



**Sarvodaya Kelavani Samaj managed,  
Shri Manibhai Virani and Smt. Navalben Virani Science College**

**(Autonomous)**

**(Affiliated to Saurashtra University, Rajkot)**

Re-Accredited at 'A' Level by NAAC

STAR college Scheme & Status by MST-DBT

UGC-College with Potential for Excellence (CPE)

UGC-DDU KAUSHAL Kendra

GAAA –Grade A-1 by KCG, Government of Gujarat

GPCB-Government of Gujarat approved Environment Audit Center

Nodal Center for capacity building by GSBTM

**Department of Chemistry**

**Syllabi of Semester B.Sc. Chemistry**

**Semester-IV**

<b>Discipline Specific Course- Core-8</b>		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - IV</b>		
Course Code	Course Title	Course Credit and Hours
	<b>Organic Chemistry (Ad)</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

This course includes an advance study of Functional groups in organic chemistry. It comprises of nomenclature, preparation and properties of various functional groups. The reactions-mechanisms of various organic functional groups are also inculcated. The course aims to address SDG No-4: Quality education.

**Course Purpose:**

This course aims to provide basic understanding of the core area of Organic chemistry. This is designed in such a way that students will be able to understand the necessary background of various functional groups. Students will be able to understand properties and preparations of organic compounds. A good understanding of important reactions with their mechanism and application will help students intending to complete a major or minor study in synthetic chemistry. This course is necessary to provide maturity and thinking ability of students which build up their career.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Recognize the basic concept of carbonyl compounds and active methylene group for a chemical reaction.	K2
CO <sub>2</sub>	Prediction and synthesis of carboxylic acid and derivatives with different reagents.	K2,K3
CO <sub>3</sub>	Understanding of classification, properties and synthesis of nitrogen containing compounds	K1, K2
CO <sub>4</sub>	Identification Classification, properties and prediction of the products of alcohol and phenol with various synthetic path.	K2, K3
CO <sub>5</sub>	Differentiate mechanisms of nucleophilic substitution and Elimination and the factors affecting it..	K4

<b>Course Content</b>	<b>Hours</b>
<b>Unit-I :Aldehyde , Ketone and Active Methylene Compounds</b>	<b>12 hrs</b>
<p><b>Aldehyde and Ketone</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Preparation of aldehyde: <ul style="list-style-type: none"> <li>➤ Reduction methods (Rosenmund, Stephen)</li> <li>➤ Oxidation method (Etard, Sarett)</li> </ul> </li> <li>• Preparation of ketone: <ul style="list-style-type: none"> <li>➤ Friedel-Craft Acylation</li> <li>➤ Organometallic compounds</li> </ul> </li> <li>• Physical properties</li> <li>• Aldehyde and ketone</li> <li>• Chemical properties of aldehyde and ketone <ul style="list-style-type: none"> <li>➤ Nucleophilic addition reaction <ul style="list-style-type: none"> <li>▪ Reaction with NaHSO<sub>3</sub></li> <li>▪ Acetal and ketal formation</li> <li>▪ Cyanohydrin formation</li> <li>▪ Oxime formation</li> <li>▪ Hydrazone formation</li> <li>▪ Reaction with Grignard reagent</li> </ul> </li> <li>➤ Reactions with principle, mechanism and applications <ul style="list-style-type: none"> <li>▪ Aldol condensation</li> <li>▪ Crossed aldol condensation</li> <li>▪ Cannizzaro reaction</li> <li>▪ Clemmensen reduction</li> <li>▪ Wolff-Kishner reduction</li> </ul> </li> </ul> </li> </ul> <p><b>Active Methylene Compounds</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Keto-enol tautomerism in acidic &amp; basic medium</li> <li>• Preparation of Ethyl acetoacetate by Claisen condensation</li> <li>• Physical &amp; chemical properties</li> <li>• Various Synthesis from EAA <ul style="list-style-type: none"> <li>➤ Monocarboxylic acid</li> <li>➤ Dicarboxylic acid</li> <li>➤ <math>\alpha,\beta</math>-Unsaturated acid</li> <li>➤ Diketone</li> <li>➤ Ketone</li> <li>➤ Heterocyclic compounds</li> </ul> </li> </ul>	
<b>Unit-II: Carboxylic acid and its derivatives</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Synthesis of monocarboxylic acid</li> </ul>	

