $\text{K}_2\text{Cr}_2\text{O}_7$  as intermediate and N-phenyl anthranilic acid as internal indicator.

**TEXT BOOKS:**

**T1.** O. P. Pandey, D. N. Bajpai, S.Giri. "Practical Chemistry", S. Chand & Co. 2012.

**REFERENCE BOOKS:**



- R1.** N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry–Lab manual, S. Viswanathan Co. Pvt., 1998.
- R2.** J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
- R3.** B. S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel’s Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Bloom’s Taxonomy Level
CLO1	<b>predict</b> presence of halogens in a given organic compound and <b>how to distinguish</b> among them.	3, 4 Applying Analyzing
CLO2	<b>show</b> and <b>analyse</b> the presence of carbonyl and phenolic groups in a given organic compound.	3, 4 Applying Analyzing
CLO3	<b>interpret</b> and <b>identify</b> cations and anions in a given inorganic mixture through quantitative chemical <b>analysis</b> .	2, 3, 4 Understanding Applying Analyzing
CLO4	<b>understand</b> and <b>determine</b> the strength of unknown solutions through titrations other than acid base titrations.	2, 5 Evaluating, Creating

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	M	L	L	L	-	-	L	L	L	L
CLO2	M	M	M	M	M	L	L	M	M	M	M
CLO3	M	M	H	L	L	-	-	M	M	H	M
CLO4	H	H	M	M	M	L	M	M	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Electricity & Magnetism**  
**BPH 2002**

L T P C  
3 1 0 4

**Course Objectives (CO) :**

- CO1** To introduce fundamental concepts and governing laws of electrostatics and apply them to standard cases
- CO2** To extend the basic understanding of magnetostatics and its application to solve realistic problems
- CO3** To explore the phenomena of electromagnetic induction with its implications and applications
- CO4** To explain basics of magnetism of matter to appreciate the classification and application of magnetic materials

**UNIT -I**

**(14 Hours)**

Coulomb's law, Electric Field and potentials, Field due to a uniform charged sphere, Derivations of Poisson and Laplace Equations, Gauss Law and its application: The Field of a conductor. Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charged distribution, Electric quadrupole, Field due to a quadrupole, Electrostatic Energy of a charged uniform sphere, Energy of a condenser. Dielectric constant, polarization, Electronic polarization, Atomic or ionic Polarisation, Polarisation charges, Electrostatic equation with dielectrics, Field, force and energy in Dielectrics.

**UNIT -II**

**(09 Hours)**

Magnetic field, Magnetic force on a current, Magnetic Induction and Biot - Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid.



**UNIT -III**

**(09 Hours)**

Faraday' s laws and Lenz' s Law. Mutual and Self Induction , Vector potential in varying Magnetic field , Induction of current in continuous media , Skin effect. Motion of Electron in changing magnetic field , Betatron , Magnetic energy in field , Induced magnetic field (Time varying electric field), Displacement current .

**UNIT -IV**

**(10 Hours)**

Magnetism of Matter:- Gauss' s law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (M). Magnetic Intensity (H). Relation between B, M and H. Stored Magnetic Energy in Matter. Magnetic Circuit. Potential Energy of a Current Loop. Ballistic Galvanometer: Current and Charge sensitivity. Electromagnetic Damping. Logarithmic Damping. CDR.

**Total Lectures: 42**

**TEXT BOOKS**

- T1. Electricity ad Magnetism – K K Tiwari – S Chand
- T2. David J. Griffiths, Introduction to Electrodynamics, 3rd Edn, (Benjamin Cummings,1998).
- T3. Electricity and Magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)

**REFERENCE BOOKS**

- R1. Fundamentals of Electricity and Magnetism By Arthur F. Kip (McGraw-Hill, 1968)
- R2. Electricity and Magnetism by J. H. Fewkes & John Yarwood. Vol. I (Oxford Univ. Press, 1991).
- R3. Electricity and Magnetism. By D C Tayal (Himalaya Publishing House,1988).





## Course Learning Outcomes:

After completing the course, the students will be able to-

- CLO1** recall and explain fundamental concepts of Electrostatics and apply them to solve practical and numerical problems.
- CLO2** relate and extend their understanding of Magnetostatics and make use of it to evaluate field strength in various practical cases.
- CLO3** state and illustrate laws of Electromagnetic Induction and understand design and application of Betatron.
- CLO4** Outline various phenomenon of magnetism of matter, classify magnetic materials and demonstrate use and application of Ballistic Galvanometer.

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	L	L	H	L	M	L	L	L
CLO2	H	M	H	M	M	H	M	M	M	M	M
CLO3	H	M	M	M	L	M	L	M	M	H	M
CLO4	H	H	H	H	H	M	L	H	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Thermal Physics**  
**BPH 2003**

L T P C  
3 1 0 4

**Course Objectives (CO):**

- CO1** To introduce basic laws of thermodynamics and their application to different thermodynamics processes
- CO2** To provide understanding about second law of thermodynamics and entropy with reference to ideal and real systems
- CO3** To gain insight of the thermodynamic potentials and derivation of Maxwell's relations with their applications to different thermodynamic processes.
- CO4** To explore idea about kinetic theory of gases, transport phenomenon and the various aspect of the ideal as well as Van der wall's gases.

**UNIT – I**

**(10 Hours)**

Zeroth and First Law of Thermodynamics :- Thermodynamical Equilibrium. Zeroth Law of Thermodynamics and Concept of Temperature. Work and Heat Energy. State Functions. First Law of Thermodynamics. Differential form of First Law. Internal Energy. First Law and Various Processes. Applications of First Law : General Relation between  $C_p$  and  $C_v$ . Work Done during Isothermal and Adiabatic Processes. Compressibility and Expansion Coefficient. Second Law of Thermodynamics :- Reversible and Irreversible Changes. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot Cycle. Carnot Engine and its Efficiency. Refrigerator and its Efficiency.

**UNIT – II**

**(10 Hours)**

Second Law of Thermodynamics : Kelvin-Planck and Clausius Statements and their Equivalence. Carnot Theorem. Applications of Second Law of Thermodynamics : Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Entropy :- Change in Entropy. Entropy of a State. Clausius Theorem. Clausius Inequality. Second Law of Thermodynamics in terms of Entropy. Entropy of a Perfect Gas. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Impossibility of Attainability of Absolute Zero : Third Law of Thermodynamics. Temperature-Entropy Diagrams.



**UNIT – III**

**(10 Hours)**

Thermodynamic Potentials :- Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials U, H, F and G : Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work. Cooling due to Adiabatic Demagnetization. Approach to Absolute Zero Maxwell' s Thermodynamic .

Relations:- (1) Derivations of Maxwell' s Relations. Applications of Maxwell' s Relations: (1) Clausius Clapeyron equation, (2) Values of  $C_p - C_v$ , (3) Tds Equations, (4) Joule-Kelvin Coefficient for Ideal and Van der Waal Gases, (5) Energy Equations and (6) Change of Temperature during an Adiabatic Process.

**UNIT – IV**

**(12 Hours)**

Kinetic theory of gas, Maxwell – Boltzmann law, Equi-partition of energy, Mean free path, transport phenomena, Brownian motion, Avogadro number. Behavior of Real Gases:- Deviations from the Ideal Gas Equation. The Virial Equation. Andrew' s Experiments on CO<sub>2</sub> Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal' s Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Joule' s Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

**Total Lectures: 42**

**TEXT BOOKS**

- T1. Thermal Physics by Garg, Bansal and Ghosh (Tata McGra-Hill, 1993)
- T2. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
- T3. Heat and Thermodynamics: An Intermediate Textbook By Mark Waldo Zemansky, Richard Dittman (McGraw-Hill, 1981)

**REFERENCE BOOKS**

- R1. A Treatise on Heat : Including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics By Meghnad Saha, B. N. Srivastava (Indian Press, 1958)
- R2. Thermodynamics By Enrico Fermi (Courier Dover Publications, 1956)



R3. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics by Francis W. Sears & Gerhard L. Salinger.( Narosa, 1986).

**Course Learning Outcomes:**

After completion of this course, the students will be able to-

- CLO1** state, explain and apply basic laws of thermodynamics to analyze various thermodynamic problems.
- CLO2** explain significance of second law, need of thermodynamic scale and the concept of entropy to analyze and evaluate the real word thermodynamic problems
- CLO3** define and utilize the thermodynamic potentials to examine the equilibrium state of the thermodynamic systems and deduce the Maxwell’s equations to solve the observed thermodynamic puzzles
- CLO4** Outline basic assumption of kinetic theory of gases, explain the transport phenomenon and analyze departure of the real gas to ideal gas behavior, illustrate the existence of inter molecular attraction as well as the role of the inversion temperature for the liquefaction of real gases and regenerative cooling

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO <sub>2</sub>	PSO3
CLO1	H	H	H	M	H	H	M	M	L	L	L
CLO2	H	H	H	M	H	H	H	H	M	M	M
CLO3	H	H	H	M	H	H	M	M	M	H	M
CLO4	H	M	M	M	H	H	M	M	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Physics Lab-II**  
**BPH 2502**

**L T P C**  
**0 0 4 2**

**Course Objectives (CO):**

**CO1:** To demonstrate the variation of magnetic field of current carrying coil and analyze the properties of hysteresis, hall effect of solids.

**CO2:** To understand the calibration of the voltmeter, potentiometer and carry Foster bridge.

**CO3:** To learn the different methods like leakage method and electrical methods for determination of high resistance and Stefan's law respectively.

**CO4:** To determine the thermal resistance, thermal conductivity of different solids and liquids medium.

**NAME OF THE EXPERIMENTS**

1. To study variation of magnetic field along the axis of Helmholtz Galvanometer and determine the radius of the Helmholtz coil.
2. To study the hysteresis loop for a given ferromagnetic material on a CRO using a solenoid.
3. To determine the (a) Hall Coefficient (b) Carrier charge concentration and (c) mobility of charge carriers of a given semiconductor material using the given setup.
4. To find the low resistance by Carey Foster bridge after calibrating the bridge wire.
5. To determine the high resistance by leakage method.
6. To determine the angle of dip in the laboratory using an earth inductor.
7. To calibrate the ammeter and voltmeter by potentiometer.
8. To verify Stefan's law by electrical method.
9. To determine total thermal resistance and thermal conductivity of composite wall.
10. To determine the thermal conductivity of a liquid.

**REFERENCE BOOKS:**

- |   |   |
|---|---|
| [1] Practical Physics                             | G. L. Squires<br>Cambridge University Press                                 |
| [2] Numerical Methods for Engineers               | Steven Chapra & R.P. Canale, Tata McGraw- Hill<br>(3 <sup>rd</sup> Edition) |
| [3] Numerical Methods in Engineering<br>& Science | B. S. Grewal<br>Khanna Publishers (7 <sup>th</sup> Edition)                 |
| [4] Fundamentals of Mathematical<br>Statistics    | S. C. Gupta<br>Sultan Chand & Sons (10 <sup>th</sup> Edition)               |



[5] Fundamental of Optics

Jenkins and White

McGraw-Hill International Ed.

[6] Optics

Brij Lal and Subramanium, S. Chand and Co.

[7] Optics

Ghatak, Tata-McGraw-Hill

[8] Engg. Physics Practical

S. K. Gupta, Krishna Prakashan Media

[9] B. Sc. Practical Physics

C. L. Arora, S. Chand and Co.

## Course Learning Outcomes:

After completion of this course student will be able to

CLO1: understand and explain the working principle of magnetic properties of current carrying coil and different solids.

CLO2: perform the calibration of different electrical instrument such as ammeter, voltmeter and bridges.

CLO3: Describe the principle working of leakage method and understand the stefan's law.

CLO4: examine the different thermal properties of the solids and liquids.

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO <sub>2</sub>	PSO3
CLO1	H	L	M	H	M	M	L	H	L	L	L
CLO2	H	L	M	M	M	H	L	M	M	M	M
CLO3	H	L	M	H	M	M	L	H	M	H	M
CLO4	H	L	M	L	M	H	M	H	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Vector calculus & Geometry**  
**BMA2004**

L T P C  
3 2 0 5

**Course Objectives (CO) :**

**CO1:** To introduce some fundamental ideas about the calculus of vector fields.

**CO2:** To provide some understanding of the concepts the calculus of vector fields and the definition of the curls and divergence of a vector function in three dimensions.

**CO3 :** To introduce the line and surface integrals and calculate the flux integral over a surface and some basic ideas of the elementary account of the geometry of curves and surfaces in two and three dimensions.

**CO4:** To explore the connection between Mathematics and current fields of applications of the subject.

**UNIT-I: VECTOR DIFFERENTIAL CALCULUS (08 Hours)**

Vector Differential Operators: Gradient, Divergence and Curl and their physical interpretations, directional derivative, vector identities.

**UNIT-II: VECTOR INTEGRAL CALCULUS (08 Hours)**

Line, Surface and Volume Integrals, applications of Gauss- Divergence theorem, Stoke's theorem and Green's theorem (without proof).

**UNIT-III: CONICS (08 Hours)**

Conics - Parabola, ellipse, hyperbola and rectangular hyperbola, General equation of second degree, confocal conics, system of conics, polar equation of conics, curve tracing of simple curves.

**UNIT-IV: PLANES (08 Hours)**

Three dimensional system of co-ordinates, Projection and direction cosines, Plane, reduction to symmetric form of a line given by a pair of planes, shortest distance between two planes.

**UNIT-V: SPHERE, CONE AND CYLINDER (08 Hours)**

Equations of a sphere, section of a sphere by a plane, coaxial system of spheres, orthogonal spheres, Cone, Right circular cone, Cylinder, Equation of the cylinder.

**Total Lectures: 40**



### TEXT BOOKS

- T1.** N. Saran and R.S. Gupta, Analytical Geometry of Three Dimensions, Pothishala Pvt. Ltd. Allahabad.
- T2.** Gorakh Prasad and H.C. Gupta, Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahabad.
- T3.** Shanti Narayan, A text Book of Vector Calculus, S. Chand & Co., New Delhi.
- T4.** Ram Ballabh, Text book of Coordinate Geometry. Prakashan Kendra, 1965.

### REFERENCE BOOKS

- R1.** R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd., 1994.
- R2.** P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Two Dimensions, Wiley Eastern Ltd. 1994.
- R3.** P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.
- R4.** Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York.
- R5.** S.L. Loney, The Elements of Coordinate Geometry, Macmillan and Company, London.





**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to

**CLO1** recall, comprehend, apply and analyze the vector differential calculus.

**CLO2** recall, understand, use and analyze Vector Integral calculus.

**CLO3** understand, analyze and apply conics and plane problem.

**CLO4** remember, comprehend, apply and analyze equation of sphere, cone and cylinder.

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CL O1	H	H	H	M	H	M	L	M	L	L	L
CL O2	H	H	H	M	H	M	L	M	M	M	M
CL O3	H	M	M	M	H	M	L	H	M	H	M
CL O4	H	L	H	M	H	M	L	M	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Calculus-II**  
**BMA2005**

L T P C  
3 2 0 5

**Course Objectives (CO):**

- CO1** To introduce some fundamental ideas about integration and its properties
- CO2** To provide some understanding of the solving-principles for integrals and its applications.
- CO3** To aim at understanding and debating what is meant by calculus of differential equations.
- CO4** To explore its connection between pure and applied mathematical aptitude.

**UNIT-I: INTEGRATION OF FUNCTIONS**

**(08 Hours)**

Integration of irrational, algebraic functions and transcendental functions, Reduction formulae, Definite integrals and its properties.

**UNIT-II: APPLICATIONS OF THE DEFINITE INTEGRAL**

**(08 Hours)**

Quadrature, Rectification, Volumes and surfaces of solids of revolution.

**UNIT-III: DIFFERENTIAL EQUATIONS-I**

**(08 Hours)**

Order and degree of a Differential Equation, Equations of first order and first degree, Separation of variable method, Homogeneous equations, Linear differential equation, Exact differential equations.

**UNIT-IV: DIFFERENTIAL EQUATIONS-II**

**(08 Hours)**

Differential equations of the first order but not of the first degree, Clairaut's equations and singular solutions, geometrical meaning of linear differential equation, Orthogonal trajectories.

**UNIT-V: DIFFERENTIAL EQUATIONS-III**

**(08 Hours)**

Linear differential equations of the second and higher order with constant and variables coefficients (up to second order), Simultaneous linear differential equations with constant coefficients.

**Total Lectures: 40**

**TEXT BOOKS**

- T1.** Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.
- T2.** Shanti Narayan, A text Book of Differential Calculus, S. Chand & Co., New Delhi.



**REFERENCE BOOKS**

- R1. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.
- R2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1999.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to

- CLO1** recall, comprehend and analyze the methods & properties of integration for various type of functions
- CLO2** recall, understand and and apply the application of integration in different fields of sciences.
- CLO3** understand, analyze and apply the methods for solving differential equation of first order and first or higher degree
- CLO4** understand, analyze and apply the methods for solving linear differential equations of the second and higher order with constant & variables coefficients

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	M	H	L	M	M	L	L	L	L	L
CLO2	M	M	H	M	H	M	L	L	M	M	M
CLO3	M	M	M	M	H	M	M	M	M	H	M
CLO4	H	M	H	M	H	M	M	M	M	H	M



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Advanced Functional English**  
**BHU-2001**

**L T P C**  
**3 0 0 3**

**Course Learning Objectives:**

**CO1** To get students proficient in drafting and editing of business letters and inter-official correspondence documents.

**CO2** To improve their oral and written communication and make it more impressive and comprehensive.

**CO3** To improve their reasoning and logical skills in finding out solutions to certain problems.

**CO4** To help the students to learn the basics of phonetics.

**UNIT-I: (10 HOURS)**

**APPLIED GRAMMAR AND VOCABULARY BUILDING**

Phrase, Clause, Sentence, Transformation.

Word formation (borrowing, clipping, blending, acronyms, compounding, conversion, backformation and affixation) Antonyms, Synonyms, and Homophones, Proverbs, Idioms, and Foreign Expressions, One Word Substitution.

**UNIT-II: (15 HOURS)**

**BUSINESS CORRESPONDENCE AND REPORT WRITING**

Business Correspondence (Letter of Sales, Credit, Enquiry, Quotation, Order, Complaint, Adjustment; Circulars, and Memos); Meeting Etiquettes—Drafting Notices, Agenda, Minutes; E-mail writing, Drafting and editing of CV/Résumé, Covering Letter

Report: Types, Features, Forms and Structure.

**UNIT III: (08 HOURS)**

**DATA INTERPRETATION**

Reading of Articles Featuring Graphs, Interpretation of the Graph, Understanding the Terminology, Use of Comparatives, Matching a Pictorial Representation to a Verbal Description, Reading and Interpretation of Articles and Brochures Related to Business, Reading of Clippings from Business Newspapers.



**UNIT-IV:**

**(07 HOURS)**

**BASICS OF PHONETICS**

Organs of Speech, Sounds of English (RP): Vowels and consonants, Syllable, Word Stress, Common Errors in Pronunciation.

**Text Books**

- T1.** Sinha, R.P. “Current English Grammar and Usage with Composition” Oxford University Press, New Delhi.
- T2.** Sethi, J. and Dhamija,P.V. “A Course in Phonetics and Spoken English” (2<sup>nd</sup> Ed.)PHI Learning Pvt. Ltd.
- T3.** Raman, M. and Sharma, S. “Technical Communication: Principles and Practice” Oxford University Press.