<ul style="list-style-type: none"> <li>➤ Oxidation of primary alcohol</li> <li>➤ Hydrolysis of an acid derivatives</li> <li>• Physical properties</li> <li>• Acidity of carboxylic acid</li> <li>• Effect of substituent on acidity of carboxylic acid</li> <li>• Chemical properties: <ul style="list-style-type: none"> <li>➤ Salt formation</li> <li>➤ Decarboxylation</li> <li>➤ Hell-Volhard-Zelinsky reaction</li> <li>➤ Formation of acid derivatives like acid chloride, acid anhydride, ester and amide</li> </ul> </li> <li>• Reactions of acid derivatives</li> <li>• Hydrolysis of an ester <ul style="list-style-type: none"> <li>➤ Acidic</li> <li>➤ Basic</li> </ul> </li> <li>• Trans Esterification</li> </ul>	
<p><b>Unit- III: Amines, Cyanide, Isocyanides and Nitro compounds</b></p>	<p><b>12 hrs</b></p>
<p><b>Amines</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Preparation of primary amines: <ul style="list-style-type: none"> <li>➤ Reduction of nitro compounds</li> <li>➤ Reaction of ammonia with alkyl halide</li> <li>➤ Hoffmann bromamide reaction</li> </ul> </li> <li>• Physical properties</li> <li>• Chemical properties: <ul style="list-style-type: none"> <li>➤ Reaction with aryl sulfonyl chloride</li> <li>➤ Reaction with acid chloride</li> <li>➤ Reaction with alkyl halide</li> </ul> </li> <li>• Hinsberg test for identification of amines</li> <li>• Diazotization and reaction of diazonium salt</li> </ul> <p><b>Cyanide, Isocyanides and Nitro compounds</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Preparation</li> <li>• Physical properties</li> <li>• Chemical properties</li> </ul>	

<b>Unit- IV: Alcohol, phenol ,Ether and Epoxide</b>	<b>14 hrs</b>
<p><b>Alcohol</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Physical properties</li> <li>• Chemical properties <ul style="list-style-type: none"> <li>➤ Reactions of O-H bond fission</li> <li>➤ Reactions of C-O bond fission</li> </ul> </li> </ul> <p><b>Phenol</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Preparation</li> <li>• Physical Properties</li> <li>• Chemical Properties <ul style="list-style-type: none"> <li>➤ Reactions of O-H group</li> <li>➤ Reactions of aromatic ring</li> </ul> </li> </ul> <p><b>Ether</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Preparation</li> <li>• Physical properties</li> <li>• Chemical properties</li> </ul> <p><b>Epoxide</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Preparation</li> <li>• Physical properties</li> <li>• Chemical properties</li> </ul>	
<b>Unit- V: Alkyl halide &amp; Aryl halide</b>	<b>12 hrs</b>
<p><b>Alkyl halide</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Preparation</li> <li>• SN<sup>1</sup> &amp; SN<sup>2</sup> reaction mechanism</li> <li>• E<sup>1</sup> &amp; E<sup>2</sup> reaction mechanism</li> <li>• Substitution and elimination reaction of alkyl halide</li> </ul> <p><b>Aryl halide</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Nomenclature</li> <li>• Classification</li> <li>• Preparation</li> <li>• Nucleophilic aromatic substitution with reactivity &amp; orientation</li> </ul>	

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|---|--|
| <ul style="list-style-type: none"> <li>• Benzyne , Elimination – Addition reaction</li> <li>• Relative reactivity of Alkyl halide, Aryl halide, Vinyl halide</li> </ul> |  |
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### Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion
- Seminar

### Text Books:

1. Bansal, Raj K. (2009, 5<sup>th</sup> edition) A Textbook of Organic Chemistry. New Delhi: New Age International (ISBN: 978-81-224-2025-8).
2. K.S.Tewari & N.K.Vishnoi(2017, 4<sup>th</sup> edition) A textbook of organicChemistry.Schandpublishing.com.(ISBN:9789385879128).<https://www.schandpublis hing.com/books/higher-education/chemistry/a-textbook-organic-chemistry-lpspe/9789354534928>.

### Reference Books:

1. T.W. Graham Solomons (2011, 10<sup>th</sup> edition)Organic Chemistry (2016, 12<sup>th</sup> edition). Hoboken: John Willey & Sons. (ISBN:978-1-118-87576-6).
2. Clayden, J., Greeves, N., Warren, S., &Wothers, P. (2012, 2<sup>nd</sup> edition). Organic chemistry Oxford: Oxford University Press (ISBN: 9780199270293).
3. Agrawal, O. P. (2009, 46<sup>th</sup> edition) Organic Chemistry: Reaction and Reagents. Meerut: Krishna Prakashan Media (p) Ltd. (ISBN: 81-87224-65-7). Morrison & Boyd (2009, 6<sup>th</sup> edition) Organic Chemistry. New Jersey: Pearson Education (ISBN: 978-81-7758).

### Suggested reading / E-resources:

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

### Suggested MOOCs:

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

### Methods of assessing the course outcomes

Components of CIA: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			10	20
C	Class activity			10	

	Grand Total	40
Assignment	<ul style="list-style-type: none"> <li>• Abstract and executive summary</li> <li>• Case study writing</li> <li>• Concept mapping</li> <li>• Student generated handbook</li> <li>• Essay writing etc...</li> </ul>	
Class activity	<ul style="list-style-type: none"> <li>• Presentation (PPT, Poster, Chart)</li> <li>• Seminar</li> <li>• Quiz</li> <li>• Model Making</li> <li>• Think Pair Share</li> <li>• Free writing</li> <li>• Class test</li> <li>• Debate/ Group Discussion</li> <li>• Open Book Test</li> <li>• Class test</li> </ul>	

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

**ATMIYA UNIVERSITY**  
**Faculty of Science**

<b>Discipline Specific Course- Core-9</b> For the students admitted from A.Y. 2022-2023& onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - IV</b>		
Course Code	Course Title	Course Credit and Hours
	<b>Core 9: Physical Chemistry (Ad)</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

The general goal of learning physical chemistry is to obtain in-depth understanding of why and how chemical reactions occur, which in turn may enable us to accurately design reactions leading to novel molecules. Physical chemistry is a good area for chemists who have a strong curiosity about how things work at the atomic level and enjoy working with lab instrumentation and machines.

This course provides a basic understanding of the core area of physical chemistry based on Thermodynamics, Electrochemistry, Free Energy, Chemical Reactions, Photochemistry and Phase rule. The course aims to address **SDG No-4: Quality education**.

**Course Purpose:**

This course aims to provide basic understanding of the change of heat between systems and surrounding and planned in such a way that students will be able to learn entropy change and its measurement with the effect of temperature and pressure on chemical potential. Students will also be able to know the potential change in different type of titrations using different electrode. To be abreast with write the photochemical reaction and its application to understand the Phase diagram.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Recall law of thermodynamics (Zero and First)	K1
CO <sub>2</sub>	Understand properties & behavior of chemical potential	K2
CO <sub>3</sub>	Distinguish Free energy change and its applications in chemical reactions.	K3
CO <sub>4</sub>	Classify the types, of concentration cell and application of EMF.	K3, K4
CO <sub>5</sub>	Derive and state photo Chemistry law and its application.	K4, K5



Course Content	Hours
<b>Unit-I : Advance Thermodynamic</b>	<b>10hrs</b>
<p><b>Advance Thermodynamics</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Reversible reactions, Spontaneous reactions</li> <li>• Statements of second law</li> <li>• Cyclic process</li> <li>• Concept of entropy</li> <li>• Determination of entropy of solid, liquid, gas</li> <li>• Effect of temperature and pressure on entropy</li> <li>• Entropy of mixing of gases</li> <li>• Nernst heat theorem</li> <li>• Statement of third law</li> <li>• Tests of third law</li> <li>• Residual entropy</li> <li>• Numerical</li> </ul>	
<b>Unit-II: Thermodynamic aspect of solution</b>	<b>12 hrs</b>
<p><b>Partial Molar Properties</b></p> <ul style="list-style-type: none"> <li>• Introduction, Definition of partial molar property</li> <li>• Concept of chemical potential</li> <li>• Gibbs-Duhem equation</li> <li>• Effect of temperature on chemical potential</li> <li>• Effect of pressure on chemical potential</li> <li>• Determination of partial molar properties by intercept method</li> <li>• Application of chemical potential <ul style="list-style-type: none"> <li>➤ Henry's law</li> <li>➤ Raoult's law</li> <li>➤ Nernst distribution law</li> </ul> </li> </ul> <p><b>Free energy and chemical equilibrium</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Free energy and work function</li> <li>• Gibbs-Helmholtz equation</li> <li>• Clausius-Clapeyron equation &amp; its Application</li> <li>• Van't Hoff isotherm &amp; Van't Hoff isochore</li> <li>• Applications &amp; Numerical</li> </ul>	