**Reference Books**

- R1.** Sharma, R.C. and Krishna, M. “Business: Correspondence and Report Writing”, Tata McGraw Hill, 3<sup>rd</sup> Edition
- R2.** Pal, R. “Business Communication”, Sultan Chand & Sons Publication
- R3.** Nitin, B. “Communicative English for Engineers and Professionals”, Pearson Education India, 2010
- R4.** Straus, J. “The Blue Book of Grammar and Punctuation”, John Wiley & Sons, 2011
- R5.** Aarts, B. “Oxford Modern English Grammar”, Oxford University Press, 2011

**Course Learning Outcomes (CLO)**

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

<b>CLO</b>	<b>Description</b>	<b>Bloom’s Taxonomy Level</b>
CLO1	<b>List</b> and <b>explain</b> the applied grammar and vocabulary building through worksheets and exercises.	Level 1,2 Remembering, Understanding
CLO2	<b>Apply</b> the art of writing good letter, drafting certain technical documents. They will <b>examine</b> and <b>analyze</b> the format and	Level 3,4



	content of technical documents.	Applying, Analyzing
CLO3	<b>Develop</b> an insight to review data. The students will <b>compare</b> and <b>evaluate</b> the data.	Level 3,4,5 Applying, Analyzing, Evaluating
CLO4	<b>Analyze</b> the basic knowledge of Phonetics- IPA Sounds, Speech and its production, Syllable division. The students will <b>evaluate</b> and <b>design</b> the same.	Level 4,5,6 Analyzing, Evaluating, Creating

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	M		M			H		H	M	
CLO2	M	M		M		M	H	M	H	M	H
CLO3	M	M		M		M	H	M	M	H	H
CLO4	M	M		M		M	H	M	H	M	



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Computer Fundamentals**  
**BCS 2009**

L T P C  
3 0 0 3

**Course Objectives (CO):**

**CO1** To **analyze** the need for data organization.

**CO2** To develop the **understanding** of software concept.

**CO3** To **Understand** Basics of internet.

**CO4** To **analyze** word, power point and excel concept.

**UNIT - I**

**(06 Hours)**

**Computer, I/O Devices, Memory and Internet:** Definition of Computer, Data and Information, Characteristics of computers, Advantages and Limitations of computer Classification of computers, Input and Output Devices, Computer Memory, Software, Types of software, , Internet, Intranet ,Extranet, WWW, Search Engine, Web Browser

**UNIT - II**

**(6 Hours)**

**Word Processor:** Examine word processing concepts and explore the Microsoft/ libre Office Word environment, create a new document, Open save and print a document. Edit and format text. Change the page layout, background and borders, Insert headers and footers, Insert and edit tables, Insert chart, clip art and pictures to documents. Perform a mail merge.

**UNIT - III**

**(4 Hours)**

**Power Point:** Examine slide show presentation concepts and explore the Microsoft / Libre Office Power Point environment, Create a new presentation, Modify presentation themes, Add, Edit text and format text to slides, Add new slides to a presentation, Insert clipart images and shapes to slides, Insert and modify tables and charts, Add sound and video to a slide presentation, Insert and edit animations and slide transitions, Display a speaker-lead and self running presentation.

**UINI-IV**

**(09 Hours)**

**Spreadsheet:** Examine spreadsheet concepts and explore the Microsoft Office Excel/ Libre Office spreadsheet environment, Create, open and view a workbook, save, format and print workbook, Enter and edit data, Modify a worksheet and workbook. Work with cell references, Learn to use functions and formulas, Create and edit charts and graphics, filter and sort table data, Work with Pivot tables and charts, Import and export data.



**Text Books:**

- T1. P.K. Sinha, “Computer Fundamentals”, BPB Publication.
- T2. Torn Carpenter, “ Microsoft Windows Operating System essentials”, Jhon Wiley.
- T3. Ellen Siever, :Linux In A Nutshell:, O, Reilly
- T4. Joe Habraken, “ Office in A Nutshell”, Pearson Education
- T5. J.H Weber, ”Getting started with Libre Office 5.0,” Friends of Open Document Inc.

**Course Learning Outcomes (CLO):** On completion of this course, the students will be able to:

CLO	Description	Bloom’s Taxonomy Level
CLO1	<b>Recall</b> all the concept of internet, <b>Analyzing</b> the role of data and information .	1,2, 4 Remembering, Understanding, Analyzing,
CLO2	<b>Understand</b> the concepts of IPO cycle <b>Analyze</b> input, output components.	2, 4 Understanding, Analyzing,
CLO3	<b>Applying</b> word processing concepts ,power point concepts <b>Analyze</b> animation features and components.	3, 4 Applying, Analyzing,
CLO4	<b>Understand</b> spreadsheet envinorment <b>Analyze</b> chart and table data. <b>Applying</b> formula to sort and filter data.	2, 3, 4 Understanding, Applying, Analyzing





Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	L	M	M	L	L	M	M	L	L	
CLO2	M	M		L	L	L	L	L		L	L
CLO3	L	L	L	L	L	L	L	L	M		L
CLO4	L	M		L	L	L	L	M	L	L	



**B.Sc. (Hons): Chemistry**  
**I Year, II Semester**  
**Computer Application Lab**  
**BCS2502**

L T P C  
0 0 2 1

**Course Objectives (CO):**

**CO1** To **analyze** the need for peripheral devices of computer system.

**CO2** To develop the **understanding** of software concept.

**CO3** To **Understand** Basics of MsOffice.

**CO4** To **analyze** word, power point and excel concept.

Lab 1-Introduction to Peripheral Devices of Computer

Lab 2- Introduction to Windows/ Linux, Software, Start Menu, Desktop Control Panel and Options

Lab 3- Working with Note Pad, Word Pad, Paint and Accessories options

Lab 4- Introduction to Internet and surfing and searching

Lab 5- Working with MS Office / Libre office word

(Create a new document, Open save and print a document. Edit and format text. Change the page layout. Background and borders, Insert headers and footers, Insert and edit tables)

Lab 6- Working with MS Office / Libre office word

(Insert chart, clip art and pictures to documents. Perform a mail merge)

Lab 7- Working with MS Excel/ Libre office spreadsheet

(Create, open and view a workbook, save, and print workbooks, Enter and edit data, Modify a worksheet and workbook. Work with cell references, Learn to use functions and formulas)

Lab 8- Working with MS Excel/ Libre office spreadsheet



(Create and edit charts and graphics, Filter and sort table data, Work with Pivot tables and charts, Import and export data)

Lab 9- Working with PowerPoint/ Libre office presentation

(Create a new presentation, Modify presentation themes, Add, Edit text to slides, Add new slides to a presentation, Insert clipart images and shapes to slides, Insert and modify tables and charts)

Lab 10- Working with PowerPoint/ Libre office presentation

(Add sound and video to a presentation, Insert and edit animations and slide transitions, Display a speaker-lead and self running presentation)

**Text Books:**

**T1.** P.K. Sinha, “Computer Fundamentals”, BPB Publication.

**T2.** Torn Carpenter, “ Microsoft Windows Operating System essentials”, Jhon Wiley.

**T3.** Ellen Siever, :Linux In A Nutshell:, O, Reilly

**T4.** Joe Habraken, “ Office in A Nutshell”, Pearson Education

**T5.** J.H Weber, ”Getting started with Libre Office 5.0,” Friends of Open Document Inc.



## Course Learning Outcomes (CLO):

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

CLO	Description	Bloom's Taxonomy Level
CLO1	<b>Recall and understand</b> all the concept of peripheral devices, <b>Analyzing</b> the role of data and information .	1,2, 4 Remembering, Understanding, Analyzing,
CLO2	<b>Understand</b> the concepts of MS.Office <b>Analyze</b> input, output components.	2, 4 Understanding, Analyzing,
CLO3	<b>Applying</b> word processing concepts ,power point concepts <b>Analyze</b> animation features and components.	3, 4 Applying, Analyzing,
CLO4	<b>Understand</b> spreadsheet environment <b>Analyze</b> chart and table data. <b>Applying</b> formula to sort and filter data.	2, 3, 4 Understanding, Applying, Analyzing

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	L	M	M	L	L	M	M	L	L	
CLO2	M	M		L	L	L	L	L		L	L
CLO3	L	L	L	L	L	L	L	L	M		L
CLO4	L	M		L	L	L	L	M	L	L	



**B.Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Inorganic Chemistry-II**  
**BCY3001**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To demonstrate the VBT, hybridization and VSEPR theory Application of VSEPR theory in determining the geometry and shape of simple molecules which contains lone pairs of electron?

**CO2** To discuss the molecular orbital theory, draw the MO diagram of homo diatomic and tri atomic molecules. Study of ionic and covalent character, Fajan's rule and calculation of dipole moment.

**CO3** To explain the molecular force of attraction in the molecules like metallic bonds, weak Vander Wall force of attraction, hydrogen bonding, dipole-dipole interaction etc, involved in solid and liquid materials.

**CO4** To illustrate the extraction of metals from its ore, gangue etc. Various methods are used to separate the metals like Ellingham diagrams, Electrolytic Reduction, Hydrometallurgy.

**CO5** To describe the definition of acids and bases according to Arrhenius, Bronsted & Lowry and Lewis theory, Hard and soft acids and bases, Hardness and Softness.

**UNIT I- Chemical Bonding-II**

**[8 L]**

Lewis structure, Valence Bond theory, Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Valence shell electron pair repulsion (VSEPR) theory, shapes of molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding ( $\sigma$  and  $\pi$  bond approach) and bond length. Resonance and resonance energy.

**UNIT II- Chemical Bonding-III**

**[10 L]**

Molecular Orbital theory, Molecular orbital diagrams of diatomic and simple polyatomic molecules  $N_2$ ,  $O_2$ ,  $C_2$ ,  $B_2$ ,  $F_2$ ,  $CO$ ,  $NO$ , and their ions;  $HCl$ ,  $BeF_2$ ,  $CO_2$ , (idea of s-p mixing and orbital interaction to be given). Formal charge. Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

**UNIT III- Chemical Bonding-IV**

**[8 L]**

Metallic Bonding and Weak Chemical Forces: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding, Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

**UNIT IV- Metallurgy**

**[8 L]**

Ore, Minerals, Matrix and Gangue. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide



process for silver and gold. Methods of purification of metals: Electrolytic process, van Arkel-de Boer process and Mond's process, Zone refining.

**Unit V-Acids and bases**

[6 L]

Definition of acids and bases according to Arrhenius, Bronsted and Lowery and Lewis theory, Solvents system concept and Lux-Flood concept for acids and bases, Hard and soft acids and bases: Definition, Pearson's HSAB concept, Acid Base Strength and Hardness and Softness., Classification of Acids and Bases as Hard and Soft.

**Total Lectures: 40**

**TEXT BOOKS:**

- T1.** J. D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup>, Blackwell Science, London, 1996.  
**T2.** Wahid U. Malik, G. D. Tuli, R. D. Madan Inorganic chemistry, 7<sup>th</sup>, S. Chand Publication., 2001.  
**T3.** B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 1<sup>st</sup>, Shobhan Lal Nagin Chand & Co., 1996.

**REFERENCE BOOKS:**

- R1.** D.F. Shriver, P.W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>, Oxford University Press, 2010.  
**R2.** F.A. Cotton, G. Wilkinson, P.L. Gaus, Basic Inorganic Chemistry, 3<sup>rd</sup>, Wiley India, 2004.  
**R3.** G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3<sup>rd</sup>, Pearson Education Ltd., 2014.  
**R4.** J. Huyee, E. A. Keiter, R. L. Keiter and Okhil K. Medhi, Inorganic chemistry, 4<sup>th</sup>, Pearson Education Ltd., 2013.  
**R5.** Dr. Sathya Prakash, S.K. Basu, R.D. Madan G.D. Tuli. Advanced Inorganic Chemistry 4<sup>th</sup> reprint, 1999 .

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Blooms Taxonomy
CLO1	Students are able to study the VBT, hybridization and VSEPR theory with use of VSEPR theory to examine the geometry and shape of simple molecules and those molecules which contains lone pairs of electron?	3, 4 Applying & Analyzing
CLO2	Students are able to explain the molecular orbital theory, Molecular Orbital diagram of homo diatomic and tri atomic molecules, students are able to discuss the ionic and covalent character, Fajan's rule and calculation of dipole moment.	4, 5 Creating & Evaluating
CLO3	Students are able to define the molecular force of attraction in the molecules like metallic bonds, weak Vander Wall force of attraction, discuss the hydrogen bonding and dipole-dipole interaction etc, involved in solid and liquid materials.	1, 2 Remembering & Understanding
CLO4	Students are show the extraction of metals from its ore,	2, 3



	gangue etc and able to find out various methods which are used to separate the metals like Ellingham diagrams, Electrolytic Reduction and Hydrometallurgy.	Understanding & Applying,
<b>CLO5</b>	Students are able to explain acids and bases according to Arrhenius, Bronsted & Lowry and Lewis theory. Students are able to find out the concept of Hard and soft acids and bases and compare the Hardness and Softness.	4, 5 Analysing and Evaluating.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	L	M	H	H	H	H	M	H	M
CLO2	H	H	H	H	H	H	H	H	H	H	H
CLO3	L	H	H	M	H	H	H	H	H	H	H
CLO4	H	H	H	H	H	H	L	M	M	H	H
CLO5	H	M	M	M	H	H	H	M	L	H	H

H: High; M: Medium; L: Low



**B.Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Physical Chemistry-II**  
**BCY3002**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To demonstrate the basic concepts and laws of thermodynamics for calculating heat capacities and work done.

**CO2** To develop the analytical ability of student to correlate internal energy change and heat change with thermodynamic parameters and predict the feasibility of a chemical reaction.

**CO3** To illustrate the physical significance of chemical equilibrium and the factors influencing it.

**CO4** To discuss the concepts and the processes involved in the flow of charge in solutions and its applications.

**CO5** To describe the colligative properties and relationship of their deviation with the solute-solvent interactions.

**UNIT I- Thermodynamics-I** **[8 L]**

Introduction and scope of thermodynamics, definitions and types of system, surroundings and processes, extensive and intensive properties, state of a system, state and path functions, concept of heat and work and their sign convention, nature of work, path dependence of heat and work, Zeroth law of thermodynamics, First law of thermodynamics, internal energy, enthalpy, heat changes at constant volume and constant pressure, heat capacities ( $C_v$ ,  $C_p$ ) and their relationship for ideal gases.

**UNIT II- Thermodynamics-II** **[7 L]**

Joule-Thomson effect, Joule-Thomson coefficient of real (van der Waal) gases, inversion temperature, thermodynamic quantities ( $w$ ,  $q$ ,  $\Delta U$ ,  $\Delta H$ ) for isothermal and adiabatic reversible expansion of ideal gases and their comparison, change in internal energy ( $\Delta U$ ) and enthalpy ( $\Delta H$ ) of chemical reactions, relation between  $\Delta U$  and  $\Delta H$ , variation of heat of reaction with temperature (Kirchhoff's equation).

**UNIT III- Chemical equilibrium** **[8 L]**

Chemical equilibria of homogeneous and heterogeneous systems, derivation of expression of equilibrium constants; temperature, pressure and concentration dependence of equilibrium constants ( $K_p$ ,  $K_c$ ,  $K_x$ ); Le Chatelier's principle of dynamic equilibrium.

**UNIT IV- Electrochemistry-I** **[9 L]**

Arrhenius theory of electrolytic dissociation, reversible and irreversible cells, Galvanic cells, cell *emf* and its measurement, free energy and *emf* of reversible cells, Single electrode potential, Nernst equation, measurement of single electrode potential and its sign convention, Standard electrode potential, *emf* of reversible cell from electrode potentials. Type of reversible and reference electrodes. Various applications





of *emf* measurement. Concentration cells with and without transference. Liquid junction potential and its removal, overvoltage, introduction to fuel cell, dry cell, acid and alkali storage cells.

**UNIT V- Colligative properties**

[8 L]

Ideal solutions and their characteristic properties, Henry's Law, Raoult's Law, lowering of vapour pressure, freezing point depression, boiling point elevation, osmosis and Reverse Osmosis, osmotic pressure, *van 't Hoff* equation, determination of molecular weight of macromolecules, abnormal colligative properties.

**Total lectures: 40**

**TEXT BOOKS:**

- T1.** Essentials of Physical Chemistry, A. Bahl and B. S. Bahl, G. D. Tuli, 27th Edition (2014), S. Chand & Company Ltd., New Delhi.
- T2.** Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
- T3.** Physical Chemistry, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
- T4.** Modern Electrochemistry, John O'M. Bockris and Amulya K. N. Reddy, 2<sup>nd</sup> Edition, KLUWER ACADEMIC PUBLISHERS, New York.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	The student will be able to identify and distinguish various types of thermodynamic properties, functions and parameters to derive fundamental thermodynamic relations.	3, 6 Applying & Creating
<b>CLO2</b>	The students will be able to calculate the energy involved in different types of thermodynamic processes.	3 Applying
<b>CLO3</b>	The student will be show to predict the direction of chemical equilibrium upon imposing a change in the physical parameters.	1, 2, 3 Remembering, Understanding & Applying
<b>CLO4</b>	The student will be able to evaluate the direction of flow of current in a solution under specified physical parameters and understand its utility in electrical devices.	5 Evaluating
<b>CLO5</b>	The student will be recall to calculate the molecular weight, concentration and mole fractions of solution and solvent based on vapour pressure measurements.	1 Remembering



CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	H	H	H	H	H	H
CLO2	H	H	H	H	H	M	H	H	H	H	L
CLO3	L	M	H	M	H	H	M	H	H	H	M
CLO4	H	H	H	H	H	H	L	M	H	H	L
CLO5	H	H	L	H	H	H	H	H	H	H	H

H: High; M: Medium; L: Low



**B.Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Chemistry Lab-III**  
**BCY3501**

**L T P C**  
**0 0 4 2**

**Course Objectives:**

**CO1** To determine concentration of  $\text{Ca}^{2+}$  or  $\text{Mg}^{+2}$  ions by EDTA using Eriochrome black T as indicator and determination of alkali content in an antacid tablet using HCl.

**CO2** To find out the density of a given liquid by Pyknometer and relative surface tension of a liquid with respect to water at room temperature by Stalagmometer.

**CO3** To determine and show the distribution coefficient of iodine between water and  $\text{CCl}_4$  at room temperature.

**CO4** To illustrate how the semi-micro qualitative analysis of inorganic mixtures can be done

**CO5** To identify given organic compounds through systematic chemical analysis and determination of its melting point and detection of functional group.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	Students are able to determine of concentration of $\text{Ca}^{2+}$ or $\text{Mg}^{+2}$ ions by EDTA using Eriochrome black T as indicator and determination of alkali content in an antacid tablet using HCl.	5 Evaluating
<b>CLO2</b>	Students are able to find out the density of a given liquid by Pyknometer and relative surface tension of a liquid with respect to water at room temperature by Stalagmometer.	1 Remembering
<b>CLO3</b>	Students are able to show & study the distribution coefficient of iodine between water and $\text{CCl}_4$ at room temperature.	1,2,3 Remembering, Understanding & Applying
<b>CLO4</b>	All student are agree, to identify the semi-micro qualitative analysis of inorganic mixtures containing not more than 4 radicals	5 Evaluating



<b>CLO5</b>	Students are discuss & examine the given organic compound through systematic chemical analysis and determination of its melting point and detection of functional group.	4,6 Analysing & Creating
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CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	H	H	H	H	H	M
CLO2	M	H	H	H	H	H	H	H	H	H	H
CLO3	H	H	H	H	H	H	H	M	H	L	H
CLO4	H	H	L	M	H	H	H	H	H	M	H
CLO5	H	H	L	H	H	H	L	H	H	H	H

H: High; M: Medium; L: Low



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Modern Physics**  
**BPH3002**

**L T P C**  
**3 1 0 4**

**Course Objectives (CO):**

- CO1** To introduce the basic ideas involved in special theory of relativity.
- CO2** To gain insight about fundamentals and working theory of x ray physics.
- CO3** To introduce basic concepts of atomic physics and different processes involved and fundamentals of nuclear physics.
- CO4** To explore different theories involved in development of Quantum mechanics.

**UNIT –I**

**(10 Hours)**

Michelson-Morley Experiment and its Outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Length Contraction. Time Dilation. Relativistic Transformation of Velocity, Frequency and Wave Number. Variation of Mass with Velocity. Rest Mass. Mass-less Particles. Mass-energy Equivalence. Relativistic Doppler effect. Transformation of Energy and Momentum. Energy-Momentum Four Vector.

**UNIT –II**

**(08 Hours)**

X-rays :- Ionizing Power, X-ray Diffraction, Bragg's Law, Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley Law. Photoelectric Effect, Compton Effect.

**UNIT –III**

**(11 Hours)**

Brief review of Bohr and Sommerfeld model of atom, effect of finite nuclear mass in relation to Rydberg constant, idea of discrete energy levels and electron spin: Franck – Hertz and Stern– Gerlach experiments, Significance of quantum numbers. Determination of  $e/m$  of the electron. Law of Radioactive Decay, Half - life, Successive Radioactive Transformations & Radioactive Series, Binding Energy, Isotopes and Isobars.

**UNIT –IV**

**(11 Hours)**

Inadequacies of classical mechanics, Wave-particle duality, de Broglie's hypothesis, concept of matter waves, two-slit experiment with electrons, probability, wave functions, experimental verification of de Broglie's hypothesis, Heisenberg's Uncertainty principle (involving canonical pair of variables), derivation from Wave Packets, Complementary principle, Basic Postulates and Formalism - Energy, Momentum and Hamiltonian Operators.



**TEXT BOOKS**

- T1:** Concepts of Modern Physics, Arthur Beiser (McGraw-Hill Book Company, 1987)  
**T2:** Modern Physics, Kenneth Krane (Wiley Publication)

**REFERENCE BOOKS**

- R1:** Modern Physics: J. Bernstein, P.M. Fisshbane, Stephen Gasiorowicz (CRC, Publications)  
**R2:** Modern Physics : A.P. Arya (Prentice-Hall International, 1998)

**Course Learning Outcomes:**

After completion of this course, the students will be able to

- CLO1** develop the basic concepts of space and time and effect of relativity on mass energy and motion of the matter.
- CLO2** understand fundamental properties of x-rays and basic concepts of photon, and their interaction with matter.
- CLO3** illustrate fundamental processes/theories involved in atomic & nuclear physics and to apply these phenomena to explain different observations of daily life.
- CLO4** develop the basic concepts of Quantum mechanics viz. de-Broglie concept, Heisenberg uncertainty principle, etc. which helped in development of quantum theory.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	H	H	H	H	H	M
CLO2	H	L	H	M	H	H	H	M	H	H	H
CLO3	H	L	H	M	H	H	H	M	H	L	H
CLO4	H	L	H	M	H	H	H	M	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Basic Electronics**  
**BPH3003**

**L T P C**  
**3 1 0 4**

**Course Objectives (CO):**

**CO1** To understand the structure of semiconductors and working principle of diodes, LED's and solar cells.

**CO2** The students will able to understand the bipolar transistor, its characteristics, biasing and use as amplifiers.

**CO3** They will able to gain knowledge of analogue circuits, hybrid parameter model of transistors, understand working of single stage transistors and learn principals if feedback amplifiers.

**CO4** To develop understanding of sinusoidal oscillators and operational amplifiers.

**UNIT –I**

**(10 Hours)**

Semiconductors, Intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, Unbiased diode, Forward bias and Reverse bias diodes, Diode as a rectifier, diode characteristics, Zener diode, Avalanche and Zener Breakdown, Power supplies; rectifier, Bridge rectifier, capacitor input filter, Calculation of Ripple Factor and Rectification Efficiency, Voltage regulation, Zener Regulator, Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.

**UNIT-II**

**(8 Hours)**

Bipolar transistors, three doped regions, forward and reverse bias, DC alpha, DC beta transistor curves. Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line. Basic AC equivalent circuits, Low frequency model, small signal amplifiers, common emitter amplifier, common collector amplifier and common base amplifier, Current and Voltage gain, Input and Output impedances.

**UNIT- III**

**(12 Hours)**

Analog Circuits: Hybrid parameter model of transistor, analysis of transistor amplifier (with and without  $R_S$  and  $R_L$ ) using h- parameters, simplified hybrid model, brief idea about hybrid model. Single stage amplifier in CE, CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier.

**Feedback in Amplifiers:**

Feedback in amplifiers, positive and negative feedback, voltage and current series feedback circuits, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.



**UNIT-IV**

**(10 Hours)**

**Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

**Operational Amplifiers:** Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. **Applications of**

**Op-Amps:** (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier.

**TEXT BOOKS:**

**T1:** Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 8<sup>th</sup> Edition, (Pearson Education, India, 2004).

**T2:** Basic Electronics & Linear Circuits By N. N. Bhargava, D. C. Kulshreshtha & S C Gupta,( Tata McGrawHill, 2006).

**T3:** A. P. Malvino, Electronic Principals,( Glencoe, 1993).

**T4:** B. L. Thareja, and A. K. Thareja, A textbook of Electrical Technology, (S. Chand).

**REFERENCE BOOKS:**

**R1:** Allen Mottershead, Electronic Circuits and Devices, (PHI, 1997).

**R2:** Solid state electronic devices By Ben G. Streetman & Sanjay Banerjee, (Pearson Prentice Hall, 2006).

**R3:** Basic Electronics – V. K. Mehta-(S. Chand).

**R4:** Electricity and Magnetism, K. K. Tiwari, (S Chand.)

**Course Learning Outcomes (CLO):**

After successfully completion of the course, students will able to-

**CLO1** Acquire the knowledge of semiconductors materials and devices.

**CLO2** Understand the basics of bipolar transistors and biasing in circuits.

**CLO3** Realize the basic understanding of hybrid model which leads them to analyze a circuit theoretically. They will able to learn the characteristics of different types of feedback in circuits and estimate gain, stability, distortion and noise in a circuit.

**CLO4** Understand and develop various amplifier circuits, their applications. Using previously gained knowledge, they will understand the practical amplifiers i.e. Op-Amps.





CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	M	L	M	H	M	H	H	H	M
CLO2	H	H	M	L	M	H	L	M	H	H	H
CLO3	H	H	M	L	M	M	M	H	H	L	H
CLO4	H	H	M	L	M	H	M	H	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Physics Lab III**  
**BPH3501**

**L T P C**  
**0 0 4 2**

**Course Objectives (CO):**

**CO1:** To verify experimentally the superposition, Thevenin, Norton maximum power theorem for AC circuits.

**CO2:** To determine the transient response of RL, RC and LCR circuits for different nature of input voltage.

**CO3:** To understand the voltage current response of different type of diodes alongwith zener diode and the working of rectifiers.

**CO4:** To explore the nature of characteristics of the CE transition and RC coupled amplifier.

**NAME OF THE EXPERIMENTS**

5. Verification of principle of superposition with dc and ac sources.
6. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits.
7. Determination of transient response of current in RL and RC circuit with step voltage input.
8. Determination of transient response of current in RLC circuit with step voltage input for under damp, critically damp and over damp cases.
9. Determination of frequency response of current in RLC circuit with sinusoidal ac input.
10. Plot V-I characteristics of Junction diode under forward and reverse-biased condition (Si & Ga).
11. Draw the wave shape of the electrical signal at the input and output points of the half-wave, full wave and bridge rectifiers.
12. Realize a voltage regulator using zener diode and study the load characteristics.
13. Plot the input-output characteristics for the common-emitter transistor.
14. To Plot frequency Vs gain in dB for a single stage RC coupled amplifier. Measurement of bandwidth of an amplifier.



**REFERENCE BOOKS:**

- [1] B. Sc. Practical Physics, (S.Chand) C. L. Arora
- [2] Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky  
(Pearson Education, India, 2004)
- [3] Electricity ad Magnetism, (S.Chand) K. K. Tiwari
- [4] A textbook of Electrical Technology B. L. Thareja, and A. K. Thareja, (S. Chand)

**Course Learning Outcomes (CLO):**

After completion of this course student will be able to-

CLO1: examine the fundamental difference between the various circuit theorem as tool in different circuit conditions.

CLO2: Describe and explain the transient nature of Rc, RL and lcr circuits according to the modified input voltages.

CLO3: understand the basic working principle of normal diode as rectified and zener diode as voltage regulator.

CLO4: explain the nature of output of the CE-transition and Rc coupled amplifier.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	L	M	H	M	M	L	H	H	H	M
CLO2	H	L	M	M	M	H	L	M	H	H	H
CLO3	H	L	M	H	M	M	L	H	H	L	H
CLO4	H	L	M	L	M	H	M	H	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Differential Equations**  
**BMA 3002**

**L T P C**  
**3 2 0 5**

**Course Objectives (CO):**

**CO1:** To introduce some fundamental concepts about series solution of second order equation, Fourier series of periodic functions and Partial Differential Equations with its applications.

**CO2:** To develop and provide the understanding of different functions and polynomials of several kinds and to connect with the mathematical applications.

**CO3:** To understand and appreciate the beauty of the analytical nature of mathematics.

**CO4:** To aim at providing and explore a solid foundation of the fundamental theories.

**UNIT-I: SERIES SOLUTIONS OF SECOND ORDER EQUATIONS (08 Hours)**

Series solutions of differential equations, Power series method, Legendre and Bessel functions, Recurrence relations of these functions and their properties.

**UNIT-II: FOURIER SERIES (08 Hours)**

Periodic Functions, even and odd functions, Fourier series, Euler's Formulae for Fourier coefficients, Fourier series of functions with arbitrary period, change of interval, half range expansions.

**UNIT-III: PARTIAL DIFFERENTIAL EQUATIONS-I (08 Hours) Order,**

degree and formation of partial differential equations, linear partial differential equations of first order, Lagrange's method.

**UNIT-IV: PARTIAL DIFFERENTIAL EQUATIONS-II (08 Hours)**

Nonlinear partial differential equations of first order, Charpit's general method, Solution of homogeneous and non-homogeneous partial differential equations of second order with constant and variable coefficients.

**UNIT-V: CLASSIFICATION AND APPLICATIONS OF (08Hours)**

Classification of PDE into elliptic, parabolic and hyperbolic forms, Solution of Heat, Wave and Laplace equation by method of separation of variables.

**TEXT BOOKS**

- R1.** G.F. Simmons, Differential Equations, Tata McGraw Hill, 1972.
- R2.** D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India), 1967.
- R3.** K. S. Rao, Introduction to Partial Differential Equations, Prentice- Hall of India, New Delhi, 1997.
- R4.** B. Rai and D.P.Choudhary, Ordinary Differential Equations, Narosa Publ. 2004.



**REFERENCE BOOKS**

- T1.E.A. Codington, An Introduction to ordinary differential equations, Prentice Hall of India, 1961.
- T2.H.T.H. Piaggio, Elementary Treatise on Differential Equations and their Applications, C.B.S Publisher & Distributors, Delhi, 1985.
- T3.W.E. Boyce and P.C. Dpirima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 1986.
- T4.A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
- T5.Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
- T6.Jane Cronin, Differential Equations, Marcel Dekkar, 1994.
- T7.Frank Ayres, Theory and Problems of Differential Equations, McGraw-Hill Book Company, 1972.

**Course Learning Outcomes (CLO):**

After successful completion of this course, the student will be able to-

**CLO1:** Explain, recall, apply and analyze the basic properties of the power series solution and the solution of different types of partial differential equations.

**CLO2:** Define, illustrate and interpret about the Legendre and Bessel functions, periodic functions and Fourier series used in various fields of applied mathematics.

**CLO3:** Solve, apply, understand and utilize application based problems of the related topics and able to translate real world problem into mathematical problems using ordinary and partial differential equations and solve them.

**CLO4:** Conclude, deduct and make use of the knowledge in more advance and complex situations of higher calculus.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	L	H	M	L	M	H	H	M
CLO2	H	H	H	L	H	M	L	M	H	H	H
CLO3	H	M	M	L	H	H	L	H	H	L	H
CLO4	H	L	H	L	H	M	L	M	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**STATICS AND DYNAMICS**  
**(BMA3003)**

**L T P C**

**3 2 0 5**

**Course Objectives (CO):**

**CO1:** To introduce fundamental ideas about Catenary, Centre of Gravity, Stable and unstable equilibrium, Velocity and acceleration and Central orbits.

**CO2:** To provide understanding and properties of Catenary, CG, Equilibrium, Velocity and acceleration and Central orbits.

**CO3:** To introduce fundamental ideas and properties with finding the solutions of Common Catenary, CG, Equilibrium, Velocity and acceleration and Central orbits in different forms.

**CO4:** To explore the connection between theory and applications of the subject topics.

**UNIT-I: STATICS-I** (08 Hours)

Common catenary, Centre of gravity, Stable and unstable equilibrium.

**UNIT-II: STATICS-II** (08 Hours)

Forces in three dimensions, general condition of equilibrium of a rigid body, equation of central axis of any given system of forces, Virtual work.

**UNIT-III: DYNAMICS-I** (08 Hours)

Velocity and acceleration along radial and transverse directions, and along tangential and normal directions, Simple harmonic motion.

**UNIT-IV: DYNAMICS-II** (08 Hours)

Motion in resisting medium, Constrained motion (circular and cycloidal only).

**UNIT-V: DYNAMICS-III** (08 Hours)

Central orbits and Kepler's law, Motion of a particle in three dimensions.

**TEXT BOOKS**

**T1.** R.S. Verma, A Text Book on Statics., Pothishala Pvt. Ltd., Allahabad.

**T2.** M. Ray and G.C. Sharma, A Text book on dynamics, S. Chand & Company Ltd., New Delhi, 1999.

**REFERENCE BOOKS**

**T3.** S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.



**Course Learning Outcome (CLO):**

After completing this course, our Student will be able to

**CLO1** Recall, comprehend, apply and analyze the basic properties of Catenary, Centre of Gravity, Stable and unstable equilibrium, Velocity and acceleration and Central orbits.

**CLO2** Recall, understand, use and analyze and communicate is to impart student’s fundamental concepts of Common Catenary, CG, Equilibrium, Velocity and acceleration and Central orbits.

**CLO3** Understand, apply, analyze and communicate to impart student’s , Common Catenary, CG, Equilibrium, Velocity and acceleration and Central orbits.

**CLO4** Remember, comprehend, apply and analyze the concept of concepts of Common Catenary, CG, Equilibrium, Velocity and acceleration and Central orbits.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	M	L	M	H	H	M
CLO2	H	H	H	M	H	M	L	M	H	H	H
CLO3	H	H	H	M	H	M	L	M	H	L	H
CLO4	H	M	M	L	M	M	L	M	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**Numerical Technique WITH C**  
**BMA 3008**

**L T P C**  
**3 0 0 3**

**Course Objectives (CO):**

**CO1** To introduce basic ideas C Language for solving Mathematical Problems.

**CO2** To provide some understanding of various Numerical techniques and when and where to apply.

**CO3** To aim at understanding how much it is useful for Mathematics and other fields.

**CO4** To explore the various applications of Numerical techniques using C Programming.

**UNIT- I** **(11 Hours)**

**Elements of C:** C character set, identifiers and keywords, Data types: declaration and definition, Type conversion.

**Operators:** Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators and their hierarchy & associativity.

**Control statements:** Selection: if, if-else, switch Repetition: for, while, and do-while loop; break, continue.

Arrays, Functions: Definition, prototypes, passing parameters to functions.

**UNIT- II** **(09 Hours)**

**Pointers:** Declaration, operations on pointers, Pointers and Arrays.

**Strings:** What are strings, Pointers and Strings, strlen( ), strcpy( ), strcat( ), strcmp( ).

**File Handling:** Streams file operations, formatted I/O, character I/O, Line I/O, Block I/O.

**UNIT III** **(09 Hours)**

**Solution of Algebraic and Transcendental Equations:-** (1) Fixed-Point Iteration Method, (2) Bisection Method, (3) Secant Method, (4) Newton-Raphson Method.

**Interpolation:-** Forward and Backward Differences. Symbolic Relation. Differences of a Polynomial. Newton' Forward and Backward Interpolation Formulas. Divided Differences.

**UNIT –IV** **(11 Hours)**

**Curve Fitting by Least Square Methods :** (1) Fitting a Straight Line. (2) Non-Linear Curve Fitting : (a) Power Function,.

**Numerical Differentiation using:** (1) Newton's Interpolation Formulas Errors in Numeric Differentiation. Maximum and Minimum Values of a Tabulated Function.

**Numerical Integration:-** General Quadrature Formula. Trapezoidal Rule. Simpson's 1/3 and 3/8 Rules.





**TEXT BOOKS:**

- T1:** Kamathe, “Programming in C”, Pearson  
**T2:** Balaguruswami, “Computing Fundamentals and C Programming”. TMH.  
**T3:** S.S. Shastri, “Introductory Methods of Numerical Analysis”, PHI.  
**T4:**Jain, Iyengar and Jain – Numerical Methods for Scientific and Engineering Computation , John Wiley & Sons Canada, Limited, 1985.

**REFERENCE BOOKS:**

- R1:** Reema Thareja “Computer Fundamental and Programming in C”, Oxford.  
**R2:** V. Rajaraman, Computer Oriented Numerical Methods, PHI.  
**R3:** S.D.Conte and C.D.Boor, Elementary Numerical Analysis, McGraw Hill.  
**R4:**K.E. Atkinson : An Introduction to Numerical Analysis, Cram101 Incorporated, 2007.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

- CLO1** recall, comprehend and apply the basic concepts of C language.  
**CLO2** recall, understand, use and analyze various C operators and functions.  
**CLO3** understand, analyze and apply Numerical Methods for solving complicated or tedious Mathematical problems..  
**CLO4** remember, comprehend, apply and analyze Numerical Techniques using C language.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	M	L	M	H	H	M
CLO2	H	H	H	H	M	M	L	M	H	H	H
CLO3	H	H	M	M	H	H	L	M	H	L	H
CLO4	H	L	M	H	H	M	L	M	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**History and Philosophy of Science**  
**BHU-3010**

L T P C  
3 0 0 3

**Course Objectives (CO):**

**CO1** To introduce fundamental issues in science and technology

**CO2** To provide understanding of the basic development of science with Aristotelian to Newtonian Worldview.

**CO3** To aim at understanding various ideas and issues proposed by philosophers of science this helped in development of science.