<b>Unit- III: Electrochemistry</b>	<b>12 hrs</b>
<p><b>Fundamentals of Electrochemistry</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of concentration cell: <ul style="list-style-type: none"> <li>➤ Electrode concentration cell</li> <li>➤ Electrolyte concentration cell</li> </ul> </li> <li>• Determination of potential of both types of cell</li> <li>• Types of electrolyte concentration cell <ul style="list-style-type: none"> <li>➤ With transference</li> <li>➤ Without transference</li> </ul> </li> <li>• Determination of potential of electrolyte concentration cell with transference.</li> <li>• Determination of potential of electrolyte concentration cell without transference</li> <li>• Liquid junction potential: <ul style="list-style-type: none"> <li>➤ Definition, Example, Elimination.</li> </ul> </li> <li>• Application of EMF <ul style="list-style-type: none"> <li>➤ Determination of solubility and solubility product of sparingly soluble salt with EMF</li> <li>➤ Determination of Valency of metal ion</li> <li>➤ Determination of transport number of ion</li> <li>➤ Determination of dissociation constant of weak acid</li> <li>➤ Determination of degree of hydrolysis and hydrolysis constant</li> <li>➤ Determination of pH by EMF method with the help of H<sub>2</sub> electrode</li> </ul> </li> <li>• Numerical</li> </ul>	
<b>Unit- IV: Electrometry</b>	<b>12 hrs</b>
<p><b>Potentiometry and pH metry</b></p> <p><b>Potentiometry</b></p> <ul style="list-style-type: none"> <li>• Introduction and interpretation of pH metry and Potentiometry.</li> <li>• Importance of indicator and reference electrode in the measurement of EMF and pH</li> <li>• E.M.F. method: <ul style="list-style-type: none"> <li>➤ Study of acid – base titration</li> <li>➤ Redox titration</li> <li>➤ Argentometric titration including mixture of Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup> with graph and proper explanation.</li> </ul> </li> </ul> <p><b>pH metry</b></p> <ul style="list-style-type: none"> <li>• Definition, instrumentation &amp; calibration</li> <li>• Interpretation of various methods of determining pH value like pH paper method (Demonstration only), potentiometric method using only hydrogen electrode as indicator electrode and calomel electrode as reference electrode to determine pH value.</li> <li>• Weak acid-strong base titration with curve and determination of dissociation constant (K<sub>a</sub>) of weak acid.</li> </ul>	

Unit- V: Phase Rule and Photochemistry	14 hrs
<p><b>Photochemistry</b></p> <ul style="list-style-type: none"> <li>• Photochemical reaction, Photosensitization, Fluorescence, Phosphorescence, Chemiluminescence</li> <li>• Difference between photochemical and Thermochemical reaction</li> <li>• Laws of Photochemistry: Grotius's-Draper law; Stark Einstein's law (i.e. law of photochemical equivalence)</li> <li>• Quantum efficiency and Factors affecting quantum efficiency</li> <li>• Reasons for low and high quantum yield (photochemical process)</li> </ul> <p><b>Phase rule</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Definitions of phase, components, degree of freedom</li> <li>• General phase diagram</li> <li>• One component system : Water system, Sulphur system</li> <li>• Two component system : Zn-Mg system, Pb-Ag system</li> </ul>	

**Pedagogic Tools:**

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

**Text Books:**

1. "Physical Chemistry" by P Atkins and J de Paula
2. "Physical Chemistry – A Molecular Approach" by D A McQuarrie and J D Simon
3. "Physical Chemistry" by David Warren Ball
4. "Advanced Problems in Physical Chemistry" by Neeraj Kumar

**Reference Books:**

1. Peter Atkins, Julio de Paula (2018, 11<sup>th</sup> edition) *Physical chemistry*. Thomson Press (ISBN: 9780198814740).
2. Peter Atkins, Julio de Paula (2015, 10<sup>th</sup> edition) *Physical chemistry*. Thomson Press (ISBN: 019872872-7).
3. Gurdeep Raj (2014, Third edition) *Thermodynamics*. Meerut: GOEL publishing House (ISBN: 8187224886).
4. Gurtu, J. N. Gurtu, A. (2014, Twelfth edition) *Advanced Physical Chemistry*. Meerut: PragatiPrakashan (ISBN: 9350060191).
5. V R Gowariker, (2012) *Polymer Chemistry*. New age International P limited. (ISBN: 978-0-85226-307-5).
6. Glasstone, Samuel. (2007) *Thermodynamics for Chemists*: Narahari Press (ISBN: 1406773220).
7. Barrow, Gordon M. (1996, Sixth edition) *Physical Chemistry*. New York: McGraw-Hill International. (ISBN: 0070051119).

**Suggested reading / E-resources:****Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of assessing the course outcomes**

Components of CIA: 40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			10	20
C	Class activity			10	
Grand Total					40
Assignment		<ul style="list-style-type: none"><li>• Abstract and executive summary</li><li>• Case study writing</li><li>• Concept mapping</li><li>• Student generated handbook</li><li>• Essay writing etc...</li></ul>			
Class activity		<ul style="list-style-type: none"><li>• Presentation (PPT, Poster, Chart)</li><li>• Seminar</li><li>• Quiz</li><li>• Model Making</li><li>• Think Pair Share</li><li>• Free writing</li><li>• Class test</li><li>• Debate/ Group Discussion</li><li>• Open Book Test</li><li>• Class test</li></ul>			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

**ATMIYA UNIVERSITY**  
**Faculty of Science**

<b>Discipline Specific Elective- DSE-Core-1</b> For the students admitted from A.Y. 2021-2022& onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - IV</b>		
Course Code	Course Title	Course Credit and Hours
	<b>DSE-Core-1: Green Methods in Chemistry</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

This course gives an introduction to basic principles of green chemistry and study about the process and advantages of alternative energy sources and materials. It also explains the use and industrial applications of ionic liquid and green catalyst. This course also reinforces the basic understanding of future trends in green chemistry, effect of green approach to human life and sustainable chemistry. The course aims to address SDG No-4: Quality education, SDG No-7: Affordable and clean energy and SDG No-13: Climate action.

**Course Purpose:**

The primary goal of this course is to make students aware of how chemical processes can be designed, developed and run in a sustainable way. Students acquire the competence to think of chemistry as a sustainable activity.

This course aims to provide bases for evaluating and designing new chemical products and processes that minimize adverse impacts on human and environmental health. It has resulted in increased laboratory safety and decreased volume and toxicity of waste. This course is design in such a ways that students will able to understand to integrate green chemistry strategies, concepts and practices throughout the chemistry curriculum. As a result, students develop the skills and vision that will enable them to contribute to a sustainable future through chemistry.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level(K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Retrieve and Understand basic principles of Green Chemistry.	K1, K2
CO <sub>2</sub>	Understand the principle and instrumentation of microwave reactor and microwave assisted organic synthesis.	K2
CO <sub>3</sub>	Application of ionic liquids and green solvents in chemical industries.	K3
CO <sub>4</sub>	Correlate use of eco-friendly green catalysts in synthesizing chemicals.	K4
CO <sub>5</sub>	Building the chemical future in green synthesis.	K6

<b>Course Content</b>	<b>Hours</b>
<b>Unit-I : Principles of green chemistry</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Principles of green chemistry and its applications</li> <li>• Green reactions like: <ul style="list-style-type: none"> <li>➤ Streckers synthesis</li> <li>➤ Reformatsky reaction</li> <li>➤ Grignard reaction</li> </ul> </li> </ul>	
<b>Unit-II: Microwave assisted organic synthesis</b>	<b>16 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Principle and instrumentation</li> <li>• Choice of solvent</li> <li>• Microwave assisted synthesis of: <ul style="list-style-type: none"> <li>➤ Knoevenagel condensation</li> <li>➤ Biginelli reaction</li> <li>➤ Aldol condensation</li> <li>➤ Microwave-assisted Heck reaction (Mizoroki-Heck reaction)</li> <li>➤ Microwave-assisted Suzuki reaction (Suzuki-Miyaura reaction)</li> <li>➤ Microwave-assisted synthesis of Drugs <ol style="list-style-type: none"> <li>1. Cephalosporin derivatives</li> <li>2. Microwave-assisted synthesis of cisplatin</li> <li>3. Microwave-assisted synthesis of phenytoin</li> </ol> </li> </ul> </li> </ul>	
<b>Unit- III: Reaction of ionic liquids and Green solvents</b>	<b>13 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction of ionic liquid</li> <li>• Application of ionic liquid in the following reactions: <ul style="list-style-type: none"> <li>➤ Diels-alder reaction</li> <li>➤ Knoevenagel condensation</li> <li>➤ Friedel crafts alkylation</li> </ul> </li> <li>• Introduction of green solvents</li> <li>• Types of green solvents</li> <li>• Industrial green solvents</li> <li>• Application of green solvents in separation process</li> <li>• Green solvents in organic synthesis</li> </ul>	
<b>Unit- IV: Green catalyst</b>	<b>11 hrs</b>
<ul style="list-style-type: none"> <li>• Introduction of catalyst</li> <li>• Concept in acidity and solid acid catalyst</li> <li>• Industrial application of various catalysts <ul style="list-style-type: none"> <li>➤ Acid catalyst</li> <li>➤ Photo catalyst</li> <li>➤ Bio-catalyst</li> </ul> </li> <li>• Recent advances in phase transfer catalysis</li> </ul>	