**CO4** To explore two most exciting development in science theory of relativity and evolution from philosophical view point.

**UNIT –I** (08 Hours)

**Fundamental Issues in Science and Technology**

What is science?, Science and its difference from other systems of belief and knowledge; difference between pure science and technology. deductive and inductive logic, problems and puzzles of Induction Logical Reconstructionist, Philosophy of Science,

**UNIT –II** (12 Hours)

**Science & Technology: from the Aristotle to the Newton**

Greek Science and Aristotelian world view, The Ptolemaic System, The Copernicus System, Kepler's System, Galileo, Philosophical and conceptual connections in the Development of the New Science, Seventeenth - century attack on Aristotelian Philosophy, Development of the Newtonian worldview.

**UNIT –III** (13 Hours)

**Metaphysical foundations of Science**

David Hume and the problem of causation, Naturalism and Anti-naturalism, Karl popper inductivism and falsificationism, idea of Instrumentalism and realism about scientific theories, scientific explanation; Scientific Law and laws of nature, , Thomas Kuhn Rationality in Paradigm Change, normal science and scientific revolutions, Feyerabend scientific rationality

**UNIT –IV** (08 Hours)

**Recent Developments in Science and Worldviews**



The special Theory of relativity, the general theory of relativity, Overview of the theory of Evolution, Philosophical and conceptual implications of Evolution, Worldviews: concluding Thoughts.

**TEXT BOOKS:**

- T1. Okasha Samir, *Philosophy of Science: A Very Short Introduction*, Oxford: Oxford University Press, 2002.
- T2. Richard DeWitt, *Worldviews: An Introduction to the History and Philosophy of Science*, Blackwell publishing, 2004.
- T3. Chalmers A. F., *What Is This Thing Called Science?*, (3<sup>rd</sup> ed.) Buckingham: Open University Press, 1999.
- T4. Christopher R. Hitchcock, *Contemporary Debates in the Philosophy of Science*, Blackwell, 2004.
- T5. John Losee, *A Historical Introduction to the Philosophy of Science*, Oxford University Press, 2001.
- T6. Hard M., A. Jamison, *Hubris and Hybrids. A Cultural history of Technology and Science*, Routledge, 2005.
- T7. Peter Godfrey-Smith *Theory and Reality: An Introduction to the Philosophy of Science*, University of Chicago

**REFERENCE BOOKS:**

- R1. Erickson, M, "Scientists and Scientific Communities" (Chapter 5) *Science, Culture and Society: Understanding Science in the 21st Century*, Cambridge: Polity, 2005.
  - R2. Hacking I., 'What is Scientific Realism?', in *Hacking, Representing and Intervening*, Cambridge: Cambridge University Press, 1983
  - R3. Popper K.R., Ch. 11, *Conjectures and Refutations*. Routledge & Kegan Paul.1963, pp. 253-292.
  - R4. Searle J., 'The Building Blocks of Social Reality' in Searle, *The Construction of Social Reality*, London: the Penguin Press, 1995, pp.1- 29.
- Shapin Steven, "Don't Let That Crybaby in Here Again," London Review of Books, September, 2000,

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to

- CLO1** recall, comprehend, apply and analyze the fundamental issues in science
- CLO2** recall, understand, use and analyze the development of science from Aristotelian era to era of Newton through two major worldviews.
- CLO3** understand, apply, analyze and communicate different ideologies followed and various issues raised by philosophers of science which helped in consolidation of science at fundamental level.
- CLO4** comprehend, apply and analyze the theory of relativity and theory of evolution from a different perspective which is very thought provoking



CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	M	L	L	H	H	L	M	H	H	M
CLO2	H	M	L	L	H	H	L	M	H	H	H
CLO3	H	M	L	L	H	H	L	M	H	L	H
CLO4	H	M	L	L	H	H	L	M	H	M	H



**B. Sc. (Hons): Chemistry**  
**II Year, III Semester**  
**C Programming lab**  
**BCS3511**

P C  
4 2

**Course Objectives (CO):**

- CO1:** Learn and understand the basic concepts of C Programming .  
**CO2:** Understand and apply C programs for solving some basic problems.  
**CO3:** Introduce some particular C programs used specially for solving Mathematical problems.  
**CO4:** Learn and use some special C programs applicable in Numerical methods.

1. Write a C program for addition of two numbers and average of 10 numbers.
2. Write a C program to generate the Fibonacci series.
3. Write a C program to find whether the given number is prime or not.
4. Write a C program using while loop to reverse the digits of the number.
5. Write a C program to compute the real roots of a quadratic equation  $ax^2 + bx + c = 0$ .
6. Write a C program to find out the root of the Algebraic and Transcendental equations using Newton Raphson.
7. Write a C program to implement Newton's forward and Newton's backward Interpolation formula.
8. Write a C program to fitting a straight line.
9. Write a C program to implement Numerical Differentiations
10. Write a C program to implement Numerical Integration.

**TEXT BOOKS:**

- T1.** E.Balagurusamy, "Programming in ANSI C", TMH.  
**T2.**S.S. Shastri, " Introductory Methods of Numerical Analysis", PHI

**REFERENCE BOOKS:**

- R1.** Ashok N. Kamthane, "Computer programming", Pearson.  
**R2.** Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford  
**R3.** V. Rajaraman, Coputer, "Oriented Numerical Methods", PHI.

**Course Learning Outcomes (CLO):**



After completing this course, our Student will be able to

**CLO1** Understand the basic concepts and functions of C language.

**CLO2** Understand and use various C operators and functions.

**CLO3** Apply Numerical Methods for solving complicated or tedious Mathematical problems using C.

**CLO4** Move along with the basic concepts and latest features of C used in Numerical Techniques.

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	M	H	M	H	H	M
CLO2	H	H	H	H	M	M	H	M	H	H	H
CLO3	H	H	M	M	H	H	H	M	H	L	H
CLO4	H	L	M	H	H	M	L	M	H	M	H

**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Inorganic Chemistry-III**



**BCY4001**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To describe the existence of Ortho and Para hydrogen, Hydrides and their utility, how to isolate the s-block elements. Explain chemical properties of the metals and the anomalous behaviour of Li, Be

**CO2** To describe the physical and chemical properties of boron family. To discuss three Centred-two electron bond and the chemical properties of oxides and hydrides.

**CO3** To discuss the physical and chemical properties of carbon and nitrogen family, allotropy and inert pair effect. To demonstrate chemical properties of nitrous acid, nitric acid, hypo nitrous acid, hydrazoic acid.

**CO4** To discuss the properties of oxygen and halogen family, their oxides, halides and oxy halides and oxidizing power of the halogens. To describe oxy acids, hypohalous and halous acid.

**CO5** To demonstrate position of zero group in the periodic table, isolation of noble gases and compounds of xenon with fluorine and oxygen.

**Unit I s-Block elements**

**[10 L]**

**Hydrogen** : Isotopes, Ortho and para-hydrogen, Hydrides and their classification. Chemical properties of the metals: reaction with water, air, nitrogen; uses of s-block metals and their compounds. Diagonal relationship, solvation and complexation tendencies, Compounds of s-block metals: oxides, hydroxides, peroxides, superoxides-preparation and properties, anomalous behavior of Li, Be.

**Unit II- p-Block elements:**

**Boron family (Group 13)**

**[9 L]**

Comparative study of physical and chemical properties of these elements with their oxides, hydrides, halides and nitrides. inert pair effect, Preparation and properties of boric acids (ortho & meta boric acids) and borax, hydrides of boron, structure and bonding in diboranes, an idea of three center-two electron bond in the light of molecular orbital theory, borazine, borohydrides.

**Unit III- Carbon and Nitrogen family (Group 14, 15)**

**[12 L]**

Comparative study of physical and chemical properties of these elements with special references to their oxides, hydrides, nitrides, sulphides and carbides, study of silicates (structural aspects only), silicones. allotropy, metallic and non-metallic character, catenation, fullerenes and its applications. oxoacids of nitrogen and phosphorus.

**Unit IV-Oxygen and Halogens family (Group 16, 17)**

**[12 L]**

Comparative study of physical and chemical properties of these elements with special reference to their hydrides, oxides, halides and oxyhalides. Study of oxyacids, peroxyacids and thio-oxyacids of sulphur .



Comparative study of physical and chemical properties of these elements, oxidizing power, reactivity of the elements, hydrides, oxides and oxyacids.

Detailed study of oxyacids, hypohalous acid HOX, halous acid  $\text{HXO}_2$ , halic oxide  $\text{HXO}_3$ , perhalic acid  $\text{HXO}_4$ , strength of oxoacids. Interhalogens, polyhalides ions:  $\text{ClF}$ ,  $\text{ICl}$ ;  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{IF}_3$ ;  $\text{ClF}_5$ ,  $\text{IF}_5$ .

**Unit V- Noble gases**

[7 L]

Position of zero group in the periodic table, history of discovery of noble gases isolation of noble gases, detailed study of the compounds of xenon with fluorine (with special emphasis on their structures and bonding).

**Total Lectures: 50**

**TEXT BOOKS:**

**T1.** J. D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup>, Blackwell Science, London, 1996.

**T2.** Wahid U. Malik, G. D. Tuli, R. D. Madan Inorganic chemistry, 7<sup>th</sup>, S. Chand Publication., 2001.

**T3.** B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 1<sup>st</sup>, Shobhan Lal Nagin Chand & Co., 1996.

**REFERENCE BOOKS:**

**R1.** D.F. Shriver and P.W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>, Oxford University Press, 2010.

**R2.** F.A. Cotton, G. Wilkinson, P.L. Gaus, Basic Inorganic Chemistry, 3<sup>rd</sup>, Wiley India, 2004.

**R3.** G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3<sup>rd</sup>, Pearson Education Ltd., 2014.

**R4.** J. Huysse, E. A. Keiter, R. L. Keiter, Okhil K. Medhi, Inorganic chemistry, 4<sup>th</sup>, Pearson Education Ltd., 2013.

**R5.** Dr. Sathya Prakash, S.K. Basu, R.D. Madan G.D. Tuli. Advanced Inorganic Chemistry 4<sup>th</sup> reprint, 1999 .

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Blooms Taxonomy
CLO1	Students will show the isomer of hydrogen molecule, hydrides of s-block elements and chemical properties	1, 2, 3 Remembering, Understanding,





	and physical properties of alkali metals.	Applying
<b>CLO2</b>	Students will show the structures of hydrides of boron family. Various types of bonding like 3-centre 2-electron bonding are involved in this unit.	1, 2, 3 Remembering, Understanding, Applying
<b>CLO3</b>	This unit classified about the allotropes of carbon and nitrogen. Students will learn about inert pair effect and chemical properties of nitrous acids nitric acids, hypo nitrous acids and hydrazoic acids.	1, 2, 3 Remembering, Understanding & Analysing
<b>CLO4</b>	Outcome of this unit is to derive the allotropes of all elements in this family and physical properties and chemical properties of hydrides, halides and oxy halides.	5 Creating
<b>CLO5</b>	Students will discuss the sequential discovery of noble gases, and decide isolation of gases and study of xenon compounds.	5, 6 Evaluating, Creating

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	M	M	H	H	H	H	H	H	H	L
CLO2	M	L	M	H	H	M	H	H	H	H	M
CLO3	H	H	H	H	H	H	M	H	M	H	H
CLO4	H	H	L	H	H	H	H	M	H	M	M
CLO5	H	L	L	H	H	L	H	H	H	H	H

H: High; M: Medium; L: Low



**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Organic Chemistry-III**  
**BCY4002**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To explain mechanism of various types of aromatic electrophile substitution reaction and concept of aromaticity.

**CO2** To describe antioxidant property of phenol and mechanism of reactions occurring on phenolic compound.

**CO3** To discuss how carbonyl compounds undergo addition reactions with good and poor nucleophile to give useful products and substituent effect on acidic strength of carboxylic acid.

**CO4** To demonstrate why epoxides are susceptible to cleavage by bases, whereas other cyclic ethers are not.

**CO5** To discuss synthesis, reaction and applications of thiols, thioethers and aliphatic sulphonic acid and importance of ylides.

**Unit I- Benzene and Electrophilic Substitution**

**[7 L]**

Structure, aromaticity, Hückel rule, mechanism of nitration, halogenations, sulphonation and Friedel-Crafts (Alkylation and acylation) reactions, Effects of substituents on reactivity and orientation.

**Unit II-Phenols**

**[10 L]**

Nomenclature, Structure and bonding. Comparative acidic strengths of alcohols, phenols and carboxylic acids, resonance stabilization of phenoxide ion. Phenol, catechol, resorcinol; general methods of preparation and reactions. Reimer-Tiemann and Kolbe reactions, Fries rearrangement, Claisen rearrangement, Gatterman Synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction. Phenols as antioxidant.

**Unit III- Aromatic Aldehyde and Ketones, Carboxylic acids and their derivatives**

**[13L]**

Structure and reactivity, general method of preparation, Structure and reactivity of Mono- and di-Carboxylic acids, general methods of preparation, and reactions. Cannizzaro and cross Cannizzaro reaction, Claisen condensation, Mannich Reaction, Mechanism of nucleophilic addition reaction to carbonyl group with special emphasis to Benzoin, Vit B12, Aldol, Perkin and Knoevenogel condensation. Benzoic acids and Cinnamic acids, oxalic acids and malonic acids, fumaric acid malic acid. General chemistry of acid chlorides, acid anhydrides, amides and esters. DCC, DMAP.

**Unit IV- Ethers and Epoxide**

**[10L]**

Nomenclature of ethers and methods of their formation, physical properties, chemical reactions-cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of Epoxides, orientation of Epoxide ring opening, reaction of Grignard reagents and organolithium with epoxides.

**Unit V- Organosulphur and organophosphorous compounds**

**[10 L]**

Introduction to Organosulphur compound, synthesis, reaction and applications of thiols, thioether and aliphatic sulphonic acids; Organophosphorous compounds: method of preparation and reactions of phosphoesters and phosphorous ylides. Wittig reactions. Comparative study of carboxylic and sulphonic acid.

**Total Lectures: 50**



### TEXT BOOK

- T1.** “Organic Chemistry”, R. T. Morrison and R. N. Boyd, 6<sup>th</sup> Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
- T2.** Solomons & Fryhle’s Organic Chemistry, T.W. Graham Solomons, C. B. Fryhle, 10<sup>th</sup> edition, 2014, Wiley
- T3.** “Organic Chemistry”, S. M. Mukherji, S. P. Singh, and R. P. Kapoor, 1<sup>st</sup> Edition (1985), 5<sup>th</sup> Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
- T4.** “Organic Chemistry-Structure and Reactivity”, Seyhan N. Ege, AITBS publishers, Delhi (1988).

### REFERENCE BOOK

- R1.** “Organic Chemistry”, Paula Y Bruice, 2<sup>nd</sup> Edition, Prentice-Hall International, Inc, New Jersey, International Edition (1988).
- R2.** B. M. Smith and Jerry March, March’s Advanced Organic Chemistry, 5<sup>th</sup> Edition (2000), John Wiley & Sons, New York.
- R3.** Peter Sykes, “A Guide book to mechanism in Organic Chemistry” 6<sup>th</sup> Edition (1997), Orient Longman Ltd., New De

### **Course Learning Outcome (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	After careful study of Unit student will be analyze to: Identify whether a given structure is aromatic, anti aromatic or non-aromatic and show mechanism and the resonating structures for the electrophile aromatic substitution.	1, 2, 3 Remembering, Understanding, Applying & Analysing
<b>CLO2</b>	After careful study of Unit student will be decide to: Compare the acidic strength of alcohols, phenols and carboxylic acid and explain how the physical properties of substituted phenols are affected.	5 Evaluating
<b>CLO3</b>	After careful study of Unit student will be able to make up : Explain the behavior of reactivity of aldehyde, ketones and acid derivatives towards nucleophile, synthetic application of DCC and DMAP and acidic behavior of substituted carboxylic acid.	6 Creating
<b>CLO4</b>	After careful study of Unit student will be agree and able to: write mechanism to describe the opening of an epoxides ring by Grignard and organo-lithium reagent and under mildly acidic conditions, and susceptible cleavage of epoxides by bases.	5 Evaluating
<b>CLO5</b>	After careful study of Unit student will be able to: analyze application of thiols, thioether and aliphatic sulphonic acids and importance of ylides for the conversion of carbonyl group to alkene.	4 Analysing



CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	L	H	H	H	H	H	H	M	M
CLO2	H	L	L	H	H	H	M	H	M	H	L
CLO3	H	H	M	H	H	H	M	H	M	H	L
CLO4	H	H	L	H	H	H	H	M	H	H	H
CLO5	H	L	L	H	H	H	H	H	H	H	H

H: High; M: Medium; L: Low

**B.Sc. (Hons): Chemistry**



**II Year, IV Semester**  
**Physical Chemistry-III**  
**BCY4003**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To discuss the energy changes in all types of physical and chemical process and the importance of thermodynamics in physical chemistry.

**CO2** To describe the concept of phases, components and degree of freedom, the phase diagram of one and two component system.

**CO3** To explain the different concepts of acid-base, types of buffer and their working principles.

**CO4** To illustrate the measurements of conductance, specific conductance and molar conductance and their applications in determinations of dissociation constant, solubility and titration.

**CO5** To explain different types of catalysis and the kinetics associated with them.

**UNIT I- Thermodynamics-III**

**[11 L]**

Spontaneous processes, Second Law of Thermodynamics, Carnot cycle, concept of entropy, entropy changes of an ideal gas in different processes, entropy changes in reversible and irreversible processes, concept of Free energy, Gibbs and Helmholtz free energies and their relationship, variation of free energy with temperature and pressure, free energy and equilibrium constant. Maxwell's relations, Gibbs-Helmholtz equations and its application for the determination of  $\Delta G$ ,  $\Delta H$ ,  $\Delta S$  of a reversible cell reaction, thermodynamics of phase transition: Clapeyron-Clausius equation and its applications, Third law of thermodynamics, deviation of entropy with temperature, determination of absolute entropies of liquid and gases.

**UNIT II- Phase Equilibrium**

**[9 L]**

Concept of phase, component and degree of freedom. Concept of phase rule and its thermodynamic derivation, phase diagrams of one component system: water and sulfur, two component system: lead-silver, the distribution law and its applications: cases of association and dissociation of solutes, solvent extraction, distribution coefficient.

**UNIT III- Ionic Equilibria**

**[9 L]**

Acids-bases and solvents: modern aspects of acids and bases: Arrhenius theory, theory of solvent system, Brønsted and Lowry concept, Lewis concept with typical examples, applications and limitations, strengths of acids and bases (elementary idea), ionization of weak acids and bases in aqueous solutions, application of Ostwald's dilution law, ionization constants, ionic product of water, pH-scale, buffer solutions and their pH values, buffer actions, hydrolysis of salts

**UNIT IV- Electrochemistry-II**

**[11 L]**

Conductance, specific conductance and molar conductance and measurement of conductance, variation of specific and equivalent conductance with dilution for strong and weak electrolytes, cell constant, migration of ions: transference number and its measurement by Hittorf and moving boundary method, Kohlrausch's law of



independent migration of ions, ion conductance and ionic mobility, applications of conductivity measurements: determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of a sparingly soluble salt and conductometric titrations.