Unit- V: Future Trends in Green Chemistry	10 hrs
<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Designing a green synthesis</li> <li>• Various oxidation reaction               <ul style="list-style-type: none"> <li>➤ Epoxidation</li> <li>➤ Dihydroxylation</li> <li>➤ Miscellaneous oxidation</li> </ul> </li> <li>• Multifunctional reagents               <ul style="list-style-type: none"> <li>➤ Diazomethane</li> <li>➤ Cyclopropene</li> <li>➤ Methyl cyclopropene</li> </ul> </li> <li>• Proliferation of solvent less reactions</li> <li>• Combinatorial green chemistry</li> <li>• Green chemistry in sustainable development</li> </ul>	

#### Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

#### Text Books:

1. Kolb, V. M. (2020). *Green Organic Chemistry and its Interdisciplinary Applications* (1st ed.). CRC Press.
2. Ahluwalia, V. K. (2013). *Green Chemistry: A Textbook. Alpha Science International, ISBN, 978-1842657539.*
3. De, A. K. (2015, 7th edition) *Environmental Chemistry*. New Delhi: New Age International (ISBN: 978-81-224-2617-5) .

#### Reference Books:

1. Douglas A. Skoog, West, Holler, Crouch (2004, 8th edition) *Fundamental of Analytical Chemistry*. Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).
2. Paul T. Anastas (2012, Volume 9: Designing Safer Chemicals) *Handbook of Green Chemistry: Green Processes*. Weinheim: Wiley-VCH Verlag& Co. (ISBN: 978-3-527-32639-6).
3. Fahey, J. T., &Maelia, L. E. (Eds.). (2016). *Green Chemistry Experiments in Undergraduate Laboratories*. Washington, DC : American Chemical Society, (ISBN: 9780841231764)
4. Henrie, S. A. (2015,1st edition). *Green chemistry laboratory manual for general chemistry*. CRC Press. (ISBN: 9781482230208)
5. Lancaster, M. (2016). *Green chemistry 3rd edition: an introductory text*. Royal society of chemistry.(ISBN: 978-1-78262-294-9)

#### Suggested reading / E-resources:

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://search.acs.org/content/search/acs/en/search.html?q=green+chemistry>
3. <https://www.pdfdrive.com>

**Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of assessing the course outcomes**

Components of CIE:40 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			10	20
C	Class activity			10	
<b>Grand Total</b>					<b>40</b>
Assignment		<ul style="list-style-type: none"> <li>• Abstract and executive summary</li> <li>• Case study writing</li> <li>• Concept mapping</li> <li>• Student generated handbook</li> <li>• Essay writing etc...</li> </ul>			
Class activity		<ul style="list-style-type: none"> <li>• Presentation (PPT, Poster, Chart)</li> <li>• Seminar</li> <li>• Quiz</li> <li>• Model Making</li> <li>• Think Pair Share</li> <li>• Free writing</li> <li>• Class test</li> <li>• Debate/ Group Discussion</li> <li>• Open Book Test</li> <li>• Class test</li> </ul>			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.



**ATMIYA UNIVERSITY**  
**Faculty of Science**

<b>Discipline Specific Course- Core-1</b> For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester -VI</b>		
<b>Course Code</b>	<b>Course Title</b>	<b>Course Credit and Hours</b>
	<b>Soil Analysis (F)</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

This course gives an introduction Soil analysis is a set of various chemical processes that determine the amount of available plant nutrients in the soil and also the chemical, physical and biological soil properties important for plant nutrition, or "soil health". This course aims to provide fundamental and classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth

**Course Purpose:**

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals, soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning. To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities. To impart basic knowledge about soil physical properties and processes in relation to plant growth. To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples. To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Gain knowledge on rocks and minerals, their composition and the types of soils formed from different parent materials	K1, K2
CO <sub>2</sub>	Understand various soil physical, chemical and biological properties and their impact on plant growth	K2, K3
CO <sub>3</sub>	Imparts knowledge on essential nutrients, soil fertility, nutrient transformations in soil.	K4