**UNIT V- Catalysis**

[10 L]

Concept of catalysis, characteristics of catalytic reactions, catalytic reactions: homogeneous and heterogeneous catalytic reactions, autocatalytic reactions, catalyst poisons, catalyst promoters. Enzyme catalysis and its mechanism, kinetics of enzyme catalysed reactions: Michaelis-Menten equation, effect of temperature and pH on enzyme catalysis, homogeneous catalysis with reference to acid-base catalysis, heterogeneous catalysis (surface reactions): kinetics of unimolecular surface reactions- inhibition and activation energy.

**Total lectures: 50**

**TEXT BOOKS:**

- T1.** *Essentials of Physical Chemistry*, A. Bahl and B. S. Bahl, G. D. Tuli, 27<sup>th</sup> Edition (2014), S. Chand & Company Ltd., New Delhi.
- T2.** *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37<sup>th</sup> Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
- T3.** *Physical Chemistry*, P. C. Rakshit, 5<sup>th</sup> Edition (1988), 4<sup>th</sup> Reprint (1997), Sarat Book House, Calcutta.

**REFERENCE BOOKS:**

- R1.** *Physical Chemistry*, P. Atkins and J. De Paul, 8<sup>th</sup> Edition (2006), International Student Edition, Oxford University Press.
- R2.** *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3<sup>rd</sup> Edition (International Edition, 1999), Houghton Mifflin Co., New York.
- R3.** *Physical Chemistry*, I. N. Levine, 4<sup>th</sup> Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Blooms Taxonomy
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<b>CLO1</b>	Able to identify spontaneous, non-spontaneous, reversible and irreversible processes and calculate $\Delta G$ , $\Delta H$ , $\Delta S$ of a reversible cell reaction using Gibbs-Helmholtz equations.	3 Applying
<b>CLO2</b>	Able to derive the phase rule to calculate degree of freedom and able to construct phase diagrams of one and two-component systems	6 Creating
<b>CLO3</b>	Drive Bronsted and Lewis acid-bases, prepare buffer solutions of desired pH range and calculate ionization constants of weak acids and ionic product of water.	3,6 Applying and Creating
<b>CLO4</b>	Decide to determine the value of molar, specific and equivalent conductance experimentally and able to calculate molar conductance from the molar ionic conductance use in Kohlrausch's law.	3,5 Applying ,Evaluating
<b>CLO5</b>	Show to distinguish between homogeneous and heterogeneous catalytic reactions, derive the rate equation for enzyme catalysis, and able to calculate the associated turnover numbers.	1,2,3 Remembering, Understanding, Applying

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	L	H	H	H	L	H	H	H	M
CLO2	H	L	H	H	H	H	M	H	H	H	H
CLO3	H	H	M	H	H	H	H	H	H	M	H
CLO4	M	M	L	M	M	M	H	M	L	M	H
CLO5	H	L	L	H	H	H	L	H	H	H	H

H: High; M: Medium; L: Low

**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Fuel Chemistry-III**  
**BCY4004**



## Course Objectives:

**CO 1** To discuss and show the importance of different energy sources, classification of fuels and their calorific value, use and processing of coal, coal gas, producer gas and water gas.

**CO2** To explain fractionation of coal tar, use of coal tar bases chemicals, requisites of a good metallurgical coke, and solvent refining along with the importance of petroleum and petrochemical Industry.

**CO2** To describe the principle and the process of fractional distillation, cracking and reforming Petroleum and non-petroleum fuels.

**CO3** To the production of fuel from waste, show that the synthetic fuels (gaseous and liquids), clean fuels, and various petrochemicals.

**CO4** To define, classify and uses of lubricants.

### UNIT I- Fuel-I

[10 L]

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining. Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

### UNIT II- Fuel-II

[8 L]

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

### UNIT III- Lubricants

[7 L]

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

**Total lectures: 25**

## TEXT BOOKS:

**T1.** Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut(1996).

## REFERENCE BOOKS:

**R1.** Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).

**R2.** Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.





**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Blooms Taxonomy
CLO1	Able to identify the drawbacks associated with the fossil fuels and benefits of the solar fuels.	3 Applying
CLO2	Able to show gross calorific value and net calorific value of a given fuel.	1, 2,3 Remembering ,Understanding & Applying
CLO3	Able to examine the application of fractional distillation in petrochemical industries.	4 Analysing
CLO4	Able to explain the importance of LPG, CNG, LNG, bio-gas and fuels derived from biomass.	4 Evaluating
CLO5	Able to discuss conducting and non-conducting, solid and semisolid, and synthetic lubricants.	6 Creating

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	H	M	H	H	M	H	H	H	M
CLO2	M	H	H	H	H	H	M	H	H	H	H
CLO3	L	H	H	M	H	H	M	H	H	H	H
CLO4	M	H	H	H	H	H	L	H	H	H	M
CLO5	M	M	H	M	H	H	M	H	L	H	H

H: High; M: Medium; L: Low

**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Pesticide Chemistry**  
**BCY4005**

L C  
2 2

**Course Objectives:**

- CO1 To discuss about pesticides, show its benefits and adverse effects.  
CO2 To apply chemistry knowledge in synthesis of pesticides.



**CO3** To explain and apply the technical manufacturing of Carbamates and Quinones.

**CO3** Discuss how to synthesize DDT and Gammexene.

**CO4** To demonstrate and show the structure activity relationship.

**UNIT-I Introduction to pesticides**

**[8 L]**

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship.

**UNIT-II Synthesis and applications-I**

**[8 L]**

Synthesis and technical manufacturing and uses of representative pesticides in the following classes: Organochlorines. (DDT, Gammexene); Organophosphates (Malathion, Parathion).

**UNIT-III Synthesis and applications-II**

**[9 L]**

Synthesis and technical manufacturing and uses of representative pesticides in the following classes: Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

**Total lectures: 25**

**TEXT BOOKS:**

**T1.** Industrial Chemistry, B.K. Sharma, 16<sup>th</sup> ed. Goel publishing house Meerut, 2011

**REFERENCE BOOKS:**

**R1.** Pesticide Chemistry and Toxicology, Dileep K. Singh, volume 1

**R2.** Cremlyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	Apply knowledge in farming as well as agricultural industries.	3 Applying
<b>CLO2</b>	Able to construct small scale and large scale preparation of different pesticides.	3 Applying
<b>CLO3</b>	Able to estimate difficulties in the synthesis of different chemicals used as pesticide.	5 Evaluating
<b>CLO4</b>	Contrast to overcome of synthetic problems in synthesis	4 Analysing
<b>CLO5</b>	To design new pesticides based on their structure activity relationships.	6 Creating



CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	H	H	H	H	H	H	H	H	H	H	M
<b>CLO2</b>	H	H	H	H	H	H	M	H	H	H	L
<b>CLO3</b>	H	H	H	M	M	H	M	H	H	H	H
<b>CLO4</b>	H	H	H	H	H	H	L	H	H	H	M
<b>CLO5</b>	M	H	H	M	H	H	M	H	L	H	H

H: High; M: Medium; L: Low



**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Polymer Chemistry**  
**BCY4101**

**Elective-I**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To explain and list the basic terms related to polymers and polymerization.

**CO2** To discuss and show the synthesis, properties and applications of general thermosetting polymers as well as thermoplastic polymers.

**CO3** To interpret and apply correlation of chemical structure with stability and processing of the polymer.

**CO4** To describe the methods of characterization of polymers and their thermodynamics.

**UNIT I** **[8 L]**

Basic concept of Polymer Science, Molecular forces and chemical bonding in polymers, Molecular weight determination, Classification of polymers, degree of polymerization and functionality.

**UNIT II** **[9 L]**

Synthesis, chemistry, properties and applications of the following thermosetting polymers: Phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, Polyurethanes, Polycarbonates, and Epoxy resins – grades and curing process, Silicones. Elastomers – polyisoprene, polybutadiene and neoprene.

**UNIT III** **[7 L]**

Synthesis, chemistry, properties and applications of the following Thermoplastics polymers:- Polyethylene, PAN, PS, PVC, PMMA, Teflon (PTFE), Nylon-6, Nylon-6,6 , Nylon-6,10, Kevlar, Glyptal, terylene and Natural rubber. Conducting polymer, Natural polymer and biodegradable polymer.

**UNIT IV** **[8 L]**

Polymer reaction: Introduction, hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions. Reaction of other functional groups. Cyclisation and cross-linking reactions, cure reactions. Modification of commercial Polymers.

**UNIT V** **[8 L]**

Degradation of polymer by thermal, oxidative, mechanical and chemical methods. Polymer processing: compression molding, casting, extrusion, fiber spinning, injection molding, thermoforming, vulcanization of elastomers.

**Total Lecture: 40**



**TEXT BOOKS:**

- T1.** “Polymer sciences” V.R. Gowarikar, N.V. Vishwanathan, J. Shreedhar, Wiley eastern, New Delhi.  
**T2.** “Principle of Polymer Sciences”, P. Bahadur and N.V. Shastri, Narosa Publishing House, New Delhi.  
**T3.** “Experiments in Polymer Science”, D.G. Hundiwale, V.D. Athawale, U.R. Kapadi and V.V. Gite, New Age Publishers.  
**T4.** “Polymer Chemistry”, B.K. Sharma, Krishna Prakashan Media (P) Ltd. Meerut. India.

**REFERENCE BOOKS:**

- R1.** “Text Book of Polymer Science” F.W. Billmeyer, John Wiley & sons, 1994.  
**R2.** “Polymer Science and Technology: Plastics, Rubbers, Blends and Composites”. Premamoy Ghosh, 3rd Edition, Tata McGraw - Hill Education, 2010.  
**R3.** Organic Chemistry: Stereochemistry and the Chemistry of Natural Products (Vol-2), I.L. Finar, 5<sup>th</sup> edition Pearson Education Singapore (P) Ltd.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	Students will be able to explain the basic terms related to polymerization.	2 Understanding
<b>CLO2</b>	Students will be able to show correlation between the structure and properties of thermosetting polymers as well as thermoplastic polymers.	1 ,2,3 Remembering, Understanding & Applying
<b>CLO3</b>	Students will able to predict the stability of a polymer in a particular environment and processing technique suitable for it.	3 Applying
<b>CLO4</b>	Student will become agree and aware of how to proceed for basic characterization of a polymer.	5 Evaluating



CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	H	H	H	H	H	H	H	H	H	H	M
<b>CLO2</b>	H	H	H	H	H	H	M	M	H	H	L
<b>CLO3</b>	H	H	M	M	M	H	M	H	H	H	M
<b>CLO4</b>	H	H	H	H	H	H	H	H	H	H	M
<b>CLO55</b>	H	H	H	M	H	H	M	H	H	L	H

H:High, M:Medium, L:Low



**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Industrial Chemicals and Environment**  
**BCY4102**

**Elective-I**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To illustrate production, use, storage and hazards of industrial gases and manufacturing, application, analysis and hazards of Inorganic Chemicals.

**CO2** To discuss Environments and its segments, air pollution, environmental effects of ozone, greenhouse effect and Global warming.

**CO3** To discuss and list about Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, techniques for measuring water pollution, Impacts of water pollution on hydrological cycle and ecosystems.

**CO4** To illustrate the Effluent treatments plants and industrial effluents.

**CO5** To apply the Industrial waste management, Water treatment and purification, Water quality parameters for waste water, industrial water and domestic water.

**UNIT-I Industrial Gases and Inorganic Chemicals** **[10 L]**

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

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

**UNIT-II Environment, its segments and Air Pollution** **[12L]**

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO<sub>2</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, H<sub>2</sub>S and other foul smelling gases. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens.

**UNIT-III Water Pollution** **[8 L]**

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

**UNIT-IV Industrial effluents and their treatments** **[5 L]**

Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

**UNIT-V Waste management and water quality parameters** **[5 L]**

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.



**TEXT BOOKS:**

- T1.** A. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.  
**T2.** E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd., UK.  
**T3.** Industrial Chemistry, B.K Sharma, krishna prakashan media(p) ltd.,meerut.  
**T4.** Puri. sharma. Kallia, Principal of Inorganic Chemistry, shoban lal Nagin chand & Co., New Delhi.  
**T5.** S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd., New Delhi.

**REFERENCE BOOKS:**

- R1.** R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.  
**R2.** J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.  
**R3.** S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	Students will be able to illustrate the industrial gases and apply like how to predict in large amount, how to handle hazardous gases and storage. Same thing for handling hazardous inorganic chemicals, production and its use.	4,3 Analysing & Applying
<b>CLO2</b>	Students will be able to explain Ecosystems, Biogeochemical, carbon, nitrogen, and sulphur cycle, and air Pollution and effect of global warming and green house effect on environment.	2,5 Understanding & Evaluating
<b>CLO3</b>	Able to explain and apply techniques for measuring water pollution and describe Hydrological cycle, water resources, aquatic ecosystems.	2, 3 Understanding & Applying
<b>CLO4</b>	Able to apply how to treat the waste and illustrate about the Industrial effluents from various industries	3, 4 Applying & Analysing
<b>CLO5</b>	Able to analyse Water quality parameters for waste water industrial water and domestic water.	4 Analysing





CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	H	H	H	H	H	H	H	H	H	H	H
<b>CLO2</b>	H	H	H	H	H	H	M	M	H	H	L
<b>CLO3</b>	H	M	M	M	M	H	M	H	H	M	M
<b>CLO4</b>	H	H	H	H	H	H	H	H	H	H	M
<b>CLO55</b>	H	H	H	H	H	H	M	H	H	M	H

H: High,M:Medium,L:Low



**B.Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Chemistry Lab-IV**  
**BCY4501**

**L T P C**  
**0 0 6 3**

**Course Objectives:**

**CO1** To determine the partition coefficient of benzoic acid between water and benzene at room temperature.

**CO 2** To determine the specific rate constant of the hydrolysis of ethyl acetate catalyzed by an acid at room temperature.

**CO3** To examine & show the semi-micro qualitative analysis of inorganic mixtures containing not more than four radicals.

**CO4** To identify the given systematic organic compounds and preparation of suitable derivative.

**CO5** To illustrate synthesis of m-dinitrobenzene from nitrobenzene.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Blooms Taxonomy</b>
<b>CLO1</b>	Students are able to find out the partition coefficient of benzoic acid between water and benzene at room temperature.	1 Remembering
<b>CLO2</b>	Students are able to determination of the specific rate constant of the hydrolysis of ethyl acetate catalyzed by an acid at room temperature.	5 Evaluating
<b>CLO3</b>	Students are able to interpret the semi-micro qualitative analysis of inorganic mixtures containing not more than four radicals.	2 Understanding
<b>CLO4</b>	To identify the given organic compounds and preparation	3,5 Applying &



	of suitable derivative.	Evaluating
<b>CLO5</b>	To make up experimentally the synthesis of m-dinitrobenzene from nitrobenzene.	6 Creating

CLO	Program Learning Outcome PLO								Program Specific Outcome PSO		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	H	H	H	H	H	H	H	H	H	H	M
CLO2	M	H	H	H	H	H	H	H	H	H	H
CLO3	H	H	L	H	H	H	M	H	H	M	H
CLO4	H	H	L	M	H	H	M	M	H	M	M
CLO5	H	H	L	H	H	L	L	H	H	H	L

H: High; M: Medium; L: Low



**B. Sc. (Hons): Chemistry**  
**II Year, IV Semester**  
**Soft Skill**  
**BSS 4501**

**L T P C**

**2 1**

**Course Objective:**

- To enable the students to improve their communication skills.
- To introduce them to professional skills & personal skills.
- To improve their grooming & manners.

**Unit 1: Introduction**

**[02]**

Introduction to soft skills: What are soft skills, importance and application of soft skills?

SWOT Analysis: Elements of SWOT Analysis, practice

**Unit 2: Communication Skills**

**[10]**

Extempore Speech: Tips on extempore speech, practice.

JAM/HAM: Tips on JAM/HAM, making short meaningful conversation.

Role Play: Role play practice on various situations.

E-mail etiquette and writing: Email fields, etiquettes, mistake's to avoid, practice.

Business and Cover Letters: Format of business & cover letter, practice business correspondence and cover letters.

Written Comprehension: Understanding a written passage & answering questions

**Unit 3: Professional Skills**

**[08]**

Presentation Skills: Slide preparation, stage & audience management, effective delivery.

Stress Management: What is stress, identifying causes of stress, handling stress.



Selling, Networking, Negotiation skills: What are selling skills, how to develop selling skills, employing the skills to achieve personal and organizational goals, networking with persons, & through sites, making a professional profile, negotiation skills for professional use.

Leadership: Types of leaders, qualities of a leader, displaying leadership.

Creativity: What is creativity, developing creativity in day to day life.

Team Work & Team Building: What is team work, advantages of team work. Building teams and team work to achieve specific goals.

**Unit 4: Personal Skills**

**[03]**

Grooming and etiquette: Importance of grooming, grooming process, dressing up for the occasion, displaying correct manners.

Problem Solving and Decision Making: Steps to problem solving and correct decision making.

Time Management: Importance of time management, making effective use if time, prioritization, identifying wasteful activities.

**Unit 5: Group Discussion**

**[01]**

Introduction to Group Discussion: Introduction, skills required, roles & techniques in Group Discussion.

**TEXT BOOKS:**

**T1.** The Ace of Soft Skills- G Ramesh, Mhadevan Ramesh-2013 Edition

**T2.** Communication Skills for Engineers & Scientists- Sangeeta Sharma, Binod Mishra-2013 Edition

**REFERENCE BOOKS:**

**R1** Personality Development by Rajiv Mishra-2014 Edition.

**Course Learning Objectives (CLO):**

On completion of this course the students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Discuss</b> the Importance of Soft Skills <b>Examine</b> the skills required to be updated. <b>Compare</b> the behavior and attitude of the students	2,4,6  Discuss, Examine, Compare.



CLO2	<b>Explain</b> the Verbal Comprehension & listening skills. <b>Illustrate</b> the role and importance of Verbal Comprehension, listening skills, HAM/JAM, public speaking , body language, <b>Examine</b> the importance of listening skills, HAM/JAM, public speaking , body language. <b>Evaluate</b> on the basis Question & answers based on read out passage. <b>Compare</b> the improvement in listening skills, body language. <b>Illustrate</b> the importance of email writing, application writing, role play <b>Demonstrate</b> the format of email and application. <b>Evaluate</b> through practice of writing applications, emails and evaluate role plays through practice.	2, 3, 4, 6, 2,2  Explain, Illustrate, Evaluate, Compare, Demonstrate
CLO3	<b>Build</b> professional skills, <b>Develop</b> presentation skills, <b>Create</b> presentations, <b>Make use of</b> selling skills personally and professionally, <b>Develop</b> leadership skills, <b>Demonstrate</b> benefits of team work	3, 3, 6, 3, 2 Build, Develop, Create, Make use of, Demonstrate
CLO4	<b>Explain</b> grooming & etiquette. <b>Experiment</b> social etiquette. <b>Construct</b> their own opinion about the grooming & etiquette <b>Analyse</b> problems, <b>Take part in</b> decision making	2,3,4,6,4,4  Explain, Experiment, Construct, Analyse, Take Part
CLO5	<b>Explain</b> GD Skills <b>Demonstrate</b> the importance of GD Skills <b>Conclude and Compare</b> Importance, purpose, types, do's & don'ts , difference between GD & Debate.	5,2,4,4  Explain, Demonstrate, Conclude, Compare,



Course Learning outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	L	M	M	M	L	L	L	M	M	L	L
CLO2	L	M	M	L	L	L	L	L	M	L	L
CLO3	M	M	L	M	L	L	L	L	H	L	L
CLO4	L	M	L	L	L	L	L	M	M	L	L

**B.Sc. (Hons): Chemistry**



**III Year, V Semester**  
**Inorganic Chemistry-IV**  
**BCY5001**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To discuss of chemistry of d-block elements.

**CO2** Describe crystal field theory.

**CO3** To demonstrate the electronic spectra of metal complexes.

**CO4** To illustrate the magnetic properties of metal complexes.

**CO5** To explain the reaction mechanism of coordination compounds.

**Unit I- Chemistry of *d*-block elements**

**[10 L]**

Salient features, characteristic properties of 3*d*-elements with reference to oxidation states, color, magnetic behavior, and complex formation tendency. **Coordination compounds:** Nomenclature, Werner's theory, Isomerism, Valence Bond Theory, Limitations of valence bond theory.

**Unit II- Theories of Metal-Ligand bonding**

**[10 L]**

Crystal-field theory and crystal-field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field splitting. Crystal-field stabilization energy, calculation, application of crystal-field stabilization energy, Jahn-Teller Distortion. Effect of Jahn-Teller Distortion on Metal-Ligand bonding.

**Unit III- Electronic spectra of Transition Metal Complexes**

**[8 L]**

Types of Electronic Transitions, Selection rules for d-d transitions, high spin and low spin complexes, spectrochemical series, Orgel-Energy level diagram for  $d^1$  and  $d^2$  states, discussion of the Electronic Spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

**Unit IV-Magnetic Properties of Transition Metal Complexes**

**[10 L]**

Types of magnetic behavior, methods of determining magnetic susceptibility, spin only formula, L-S coupling, orbital contribution to magnetic moments and application of magnetic moment data for 3*d* metal complexes.

**Unit V- Thermodynamics and Kinetics, Reactions of Coordination complexes**

**[12 L]**

A brief outline thermodynamic stability of metal complexes and factors affecting the stability, Substitution in square planar complexes. The trans-effect, its synthetic application, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, inner sphere type reactions.

**Total Lectures: 50**

**TEXT BOOKS:**

**T1.** J. D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup>, Blackwell Science, London, 1996.

**T2.** Wahid U. Malik, G. D. Tuli, R. D. Madan Inorganic chemistry, 7<sup>th</sup>, S. Chand Publication., 2001.

**T3.** B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 1<sup>st</sup>, Shobhan Lal Nagin Chand & Co, 1996.

**REFERENCE BOOKS:**

**R1.** D.F. Shriver and P.W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>, Oxford University Press, 2010.

**R2.** F.A. Cotton, G. Wilkinson, and P.L. Gaus, Basic Inorganic Chemistry, 3<sup>rd</sup>, Wiley India, 2004.

**R3.** G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3<sup>rd</sup>, Pearson Education Ltd., 2014.





R4. J. Huysse, E. A. Keiter, R. L. Keiter and Okhil K. Medhi, Inorganic chemistry, 4<sup>th</sup>, Pearson Education Ltd., 2013.

R5. Dr. Sathya Prakash, S.K. Basu, R.D. Madan G.D. Tuli. Advanced Inorganic Chemistry 4<sup>th</sup> reprint, 1999 .

### Course Learning Outcomes (CLO):

After completing this course, our Student will be able to-

CLO	Description	Bloom's Taxonomy Level
CLO1	<b>Explain</b> Salient features and characteristic properties of 3d-elements and be able to <b>categorize</b> the coordination compounds.	2, and 4 Understand and analyze
CLO2	<b>Predict</b> the bonding in complexes using VBT and CFT and be able to <b>explain</b> effect of Jahn-Teller Distortion on Metal-Ligand bonding.	2, 3 and 6 Understand, apply, and create
CLO3	<b>Identify</b> molecular geometries associated with various d-orbital splitting patterns and be able to <b>explain</b> reaction mechanism of coordination compounds.	1,2,3 Remember, understand, apply
CLO4	<b>Predict and discuss</b> the electronic spectra of transition metal complexes, the magnetic nature of metal complexes and number and types of peaks.	2, 6 Understand and create

Course Learning	Programme Learning outcomes (PLO)	Programme specific Outcomes (PSO)
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outcomes (CLO)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	M	L	L	M	L	L	L	M	M	M
CLO2	M	M	M	L	L	L	L	L	L	M	L
CLO3	L	L	M	L	L	L	-	L	M	M	M
CLO4	M	M	M	M	L	L	L	L	M	M	M

H: High, M: Medium, L: Lo

**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Organic Chemistry-IV**



**BCY5002**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To discuss the role of Organometallic compounds in C-C bond formation.

**CO2** To explain why and how molecules undergo rearrangements and their mechanisms.

**CO3** To describe the synthesis and important applications of Organic compounds containing nitrogen.

**CO4** To discuss and show synthesis and uses of important 5 and 6 membered heterocyclic compounds.

**CO5** To demonstrate the preparation and synthetic applications of condensed heterocyclic systems.

**Unit I- Organometallic Compounds**

**[12L]**

Organomagnesium compounds: Grignard reagents, synthesis, structure and chemical reactions; Organocopper reagents; synthesis and chemical reactions, Organozinc Compounds: synthesis and chemical reactions; Organolithium Compounds: Synthesis and chemical reactions.

**Unit II- Molecular Rearrangement involving electron deficient atoms**

**[10 L]**

Mechanism and Applications of: Semi-pinacol, Wagner Meerwein, Benzilic acid, Beckmann, Hoffmann, Curtius, Schmidt, Baeyer-villiger and Favorskii.

**Unit III- Nitrogen Containing Compounds**

**[12 L]**

Preparation and important reactions of: nitro compounds, Nitrobenzene and its reduction. Nitriles and isonitriles. Amines: Structure and nomenclature of amines, Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Effect of substituent and solvent on basicity of amines, Preparation and properties: Gabriel phthalimide synthesis, Hofmann bromamide reaction Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation,. Comparative basicity of aliphatic amine and aromatic amines. Diazonium salts: preparation and synthetic applications.

**Unit IV- Hetrocyclic Chemistry-I**

**[8 L]**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions of pyrrole, furan, thiophene and pyridine with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives. Basicity of nitrogen containing heterocyclic compounds.

**Unit V-Hetrocyclic Chemistry-II**

**[8 L]**

Synthesis and reactions of indole, quinoline and isoquinoline: Fischer indole synthesis and Madelung synthesis, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pomeranz-Fritsch reaction. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

**Total Lectures: 50**

**TEXT BOOKS:**

- T1.** Organic Chemistry, Paula Y. Bruice, 2<sup>nd</sup> Edition, Prentice-Hall, International Edition (1998).
- T2.** Organic Chemistry, R. T. Morrison and R. N. Boyd, 6<sup>th</sup> Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
- T3.** Solomons & Fryhle's Organic Chemistry, T.W. Graham Solomons, C. B. Fryhle, 10<sup>th</sup> edition, 2014, Wiley



- T4. Arun Bahl and B. S. Bahl, Advanced Organic Chemistry, First multicolor revised edition, S. Chand and company Ltd. New Delhi

**REFERENCE BOOKS:**

- R1. M.B. Smith & Jerry March, March's Advanced Organic Chemistry, 5<sup>th</sup> Edition (2001), John Wiley & Sons, New York.  
R2. Peter Sykes, A Guide book to Mechanism in Organic Chemistry, 6<sup>th</sup> Edition (1997), Orient Longman Ltd., New Delhi.  
R3. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, Oxford University Press, Oxford (2001).  
R4. P.S. Kalsi, Organic Reactions and their Mechanisms, 1<sup>st</sup> Edition (1996), New Age International Publication, New Delhi.  
R5. Organic Chemistry, John Mcmurry, 7<sup>th</sup> edition, Brooks Cole, 2008.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

CLO	Description	Bloom's Taxonomy Level
CLO1	Students can <b>perform</b> synthesis of wide variety of important compounds from organometallic reagents and can choose better reagent for specific reaction.	1,2,3, 6 Remember, Understand, Apply, and create
CLO2	Students can <b>predict</b> when a rearrangement will occur and the unusual product that will be formed.	2, 6 Understand and create
CLO3	Students will be able to <b>perform</b> synthesis of important derivatives of nitro, nitriles, isonitriles and amines in lab.	2,3, 6 Understand, apply and create
CLO4	Students will be able to <b>explain</b> reactivity of heterocyclic aromatic compounds and can <b>perform</b> the synthesis of useful derivatives of 5	2, ,3, 6 Understand, Apply and



	and 6 membered heterocyclic compounds.  Students will be able to <b>understand</b> important reactions of fused ring heterocyclic compounds and their <b>role</b> in pharmaceutical and chemical industries.	Create
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Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	M	M	M	L	L	M	L	H	M	L
CLO2	L	M	L	L	L	M	L	L	M	M	L
CLO3	M	H	H	M	L	L	M	L	H	M	L
CLO4	M	M	H	M	M	L	M	L	H	M	L

H: High, M: Medium, L: Low

**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Physical Chemistry-IV**  
**BCY5003**

L T P C  
4 1 0 5

**Course Objectives:**



**CO1** To illustrate the utility of MOT in explain the filling of electrons in molecular orbitals and calculate bond order.

**CO2** To discuss the concept of quantization of energy and significance of Schrödinger's wave equation.

**CO3** To explain the adsorption, its types and factors influencing it.

**CO4** To show physicochemical properties of colloidal state and their utility.

**CO5** To explain use of study of chemical potential in determining the change in the thermodynamic functions during mixing.

**UNIT I- The Chemical Bond**

**[10 L]**

Molecular orbital theory and types of molecular orbital, the hydrogen molecule ion, hydrogen molecule (MO and VB descriptions), simple molecular orbitals for homonuclear and heteronuclear diatomic molecules, bond description and hybridization.

**UNIT II- Quantum Chemistry**

**[12 L]**

Postulates of quantum mechanics, elementary concepts of quantum mechanical operators, eigen functions and eigen values, linear operators, commutation of operators, fundamental commutator and uncertainty relation only, expectation value of physical quantity, Hermitian operator, Schrödinger's wave equation and its solution for a particle in a one dimensional box.

**UNIT III- Surface Chemistry**

**[10 L]**

Surface dynamics: Physical and chemical adsorption, Freundlich and Langmuir adsorption isotherms, multilayer adsorption and BET isotherm (no derivation) and its application, Gibbs adsorption isotherm and adsorption from solutions.

**UNIT IV- Colloidal state**

**[9 L]**

Introduction, types of colloidal systems, classification of colloids, types of sols, preparation and purification of colloids, properties of colloidal systems: Colligative, optical, and electrical, concept of electrical double layer and zeta potential, coagulation of colloidal solutions, applications of colloids.

**UNIT V- Thermodynamics of solutions**

**[9 L]**

Activity of a component in an ideal solution, Gibbs-Duhem-Margules equation and its application, thermodynamic functions of mixing ( $\Delta G_{\text{mix}}$ ,  $\Delta S_{\text{mix}}$ ,  $\Delta V_{\text{mix}}$ ,  $\Delta H_{\text{mix}}$ ), vapour pressure composition and boiling point composition curves of completely miscible solutions.

**Total lectures: 50**

**TEXT BOOKS:**

**T1.** *Essentials of Physical Chemistry*, A. Bahl and B. S. Bahl, G. D. Tuli, 27th Edition (2014), S. Chand & Company Ltd., New Delhi.

**T2.** *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.

**T3.** *Physical Chemistry*, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.

**REFERENCE BOOKS:**



- R1.** *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
- R2.** *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.
- R3.** *Physical Chemistry*, I. N. Levine, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.
- R4.** *Physical Chemistry - A Molecular Approach*, D. A. Mc Quarrie and J. D. Simon, South Asian Edition (1998), University Science Books, Sausalito CA, by Viva Books, New Delhi.

### Course Learning Outcomes (CLO):

After completing this course, our students will be able to-

CLO	Description	Bloom's Taxonomy Level
CLO1	The students will be able to <b>predict</b> the bond length and stability of molecules on the basis of Molecular orbital theory.	1,2,6 Understand, Apply and create
CLO2	The pupil will <b>understand</b> the reduction of bands to energy level at molecular level and use Schrödinger's equation to <b>determine</b> the energy of a particle in one dimensional box.	2, 3, 5 Understand, apply and evaluate
CLO3	The students will be able to <b>correlate</b> the adsorption behaviour of a material with the nature of its surface and vice-versa.	2, 4 Understand and apply
CLO4	The students will be able to <b>distinguish</b> and <b>classify</b> colloids and also <b>calculate</b> the many physical properties of colloidal systems. The student will be able to <b>determine</b> the effect of mixing two components on their vapour pressure and boiling point.	2,3,4,5 Understand, apply, analyze and evaluate



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	M	L	M	L	L	L	L	M	L
<b>CLO2</b>	H	M	M	L	L	L	-	L	M	M	L
<b>CLO3</b>	M	L	M	L	L	L	L	L	M	M	L
<b>CLO4</b>	M	M	L	M	L	M	L	L	M	M	L

H: High, M: Medium, L: Low





**B.Sc. (Hons): Chemistry**

**III Year, V Semester**

**Analytical Chemistry**

**BCY5101**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To discuss and show analytical methods and their range of application within detection of inorganic and organic compounds and various steps involved in quantitative analysis.

**CO2** How to determine quantitative estimates of the nature and size of experimental errors and to predict how these errors affect the reliability of the final result and benefit of taking many measurements of a single property and identify sources of error in measurement.

**CO3** To demonstrate a theoretical as well as a practical introduction to principles and techniques of some chromatographic techniques.

**CO4** To explain and show function of chelating agents in extraction process and various factors by which rate and selectivity of extraction process can be enhanced.

**CO5** To illustrate the various steps of gravimetric analysis and their advantages and desirable properties of gravimetric precipitates and precipitating agents.

**UNIT I- Introduction**

**[11 L]**

Introduction & objectives of analytical chemistry, difference between chemical analysis and analytical chemistry, classification of analytical methods, sampling processes, difference between quantitative and qualitative analysis, Steps in a quantitative analysis, bipartite classification, Analytical validations and good laboratory practices.

**UNIT II- Statistical Methods in Chemical analysis**

**[9 L]**

Errors in chemical analysis: Determinant and indeterminate errors, systematic and random errors in chemical analysis with examples. Accuracy and precision of measurements, Relative and standard deviation, distribution of random errors and normal error curve. Methods for minimizing errors, significant figures.

**UNIT III- Chromatography**

**[8 L]**

Introduction to chromatography, Principle of chromatography, Classification of chromatographic methods, concept of adsorption and its application. Column Chromatography, Thin layer chromatography, paper chromatography, gas chromatography and high performance liquid chromatography.

**UNIT IV- Solvent extraction**

**[6 L]**

Nernst's distribution law, types of extraction: single and multiple extraction, Craig concept of counter-current distribution, significant solvent systems: chelate extraction, synergic extraction, extraction by solvation, ion-pair extraction.



**UNIT V- Qualitative and quantitative analysis**

[6 L]

Titration: Introduction, classification and uses. Properties of gravimetric precipitates and precipitating reagents, Formation of gravimetric precipitates, Conditions for quantitative precipitations, Steps involved in quantitative precipitation.

**Total lectures: 40**

**TEXT BOOKS:**

- T1.** 'Basic Concepts of Analytical Chemistry', S.M.Khopkar, 2nd edition (1998), New Age International Publications, New Delhi.  
**T2.** 'Analytical Chemistry', G.D. Christian, John Willey & sons, New York (2001).

**REFERENCE BOOKS:**

- R1.** 'Principles of Instrumental Analysis', D.A. Skoog, F.J.Holler and T.A. Nieman, 5th edition (1998), Horcourt Brace & Company, Florida.  
**R2.** 'Vogel's textbook of quantities chemical analysis', G. H. Affery J. Bassett, J .Mendham, R. C. Denney, 5th edition, John Wiley and Sons Inc.  
**R3.** 'Modern Methods of Chemical Analysis', R.L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, 2nd edition, John Wiley, New York.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Classify</b> analytical method on the basis of sample size and concentration of constituent present in the sample	1,2 Remember and understand
<b>CLO2</b>	<b>Predict</b> types of error in measurements.	2,3, 6 Understand, apply and create
<b>CLO3</b>	<b>Separate</b> mixture into individual components by <b>using</b> some common chromatographic technique.	1,2,3 Remember, understand and apply
<b>CLO4</b>	<b>Explain</b> different types of extraction procedure and principle behind the extraction process, <b>Explain</b> steps of a gravimetric analysis like precipitation, digestion, filtration, washing, drying, weighing, and their advantages	1,2 3 Remember, understand and apply



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	L	M	M	M	L	M	L	L	L	M	L
<b>CLO2</b>	L	M	M	M	L	L	L	L	M	L	L
<b>CLO3</b>	M	M	M	M	L	L	L	-	H	M	L
<b>CLO4</b>	L	M	M	M	M	L	-	-	H	L	L

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Green Chemistry**  
**BCY5102**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To discuss and show importance of different energy sources, classification of fuels and their calorific value, uses and processing of coal, coal gas, producer gas and water gas.

**CO2** To explain fractionation of coal tar, uses of coal tar based chemicals, requisites of a good metallurgical coke, and solvent refining along with the importance of petroleum and petrochemical industry.

**CO3** To describe principle and process of fractional distillation, cracking and reforming Petroleum and non-petroleum fuels.

**CO4** To demonstrate the production of fuel from waste, synthetic fuels (gaseous and liquids), clean fuels, and various petrochemicals.

**CO5** To explain the definition, classifications and uses of lubricants.

**UNIT-I Introduction and principles of Green Chemistry** **[6 L]**

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanations and examples.

**UNIT-II Chemical Synthesis by principles of green chemistry-I** **[9 L]**

Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity.  $\text{risk} = (\text{function}) \text{hazard} \times \text{exposure}$ ; waste or pollution prevention hierarchy.

**UNIT-III Chemical Synthesis by principles of green chemistry-II** **[8 L]**

Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.



**UNIT-IV Chemical Synthesis by principles of green chemistry-III**

**[10 L]**

Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carbocarbonyl) and Flixborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

**UNIT-V Future Trends in Green Chemistry**

**[7 L]**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis ( $C_2S_3$ ); Green chemistry in sustainable development.

**Total lectures: 40**

**TEXT BOOKS:**

- T1.** Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).  
**T2.** Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).  
**T3.** Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).