CO <sub>4</sub>	Describe the Organic Forms of Nitrogen, Mineralizable Nitrogen	K3, K4
CO <sub>5</sub>	Analyze Soil Health by applications of different Chemical Test	K2

<b>Course Content</b>	<b>Hours</b>
<b>Unit-I : Soil Chemistry</b>	<b>12 hrs</b>
<ul style="list-style-type: none"> <li>• Definition</li> <li>• Soil functions and composition</li> <li>• Inorganic and organic colloids</li> <li>• Origin and type of charge</li> <li>• Soil aeration</li> <li>• Water Holding Capacity</li> <li>• Soil formation, factor affecting soil formation process</li> <li>• Weathering of soil               <ul style="list-style-type: none"> <li>➤ Chemical weathering</li> <li>➤ Physical/Mechanical weathering</li> </ul> </li> <li>• Soil taxonomy and classification</li> <li>• Soil order, colour, texture and structure</li> </ul>	
<b>Unit-II: Soil Physics</b>	<b>12 hrs</b>
<ul style="list-style-type: none"> <li>• Soil density               <ul style="list-style-type: none"> <li>➤ Particle density</li> <li>➤ Bulk density</li> </ul> </li> <li>• Soil porosity and consistency</li> <li>• Soil water and soil water movement</li> <li>• Potassium, phosphate and ammonium fixation in soil</li> <li>• Soil covering and nonspecific sorption</li> <li>• Soil temperature</li> </ul>	
<b>Unit- III: Soil Fertility and Nutrient Management</b>	<b>10 hrs</b>
<ul style="list-style-type: none"> <li>• Ion exchange process in soil cation exchange</li> <li>• Theories based on law of mass action (Kerr Vanselow, Gapon equations hysteresis Jenny's concept)</li> <li>• Adsorption isotherms</li> <li>• Donnan –membrane equilibrium concept</li> <li>• Diffuse double layer</li> <li>• Step for determination soil acidity</li> <li>• Soil salinity and alkalinity</li> <li>• Essential plant nutrient</li> <li>• Soil N: important of nitrogen, forms of nitrogen, nitrogen cycle, fate of nitrogen in soil</li> <li>• Soil P and K: phosphorus and its available forms, potassium and its available forms</li> </ul>	

<b>Unit- IV: Soil Biology and Biochemistry</b>	<b>13 hrs</b>
<ul style="list-style-type: none"> <li>• Soil biota</li> <li>• Soil microbial ecology</li> <li>• Type of organisms in different soil</li> <li>• Microbial transformation of nitrogen, phosphorus, Sulfur, iron and manganese in soil</li> <li>• Biochemical composition and biodegradation of soil organic matter and crop residue</li> <li>• Biofertilizer <ul style="list-style-type: none"> <li>➤ Definition</li> <li>➤ Classification</li> <li>➤ Specification method of production and role in crop production</li> <li>➤ BIS standards for biofertilizer for quality control</li> </ul> </li> </ul>	
<b>Unit- V: Analytical Technique and Instrumental Method in Soil Analysis.</b>	<b>13 hrs</b>
<ul style="list-style-type: none"> <li>• Principle of visible , Ultraviolet and infrared spectrophotometer</li> <li>• Atomic absorption</li> <li>• Flame photometry</li> <li>• Soil testing: <ul style="list-style-type: none"> <li>➤ Soil pH</li> <li>➤ SOC</li> <li>➤ Available N</li> <li>➤ Available P</li> <li>➤ Available K</li> <li>➤ Available Ca, Mg and S</li> <li>➤ Available micronutrient</li> </ul> </li> </ul>	

**Pedagogic Tools:**

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

**Text Books:**

1. Burges A & Raw F. 1967. Soil Biology. Academic Press.
2. McLaren AD & Peterson GH. 1967. Soil Biochemistry. Vol. XI. Marcel Dekker.
3. Jackson ML. 1967. Soil Chemical Analysis. Prentice Hall of India.
4. Keith A Smith 1991. Soil Analysis; Modern Instrumental Techniques. Marcel Dekker.

**Reference Books:**

1. Bear RE. 1964. Chemistry of the Soil. Oxford and IBH.
2. Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.
3. Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
4. Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.
5. Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.