**Reference Books:**

- R1.** Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).  
**R2.** Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).  
**R3.** Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Explain</b> the principles of green chemistry and establish the arguments for our need to <b>recognize</b> green criteria in the practice of chemistry.	1,2, 3 Remember, understand and apply



<b>CLO2</b>	<b>Explain</b> green synthesis <b>using</b> atom economy concept, <b>calculate</b> atom economy in various types of organic reactions, waste or pollution prevention hierarchy.	2,3 and 5 Understand, apply and evaluate
<b>CLO3</b>	<b>Explain</b> the chemical <b>synthesis</b> using green solvent, careful <b>use</b> of protecting group for derivatization.	2, 3, 6 Understand, apply and create
<b>CLO4</b>	<b>Explain</b> the synthesis using catalytic reagent, <b>comparison</b> of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis, <b>development</b> of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Explain the combinatorial green chemistry, definition, classifications and uses of lubricants.	2, 3,6 Understand, apply and create

Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	M	H	L	L	M	L	M	M	L
<b>CLO2</b>	M	M	H	H	L	L	M	L	H	M	M
<b>CLO3</b>	M	M	M	M	L	L	M	L	M	L	L
<b>CLO4</b>	M	M	H	H	M	M	H	L	H	M	L

H: High, M: Medium, L: Lo



**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Seminar**  
**BCY5502**

L T P C

0 0 2 1

**Course Objectives:**

**CO1** To **develop** an **understanding** among students about scientific reasoning and analytical problems.

**CO2** To **explore** students towards the key **understanding** of carrying out theoretical work.

**CO3** To prepare students for **developing** carriers as professional in the field of chemistry.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>understand</b> and <b>explain</b> fundamental concepts and application of some recent chemical and scientific theories of specific branch of chemistry.	2, 5 Understanding, Evaluating
CLO2	carry out work effectively in chemical laboratories and <b>analyse compare</b> and <b>explain</b> their findings.	4, 5 Analyzing, Evaluating
CLO3	<b>develop</b> their carriers in chemical and pharmaceutical industries.	6 Creating

Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)			
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO 1	PSO 2	PSO3	PSO4
CLO1	H	M	M	H	M	-	M	M	M	L	M	M
CLO2	H	M	M	H	M	M	M	M	M	L	M	M
CLO3	M	H	M	H	M	-	M	M	M	-	M	M



**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Term Paper-I**  
**BCY5503**

L T P C  
0 0 2 1

**Course Objectives:**

**CO1** To **develop** an **understanding** among students about scientific reasoning and analytical problems.

**CO2** To **build** the skills required to succeed in educational and industrial chemical laboratories.

**CO3** To **build** basic foundation among students towards some modern spectroscopic techniques for the characterization of molecules.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>understand</b> and <b>develop</b> the laboratory skills needed to <b>design</b> , conduct with safety and <b>interpret</b> research in chemistry.	2, 3, 5, 6 Understanding, Applying Evaluating Creating
CLO2	<b>build</b> sufficient understanding at undergraduate level which will allow them to <b>interpret</b> the chemical literature.	5, 6 Evaluating Creating
CLO3	<b>develop</b> the ability to communicate scientific information and research results in the form of literature as well as presentation.	6 Creating





Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	H	M	M	-	M	H	H	M	H
CLO2	L	M	M	L	L	M	L	M	M	M	L
CLO3	M	M	M	M	M	H	M	M	M	M	M



**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Chemistry Lab-V**  
**BCY5501**

**L T P C**  
**0 0 6 3**

**Course Objectives:**

**CO1** To **develop** practical skills in **calculating** strength of solutions through some important titrations of analytical chemistry.

**CO3** To **develop** hands on experience on making various organic compounds by employing a variety of synthetic strategies.

**CO4** To **develop** experimental skills of preparation and purification of organic compounds

**CO5** To **acquire** knowledge of laboratory techniques for organic synthesis and characterization.

**CO6** To teach **analysis** of concentration of iron by colorimetric method.

**CO7** **Understand** good laboratory practices and safety.

**LIST OF EXPERIMENTS**

1. To study the kinetics of acid catalyzed hydrolysis of an ester.
2. Determination of the strength of copper sulphate solution using thiosulphate solution.
3. To determine the concentration of iron in the water sample by colorimetric method.
4. Determination of  $R_f$  values and identification of organic compounds.
5. Preparation and purification of iodoform from ethanol or acetone.
6. Preparation and purification of aniline from nitrobenzene.
7. Purification of solvents through distillation.
8. Oxidation of anthracene to anthraquinone.
9. Reduction of benzophenone to benzhydrol.
10. Preparation of cis diol from cinnamic acid.

**TEXT BOOKS:**

**T1.** O. P. Pandey, D. N. Bajpai, S.Giri. "Practical Chemistry", S. Chand & Co. 2012.

**T2.** Arun Sethi, systematic lab experiments in Organic Chemistry, 2<sup>nd</sup> edition, New Age International (P) Limited, 2011.

**T3.** Arun Sethi, systematic experiments in Chemistry, 1<sup>st</sup> edition: 2009, New Age International Publisher, 2012.



**REFERENCE BOOKS:**

- R1.** S. S. Dara. “Text book on Experiment and calculation in Engg. Chemistry”, S. Chand & Co.  
**R2.** G. H. Affery J. Bassett, J .Mendham, R. C. Denney, “ Vogel’s textbook of quantities chemical analysis 5<sup>th</sup> edition”, John Willy and Sons Inc.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom’s Taxonomy Level</b>
<b>CLO1</b>	<b>Perform and Discuss</b> the study of kinetics of acid catalyzed hydrolysis of an ester.	2, 3, 4, 5 Understand, apply, analyze and create
<b>CLO2</b>	To <b>analyze</b> concentration of iron in water sample by colorimetric method	2, 3 and 6 Understand, apply, and create
<b>CLO3</b>	<b>Carry out</b> experiments in the area of organic synthesis, separation and identification.	1,2,3 , 4 Remember, understand, apply and evaluate
<b>CLO4</b>	<b>understand</b> and <b>determine</b> the strength of unknown solutions through titrations.	2, 3, 5 Understand, apply and evaluate



Course Learning outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	L	M	M	M	L	L	L	M	M	L	L
<b>CLO2</b>	L	M	M	L	L	L	L	L	M	L	L
<b>CLO3</b>	M	M	L	M	L	L	L	L	H	L	L
<b>CLO4</b>	L	M	L	L	L	L	L	M	M	L	L

H: High, M: Medium, L: Low



**B. Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Aptitude & Reasoning and Online Test**  
**BAP 5501**

**L T P C**  
**0 0 2 1**

**Course Objectives (CO):**

**CO1** To enable the students to examine their mathematical , logical and analytical skills.

**CO2** To develop their employability skills.

**CO3** To improve the student skill for competition.

**CO4** To identify their speed and confidence for aptitude and Reasoning.

**UNIT 1- INTRODUCTION TO BASIC LR (3 hours)**

Coding and decoding, alphabet , blood relationship,direction sense test,series completion

**UNIT 2- INTRODUCTION TO DATES AND TIME (3 hours)**

calender : day fetching using the concept of standard table,backward stepping table,forward stepping table,clock:problem on angle,time variation,incorrect time

**UNIT 3 - NUMBER SYSTEM (6 hours)**

Number system,introduction, divisibility rule,last digit calculation, number of zeroes,remainder theorem

**UNIT 4 - BASICS OF QUANTITATIVE APTITUDE (8 hours)**

HCF and LCM, work and time, statistics ,power and roots ,percentage

**UNIT 5- PROFIT LOSS AND DISCOUNT (4 hours)**

profit and loss, function inequalities and crypto arithmetic



**REFERENCE BOOKS:**

Dr. R S Aggarwal “Quantitative aptitude”,S. Chand Publishing , 2018

Dr. R S Aggarwal “A modern approach to logical reasoning”,S. Chand Publishing , 2018

**Course Learning Outcomes (CLO):**

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

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>Improve</b> quantitative and reasoning skills.	3 Apply
CLO2	<b>Examine</b> their employability skills	4 Analyze
CLO3	<b>Develop</b> their Competitive skills	6 Create
CLO4	<b>Improve</b> their quantitative and reasoning skills.	6 Create



Course Learning outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	L	M	M	M	L	L	L	M	M	L	L
<b>CLO2</b>	L	M	M	L	L	L	L	L	M	L	L
<b>CLO3</b>	M	M	L	M	L	L	L	L	H	L	L
<b>CLO4</b>	L	M	L	L	L	L	L	M	M	L	L



**B.Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Inorganic Chemistry-V**  
**BCY6001**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To show about chemistry of lanthanides and actinides.

**CO2** To outline of organometallic compounds.

**CO3** A chapter of bioinorganic chemistry is introduced to illustrate the role of metals in living organism.

**CO4** To explain structure and bonding issues to understand the stability of simple organometallic compounds.

**CO5** To interpret the relationship between metal ion present and structural and functional roles.

**Unit I- Lanthanides**

**[8 L]**

Comparative study of lanthanide elements with respect to electronic configuration atomic and ionic radii, oxidation state and complex formation, lanthanide contraction. Separation of lanthanides. Application of lanthanide complexes.

**Unit II-Chemistry of Actinides**

**[8 L]**

Electronic structure, oxidation states, ionic radii, actinide contraction, complex formation, Comparison with lanthanides in terms of magnetic properties and spectral properties.

**Unit III- Organometallic Compounds-I**

**[12 L]**

Introduction – Definition, classification based on metal carbon bond, naming of organometallic compounds. Application of  $18e^-$  rule to predict M-M bond. Preparation, properties, bonding and applications of alkyl and aryls of Li, Al, Hg, Sn, Ti.

**Unit IV- Organometallic Compounds-II and Metal Carbonyls**

**[10 L]**

Metal-alkene complexes, metal-alkyne complexes, Preparation, properties, structure and bonding in ferrocene, Synthesis and properties of metal carbonyls, Nature and bonding in metal carbonyls Application of metal carbonyls.

**Unit V- Bio-Inorganic Chemistry**

**[12 L]**

Essential and Trace Elements in Biological Processes, Metalloporphyrins with special reference to Hemoglobin and Myoglobin, oxygen transport with reference to hemoglobin Biological role of alkali and alkaline earth metal ions with special reference to  $Na^+$  and  $Ca^{2+}$ .

**Total Lectures: 50**

**TEXT BOOKS:**

**T1.** J. D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup>, Blackwell Science, London, 1996.

**T2.** Wahid U. Malik, G. D. Tuli, R. D. Madan Inorganic chemistry, 7<sup>th</sup>, S. Chand Publication., 2001.

**T3.** B.R. Puri, L.R. Sharma, K.C. Kalia, Principles of Inorganic Chemistry, 1<sup>st</sup>, Shobhan Lal Nagin Chand & Co., 1996.





**REFERENCE BOOKS:**

- R1.** D.F. Shriver and P.W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>, Oxford University Press, 2010.  
**R2.** F.A.Cotton, G.Wilkinson, and P.L.Gaus, Basic Inorganic Chemistry, 3<sup>rd</sup>, Wiley India, 2004.  
**R3.** G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3<sup>rd</sup>, Pearson Education Ltd., 2014.  
**R4.** J. Huysse, E. A. Keiter, R. L. Keiter and Okhil K. Medhi, Inorganic chemistry, 4<sup>th</sup>, Pearson Education Ltd., 2013.  
**R5.** Dr. Sathya Prakash, S.K. Basu, R.D. Madan G.D. Tuli. Advanced Inorganic Chemistry 4<sup>th</sup> reprint, 1999 .

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Explain</b> general characteristics and the separation of Lanthanoids and Actinoids, its color, spectra and magnetic behavior and <b>discuss</b> the <b>importance</b> of lanthanides and actinides complexes.	2, 5 Understand and evaluate
<b>CLO2</b>	<b>Explain how</b> to name organometallic compound and be able to <b>describe</b> chemical bonding and structure of organometallic compounds <b>by using</b> the basic principles of molecular orbital theory students will be able to <b>predict</b> the chemical behavior, M-M bond and reactivity of organometallic compounds.	1,3, 5,6 Remember, apply, evaluate and create
<b>CLO3</b>	<b>Show</b> and <b>explain</b> how organometallic compounds are used as catalysts in organic synthesis.	2, 5 Understand and evaluate
<b>CLO4</b>	<b>Understand</b> and <b>explain</b> the chemistry of haemoglobin, myoglobin and <b>importance</b> of alkali and alkaline earth metal ions in living organism.	2, 5 Understand and evaluate



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	M	L	L	L	-	-	M	M	-
<b>CLO2</b>	H	L	M	L	L	L	L	-	M	L	-
<b>CLO3</b>	M	M	M	M	L	L	L	-	M	M	-
<b>CLO4</b>	M	L	M	L	M	L	-	-	M	L	L

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Organic Chemistry-V**  
**BCY6002**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To interpret aromatic compounds beyond benzene.

**CO2** To discuss about the chemistry of most abundant class of Organic compounds in biological world-carbohydrate.

**CO3** To explain separation and purification, synthesis and importance of amino acids.

**CO4** To describe and show about the structure and properties of peptides/proteins and nucleic acids.

**CO5** To demonstrate how to synthesize polymers and to choose better experimental conditions.

**Unit I- Polycyclic aromatic hydrocarbons**

**[8 L]**

Structure, synthesis and chemical properties of naphthalene, Phenanthrene and anthracene. Nomenclature, synthesis and important reactions of derivatives of Naphthalene and Anthracene.

**Unit II- Carbohydrates**

**[14L]**

Introduction and classification of carbohydrates. Monosaccharides: Classification, nomenclature and configuration. Reducing and non reducing sugars. Structure of D-glucose and D-fructose (open chain and cyclic structure), conformations, anomeric effect, mutarotation. Reactions of open chain and cyclic form of Glucose with special emphasis on reduction reactions, osazone formation, action of alkali, formation of ethers and esters. Interconversion of glucose and fructose, stepping-up (Kiliani-Fischer synthesis), stepping-down (Ruff's & Wohl's method) of aldoses, Epimerization. Introduction, nature of glycosidic linkage and chemical names of disaccharides (Sucrose, maltose and lactose) and polysaccharides (starch and cellulose).

**Unit III- Amino acids**

**[8 L]**

Introduction, nomenclature, classification and stereochemistry of  $\alpha$ -aminoacids. Acid- base behavior, Zwitterions, isoelectric point and electrophoresis. Synthesis of  $\alpha$ -amino acids (Direct amination of  $\alpha$ -halo acids, Amidomalonate synthesis, Gabriel phthalimide reaction, Strecker's synthesis, azalactone synthesis, reductive amination of  $\alpha$ -keto acids, hydantoin synthesis.). Properties and Chemical reactions of  $\alpha$ -amino acids.

**Unit IV- Peptides and nucleic acids**

**[8 L]**

**Peptides:** Classification and nomenclature of peptides. Classical peptide synthesis, Merrifield solid phase synthesis. Classification and general characteristics of proteins, denaturation and renaturation of proteins.

**Nucleic acids:** Introduction, constituents of nucleic acids, ribonucleosides and ribonucleotides, structure of Purines and Pyrimidines (synthesis excluded), double helical structure of DNA.

**Unit V- Synthetic Polymers**

**[12 L]**

Introduction and classification of polymers. Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth-polymerization. Synthesis, physical properties and uses of polyethylene, styrene, PVC, Teflon, PMMA, PAN, Polyesters (Terylene, Glyptal), polyamides (Nylons), phenol- formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural, and vulcanized rubber, synthetic rubber (Buna-S, Buna-N and neoprene).

**Total Lectures: 50**



**TEXT BOOKS:**

- T1. Organic Chemistry, Paula Y. Bruice, 2<sup>nd</sup> Edition, Prentice-Hall, International Edition (1998).
- T2. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6<sup>th</sup> Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
- T3. Solomons & Fryhle's Organic Chemistry, T.W. Graham Solomons, C. B. Fryhle, 10<sup>th</sup> edition, 2014, Wiley
- T4. Arun Bahl and B. S. Bahl, Advanced Organic Chemistry, First multicolor revised edition, S. Chand and company Ltd. New Delhi.
- T5. Polymer sciences" V.R. Gowarikar, N.V. Vishwanathan, J. Shreedhar, 1<sup>st</sup> edition, New Age International (P) Ltd., Publishers, 1986.

**REFERENCE BOOKS:**

- R1. M.B. Smith & Jerry March, March's Advanced Organic Chemistry, 5<sup>th</sup> Edition (2001), John Wiley & Sons, New York.
- R2. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, Oxford University Press, Oxford (2001).
- R3. Organic Chemistry, John McMurry, 7<sup>th</sup> edition, Brooks Cole, 2008.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

CLO	Description	Bloom's Taxonomy Level
CLO1	Students will be able to <b>synthesize</b> polynuclear aromatic hydrocarbon with their <b>applications</b> .	3, 6 Apply and create
CLO2	Students will <b>explain</b> structures, sources, synthesis and reactions of mono, di and polysaccharides and can understand <b>importance</b> of carbohydrates as the major energy source.	1 and 2 Remember and understand
CLO3	Students will be able to <b>synthesise</b> and separate amino acids (building block of peptides/proteins)by <b>comparing</b> their properties	2, 3, and 4 Understand, apply and analyze
CLO4	Students will <b>explain</b> biological activities of peptides and nucleic acids which is burning area of research for few decades.It will help students to work in the various <b>synthetic</b> polymer based industries.	2, 6 Understand and create



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)	
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2
<b>CLO1</b>	M	M	M	L	M	M	-	-	M	H
<b>CLO2</b>	M	-	M	L	M	M	L	L	L	M
<b>CLO3</b>	M	-	H	M	M	H	L	-	H	M
<b>CLO4</b>	M	M	H	M	M	M	M	M	H	M

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**

**III Year, VI Semester**

**Physical Chemistry-V**

**BCY6003**

**L T P C**  
**4 1 0 5**

**Course Objectives:**

**CO1** To relate the effect of temperature on velocity and its distribution, of thermodynamic quantities and various types of motions.

**CO2** To interpret the effect of light on a photochemical reaction and its kinetics, different kinds of photochemical processes involved in photo-chemical reactions and calculation of the quantum yield.

**CO3** To explain the different kinds of ion-ion interactions in solution, the factors influencing the conductivity of a solution and calculation of the conductivity of solutions.

**CO4** To discuss nuclear reaction and its types and differentiation between the energy produced along with other processes involved in nuclear fission and fusion reactions.

**CO5** To describe and show the factors influencing the transport of ions and the correlation between viscosity and diffusion.

**UNIT I- Statistical Thermodynamics**

**[10 L]**

Type of statistics, The Boltzmann distribution, Maxwell distribution law for distribution of molecular speeds, the Maxwell-Boltzmann distribution law for the distribution of molecular energies, the partition functions, thermodynamic quantities from partition functions, thermodynamic properties of ideal mono atomic gases, rotational and vibrational partition functions, calculation of Gibbs free energy changes and equilibrium constant in terms of partition functions.

**UNIT II- Kinetics of photochemistry**

**[10 L]**

Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra, bond dissociation and principle of determination of dissociation energy (ground state), decay of excited states by radiative and non-radiative paths, fluorescence and phosphorescence, Jablonski diagram, laws of photochemistry: Grotthus-Draper law, Stark-Einstein law of photochemical equivalence and Lambert-Beer's law; quantum yield and its measurement for a photochemical process, actinometry, photosensitized reactions, kinetics of HI decomposition,  $H_2+Br_2$  reaction, dimerization of anthracene.

**UNIT III- Electrochemistry-III**

**[11 L]**

Theory of strong electrolytes: qualitative idea of Debye-Hückel theory of ion-ion interactions, Debye-Hückel limiting law for activity coefficient of ions in electrolyte solution (derivation not required), its modification for concentrated solutions, Debye-Hückel-Onsager theory of electrolytic conductance: qualitative idea of electrophoretic and relaxation effects, Debye-Hückel-Onsager equation for conductance of electrolyte solutions, effect of high frequency and high field on conductance.

**UNIT IV- Nuclear Chemistry**

**[9 L]**

Nuclear reactions: Bethe notation, types of nuclear reactions ( $n$ ,  $p$ ,  $\alpha$ ,  $\beta$  and  $\gamma$ ), conservation of quantities (mass-energy and linear momentum) in nuclear reactions, reaction cross-section, nuclear reactions, nuclear fission: the process, fragments, mass distribution, and fission energy, nuclear reactor: the natural uranium reactor, classification of reactors, breeder reactor, nuclear fusion and stellar energy.



**UNIT V- Liquid state and Transport Phenomena**

[10L]

Transport number, general transport equation, viscosity, diffusion (Fick's first law of diffusion), frictional coefficient, Stokes-Einstein equation.

**Total lectures: 50**

**TEXT BOOKS:**

- T1.** *Essentials of Physical Chemistry*, A. Bahl and B. S. Bahl, G. D. Tuli, 27th Edition (2014), S. Chand & Company Ltd., New Delhi.
- T2.** *Principles of Physical Chemistry*, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
- T3.** *Physical Chemistry*, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.

**REFERENCE BOOKS:**

- R1.** *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
- R2.** *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.

**Course Learning Outcomes (CLO):**

After completing this course, our Students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Predict</b> Gibbs free energy changes in a process and the associated equilibrium constant in terms of partition functions	1,2,3 & 5 Remember, understand, apply and evaluate
<b>CLO2</b>	<b>Distinguish</b> radiative and non-radiative processes, <b>calculate</b> dissociation energy of a diatomic molecule and quantum yield of a photochemical reaction	2, 3, 4, 5 Understand, apply, analyze and evaluate
<b>CLO3</b>	<b>Explain</b> the importance of electrophoretic and relaxation effects in conductance value and the effects of high voltage and frequency on them	2 and 3 Understand and apply



<b>CLO4</b>	<b>Predict</b> the binding energy of a nucleus from the mass defects and <b>identify</b> the origins of the huge energy produced in nuclear fission and fusion and <b>solve</b> problems on viscosity coefficient of a solutions.	2,3,5 Understand, apply and evaluate
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Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	H	L	M	M	-	-	M	M	L
<b>CLO2</b>	M	M	M	L	L	L	-	L	M	M	L
<b>CLO3</b>	M	L	M	L	L	L	-	-	M	M	L
<b>CLO4</b>	H	M	M	L	M	L	L	L	M	M	L

H: High, M: Medium, L: Low





**B.Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Introduction to Spectroscopy**  
**BCY6004**

**Skill Enhancement Course**

**L T P C**  
**2 0 0 2**

**Course Objectives:**

**CO1** To explain about the basic concepts of UV-Spectroscopy and also how the maximum absorbance varies with the structure of molecule.

**CO2** To discuss about the different molecular vibrations and also characteristic absorptions of various classes of organic molecules.

**CO3** To relate various factors which affect vibrational frequencies of molecules.

**CO4** To describe the fundamental concepts of NMR spectroscopy.

**CO5** To demonstrate how to arrive at the structure of the molecule by using the concepts of chemical shift values and coupling constants.

**UNIT I- UV-Visible Ultraviolet (UV) absorption spectroscopy [8 L]**

UV-Visible Ultraviolet (UV) absorption spectroscopy - absorption laws (Beer-Lambert law); molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V. spectra of conjugated enes and enones. Woodward-Fieser rules.

**UNIT II- Infrared (I.R.) absorption spectroscopy [7 L]**

Molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, measurement of I.R. spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds. Effect of hydrogen bonding on IR spectrum.

**UNIT III - NMR spectroscopy [10 L]**

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance ( $^1\text{H}$  NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants. Interpretation of  $^1\text{H}$  NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and  $^1\text{H}$  NMR spectroscopic techniques.

**Total lectures: 25**

**TEXT BOOKS:**

**T1.** 'Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T. C. Morrill, John Wiley & Sons, New York, 5th Ed. 1991.

**T2.** Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, 4th ed., 1988.

**T3.** Spectroscopy of Organic Compounds, P. S. Kalsi, New Age Publication, 6<sup>th</sup> edn., 2004.

**T4.** Elementary Organic Chemistry, Y. R. Sharma, S. Chand Publication, New Delhi, 2004.



**REFERENCE BOOKS:**

**R1.** W. Kemp, Organic Spectroscopy, 3<sup>rd</sup> Ed., (1991), Macmillan, London

**R2.** NMR Spectroscopy - An Introduction, H. Gunther, John Wiley, 1980.

**R3.** Fundamental of Molecular Spectroscopy, C. N. Banwell, E. Maccash, McGraw-Hill Publication, 1994.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

CLO	Description	Bloom's Taxonomy Level
CLO1	<b>Explain the</b> important structural features that are responsible for electronic transitions and can theoretically <b>calculate</b> $\lambda_{\max}$ for molecules as well as can <b>predict</b> the exact colour of substances.	2,3, 5 Understand, apply and evaluate
CLO2	Students will <b>explain</b> why various functional groups have characteristic absorption frequencies and also the factors affecting them this will help in ascertaining structure of molecules.	2 and 3, 5 Understand, apply and evaluate
CLO3	<b>Predict</b> the type of functional group present in the unknown organic molecules. Students will be able to <b>use</b> <sup>1</sup> H-NMR spectra to predict the structure of compounds.	2, 3 and 4 Understand, apply and evaluate
CLO4	<b>Solve</b> typical problems by combining results obtained from UV, IR and NMR spectroscopy. which will help them in qualifying competitive exams like JAM,GATE etc	1,2,3,4,6 Remember, understand, apply, evaluate and create



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	H	M	L	L	L	L	H	M	M
<b>CLO2</b>	M	M	M	M	M	L	L	-	H	M	-
<b>CLO3</b>	M	M	H	M	M	L	-	-	M	M	-
<b>CLO4</b>	M	M	H	M	M	L	-	-	H	M	L

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Chemistry and Society**  
**BCY6005**

**Skill Enhancement Course**

**L T P C**  
**2 0 0 2**

**Course Objectives:**

**CO1** To illustrate the some basic principle of chemical technology like distillation, solvent extraction, solid-liquid leaching and liquid- liquidextraction, separation etc. Some basic principle of cleantechnology.

**CO2** To examine and find the relation between society and chemical technology in terms of useful and hazardous perspective and study of energy from natural sources (i.e. solar and renewable forms).

**CO3** To discuss the plastics and polymers technology and natural analogues like proteins and nucleic acids technology. To study the molecular reactivity and interconversions from simple examples.

**UNIT I- Chemical Technology**

**[10 L]**

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquidextraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

**UNIT II-Chemical technology and Society-I**

**[7 L]**

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission;

**UNIT III- Chemical technology and Society-II**

**[8 L]**

Materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs. Chemistry and Forensic science.

**Total lectures: 25**

**TEXT BOOKS:**

**T1.** Industrial Chemistry, B.K. Sharma, 16<sup>th</sup> ed. Goel publishing house Meerut, 2011

**T2.** Environmental Chemistry, B.K. Sharma, 2014, Krishna Publication, Meerut 2007.

**REFERENCE BOOKS:**

**R1.** John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times* 13<sup>th</sup> Ed.

**R2.** N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab manual, S. Viswanathan Co. Pvt., 1998.

**R3.** J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.

**R4.** B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. 5th Edn., Pearson Education, 2005.



### Course Learning Outcomes (CLO):

After completing this course, our Student will be able to

CLO	Description	Bloom's Taxonomy Level
CLO1	<b>Explain</b> the basic technology which are used in distillation and solvent extraction technology, solid liquid leaching and separation process	1 and 2 Remember and understand
CLO2	<b>Explain</b> the inter relation between society and chemical technology in terms of useful and hazardous for human being	2 Understand
CLO3	<b>Explain</b> how sequentially <b>improve</b> the plastics and polymers technology.	3,4 and 6 Apply, analyze and create

Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	M	H	M	M	L	L	-	H	M	L
CLO2	M	M	L	L	M	H	L	-	M	L	L
CLO3	M	M	M	M	L	L	M	-	M	L	L-

H: High, M: Medium, L: Low



**B. Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Pharmaceutical Chemistry**  
**BCY6103**

**Elective-III**

**L T P C**  
**3 1 0 4**

**Course Objectives:**

**CO1** To tell about Drug discovery, design and development and discuss synthesis of analgesic agents, antipyretic agents, antiinflammatory agents.

**CO2** To explain about Antibiotics, antibacterial and antifungal agents & antiviral agents.

**CO3** To describe Central Nervous System agents, Cardiovascular, antilaprosy, HIVAIDS related drugs.

**CO4** To interpret the fermentation process & the formation of different products by fermentation

**CO5** To understand the mechanism of drug action and role of metals in drug.

**UNIT I- Drugs & Pharmaceuticals-I**

**[8 L]**

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflammatory agents (Aspirin, paracetamol, Ibuprofen).

**UNIT-II Drugs & Pharmaceuticals-II**

**[6 L]**

Antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir).

**UNIT-III Drugs & Pharmaceuticals-III**

**[6 L]**

Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

**UNIT-IV Fermentation**

**[10 L]**

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

**UNIT- V Mechanism of Drug Action and role of metals in Drug**

**[10 L]**

Drug absorption and distribution, Mechanism of drug action, Drug disposition. Metal ions and chelating agents in medicine, synthetic metal chelates, Metal complexes as antitumor agents, cis-platin, Metal ion toxicity and chelation therapy, antidotes to heavy metal poisoning.

**Total lectures: 40**



**TEXT BOOKS:**

- T1.** Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.  
**T2.** Inorganic chemistry, J. Huyee, E. A. Keiter, R. L. Keiter, 4rd Edn., Pearson Education.  
**T3.** Medicinal Chemistry, Ashutosh Kar, 6<sup>th</sup> edition ,2015-New Age International Publishers

**REFERENCE BOOKS:**

- R1.** 'G.L. Patrick: Introduction to *Medicinal Chemistry*, Oxford University Press, UK  
**R2.** 'William O. Foye, Thomas L., Lemke, David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Explain</b> the synthesis and mechanism of action of antibiotics, antibacterial, antifungal, antiviral agents, and be able to <b>plan</b> and <b>discover</b> the antimicrobial drugs	2, 3,4 Understand, apply and analyze
<b>CLO2</b>	<b>Explain</b> the synthesis, mechanism of action and <b>importance</b> of the central nervous system agents, cardiovascular, antilaprosy, HIV-AIDS related drugs on the basis of their structure	2, 5 Understand and evaluate
<b>CLO3</b>	<b>Explain and Interpret</b> the mechanism of aerobic and anaerobic fermentation and the <b>explain</b> the formation and <b>importance</b> of antibiotics and vitamin	2, 3 Understand and evaluate
<b>CLO4</b>	<b>Explain</b> drug absorption and drug distribution, Drug disposition and be able to <b>design</b> and <b>develop</b> antidotes to heavy metal poisoning.	1,2,3,6 Remember, understand, apply and create



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	H	L	L	-	M	-	H	L	-
<b>CLO2</b>	M	M	M	M	L	M	L	L	H	M	L
<b>CLO3</b>	M	M	M	L	L	L	M	-	M	L	-
<b>CLO4</b>	M	L	H	L	L	L	H	-	H	L	-

H: High, M: Medium, L: Low





**B. Sc. (Hons): Chemistry**

**III Year, VI Semester**

**Molecules of Life**

**BCY6104**

**Elective-III**

**L T P C**  
**3 1 0 4**

**Course Learning Objectives:**

**CO1** Understanding the different energetic processes in biosystems such as respiration, fermentation etc.

**CO2** To describe structure, nomenclature and about the formation of nucleic acids

**CO3** To discuss about the lipids, their classification and importance.

**CO4** Understanding the mechanism of enzymatic action, enzyme inhibitors & their importance.

**CO5** Understanding the different theories regarding drug action & structure-activity relation of drug.

**UNIT I- Energetics in Biosystems**

**[10 L]**

Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis ( $Mg^{2+}$ -ATP complex) and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

**UNIT II- Nucleic Acids**

**[9 L]**

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (**nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

**UNIT III- Lipids**

**[8 L]**

Introduction to lipids , classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides , phospholipids, glycolipids, and steroids (cholesterol).

**UNIT IV- Enzymes and correlation with drug action-I**

**[7 L]**

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Noncompetitive inhibition including allosteric inhibition).

**UNIT V- Enzymes and correlation with drug action-II**

**[6 L]**

Drug action-receptor theory. Structure-activity relationships of drug molecules, binding role of -OH group, -NH<sub>2</sub> group, double bond and aromatic ring.

**Total lectures: 40**



**TEXT BOOKS:**

- T1.** Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).  
**T2.** Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).  
**T3.** Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

**REFERENCE BOOKS:**

- R1.** Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.  
**R2.** Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Explain</b> the basic properties of biomolecules essential to life processes as well as <b>outline</b> of metabolic pathways.	1 & 2 Remembering, understanding
<b>CLO2</b>	<b>Explain</b> and <b>compare</b> the structure, chemical composition and biological function of major classes of biomolecules as well as chemical and physical roles of energy rich compounds and enzyme chemistry and role of prosthetic groups in biological reactions and <b>explain</b> how various types of drugs action in the body.	2, 3 & 4 Understand, apply and analyze
<b>CLO3</b>	<b>Interpret</b> the mechanism of metabolic pathways and be able to <b>explain</b> various processes involved in the biosynthesis of biomolecules (protein, nucleic acids and lipids).	5, Evaluating
<b>CLO4</b>	<b>Describe</b> how some concepts are applied within the biomolecular and pharmaceutical field and be able to <b>differentiate</b> between chemical reaction in the laboratory and that occurring in the living system and explain enzymes participation in the chemical reactions inside the body and their functions. Students will be able to <b>predict</b> the different action of drug-receptor theory.	6, Creating



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	M	L	H	M	L	L	H	M	L
<b>CLO2</b>	M	H	H	L	M	M	L	L	H	M	L
<b>CLO3</b>	H	L	H	L	M	M	L	L	M	L	M
<b>CLO4</b>	M	L	M	M	M	M	L	L	M	M	L

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**  
**III Year, VI Semester**  
**Chemistry Lab-VI**  
**BCY6501**

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**Course Objectives:**

**CO1** To **develop** practical skills in **calculating** strength of solutions through some important titrations of analytical chemistry.

**CO2** To **develop** hands on experience on making various organic compounds and inorganic complexes by employing a variety of synthetic strategies.

**CO3** To **develop** experimental knowledge of **calculating** molecular weight by Rast's micro method.

**CO4** To practically **apply** the concepts learnt about conductometric method.

**CO5** To **develop** an **understanding** among students for **identifying** Carbohydrate and Amino acid through Paper Chromatography.

**CO6** To **explain** students **how** to crystallize organic and inorganic compound.

**CO7** **Understand** good laboratory practices and safety.

**CO8** To **illustrate** students about the qualitative **analysis** of Sulphur in organic compounds.

**LIST OF EXPERIMENTS**

1. Preparation of Tetraamine complexes.
2. Determination of the strength of given acid conductometrically.
3. To determine the molecular weight by Rast's micro method.
4. To study the adsorption of acetic acid on activated charcoal.
5. Crystallization of organic and inorganic compounds.
6. Identification of Carbohydrate and Amino acid through Paper Chromatography.
7. Synthesis of acetanilide from Aniline.
8. Conversion of acetanilide into p-Bromoacetanilide.
9. Reimer-Tiemann reaction.(synthesis of 2-hydroxy 1-naphthaldehyde from 2-naphthol
10. Qualitative analysis of sulphur in given organic compound.

**TEXT BOOKS:**

**T1.** O. P. Pandey, D. N. Bajpai, S.Giri. "Practical Chemistry", S. Chand & Co.2012.



T2. Arun Sethi, systematic lab experiments in Organic Chemistry, 2<sup>nd</sup> edition, New Age International (P) Limited, 2011.

**REFERENCE BOOKS:**

R1. S. S. Dara. "Text book on Experiment and calculation in Engg. Chemistry", S. Chand & Co.

R2. G. H. Affery, J. Bassett, J. Mendham, R. C. Denney, "Vogel's textbook of quantities chemical analysis 5<sup>th</sup> edition", John Willy and Sons Inc.

**Course Learning Outcomes (CLO):**

After completing this course, our Student will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
<b>CLO1</b>	<b>Calculate</b> strength of unknown solution and molecular weight of solute <b>in laboratory</b>	2, 3, 4, 5 Understand, apply, analyze and evaluate
<b>CLO2</b>	<b>Identify</b> carbohydrates and amino acids using paper chromatography.	2, 3 Understand, apply,
<b>CLO3</b>	<b>Carry out</b> experiments in the area of inorganic and organic <b>synthesis, separation and identification</b> and purification.	1,2,3, 4 Remember, understand, apply and evaluate
<b>CLO4</b>	<b>Analyze</b> sulphur qualitatively in given organic compound.	2, 3, 5 Understand, apply and evaluate



Course Learning outcomes (CLO)	Programme Learning outcomes (PLO)								Programme specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
<b>CLO1</b>	M	M	M	M	L	L	L	L	M	M	M
<b>CLO2</b>	L	M	L	M	L	L	L	L	L	L	L
<b>CLO3</b>	L	M	M	L	L	L	L	M	M	L	L
<b>CLO4</b>	L	L	M	M	L	L	L	L	L	L	L

H: High, M: Medium, L: Low



**B.Sc. (Hons): Chemistry**  
**III Year, V Semester**  
**Term Paper-II**  
**BCY6503**

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**Course Objectives:**

**CO1** To **develop** an **understanding** among students about scientific reasoning and analytical problems.

**CO2** To **build** the skills required to succeed in educational and industrial chemical laboratories.

**CO3** To **build** basic foundation among students towards some modern spectroscopic techniques for the characterization of molecules.

**Course Learning Outcomes (CLO):**

After completing this course, our students will be able to-

<b>CLO</b>	<b>Description</b>	<b>Bloom's Taxonomy Level</b>
CLO1	<b>understand</b> and <b>develop</b> the laboratory skills needed to <b>design</b> , conduct with safety and <b>interpret</b> research in chemistry.	2, 3, 5, 6 Understanding, Applying Evaluating Creating
CLO2	<b>build</b> sufficient understanding at undergraduate level which will allow them to <b>interpret</b> the chemical literature.	5, 6 Evaluating Creating
CLO3	<b>develop</b> the ability to communicate scientific information and research results in the form of literature as well as presentation.	6 Creating



Course Specific Outcomes (CLO)	Programme Learning Outcomes (PLO)								Programme Specific Outcomes (PSO)		
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PSO1	PSO2	PSO3
CLO1	M	H	H	M	M	-	M	H	H	M	H
CLO2	L	M	M	L	L	M	L	M	M	M	L
CLO3	M	M	M	M	M	H	M	M	M	M	M