**Suggested reading / E-resources:**

1. <http://www.keralasoils.gov.in/index.php/2016-04-29-07-32-16/soil-analysis>
2. <https://www.agrivi.com/blog/why-successful-farmers-practice-soil-analysis/>
3. <https://eos.com/blog/soil-testing/>
4. <https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual/soil-testing>

**Suggested MOOCs:**

1. <https://nptel.ac.in/>
2. <https://swayam.gov.in/>

**Methods of assessing the course outcomes**

Components of CIE: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			10	20
C	Class activity			10	
Grand Total					40
Assignment		<ul style="list-style-type: none"> <li>• Abstract and executive summary</li> <li>• Case study writing</li> <li>• Concept mapping</li> <li>• Student generated handbook</li> <li>• Essay writing etc...</li> </ul>			
Class activity		<ul style="list-style-type: none"> <li>• Presentation (PPT, Poster, Chart)</li> <li>• Seminar</li> <li>• Quiz</li> <li>• Model Making</li> <li>• Think Pair Share</li> <li>• Free writing</li> <li>• Class test</li> <li>• Debate/ Group Discussion</li> <li>• Open Book Test</li> <li>• Class test</li> </ul>			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

<b>Discipline Specific Course</b>		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester-IV</b>		
Course Code	Course Title	Course Credit and Hours
	<b>Core Practical-4-Combine Practical</b>	<b>3 Credits - 9hrs/wk</b>

**Course Description:**

This course will provide advance concepts of organic chemistry to the student through laboratory. They will be able to learn different reactions for the qualitative identification of different functional groups and various purification procedures of organic analysis. Students will be familiar with the different strategies of organic synthesis. This course also helps student to understand the working principle of different instruments like pH meter and Potentiometry. This course also helps students to learn different parameters like distribution coefficient, phase diagram and partial molar properties.

**Course Purpose:**

From this course student will be able to separate and identify unknown organic compounds. To develop skill regarding purity of different organic compounds with different methods. Find out  $P^H$  value and Potential difference value of different solutions using instruments. To understand different functions like distribution coefficient and polarity of various solvents.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms Taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions	K1
CO <sub>2</sub>	To synthesize and identify organic compounds by physical and chemical experimental methods.	K2, K3
CO <sub>3</sub>	To understand principle of electrometry method.	K1, K2
CO <sub>4</sub>	To develop skill for the standardization of instrument.	K2, K3
CO <sub>5</sub>	To determine distribution coefficient by partition function.	K4

CourseContent	Hours
<p><b>Suggested laboratory experiments:</b></p> <ul style="list-style-type: none"> <li>• <b>To perform Organic qualitative analysis of given unknown bi-functional Organic substance(08)</b> <ul style="list-style-type: none"> <li>➤ Cinnamic acid</li> <li>➤ Resorcinol</li> <li>➤ Di phenyl amine</li> <li>➤ m-di nitro benzene</li> <li>➤ Pthalic acid</li> <li>➤ Salicylic acid</li> <li>➤ m-nitro aniline</li> <li>➤ Benzyl Alcohol</li> <li>➤ P-toluidine</li> <li>➤ o/m/p- nitro phenol</li> </ul> </li> <li>• <b>Organic binary mixture separation (Solid-Solid &amp; Solid-Liquid) (08)</b> <ul style="list-style-type: none"> <li>➤ Acid-Phenol</li> <li>➤ Acid-Base</li> <li>➤ Acid-Neutral</li> <li>➤ Phenol-Base</li> <li>➤ Phenol-Neutral</li> <li>➤ Base-Neutral</li> </ul> </li> <li>• <b>Synthesis of different organic compounds (08)</b> <ul style="list-style-type: none"> <li>➤ Acetylation of Salicylic acid</li> <li>➤ Benzoylation of aniline</li> <li>➤ Nitration of Benzene</li> <li>➤ Nitration of Acetanilide</li> <li>➤ Bromination of Acetanilide</li> <li>➤ Bromination of Aniline</li> <li>➤ Diazotization of sulphanilic acid</li> <li>➤ Oxidation of Benzaldehyde</li> <li>➤ Reduction of m-dinitro benzene</li> </ul> </li> </ul>	
<p><b>CourseContent</b></p>	<p><b>Hours</b></p>
<p><b>Suggested laboratory experiments:</b></p> <ul style="list-style-type: none"> <li>• <b>pH metry</b> <ul style="list-style-type: none"> <li>➤ To determine normality and gms/lit. of xNHCl by pH metry</li> <li>➤ To determine normality and dissociation constant of weak acid (xNCH<sub>3</sub>COOH) by pH metry.</li> <li>➤ To determine normality and dissociation constant of dibasic acid (xN Oxalic acid/malonic acid/maleic acid) using 0.5N NaOH solution.</li> </ul> </li> </ul>	

- To determine amount of aspirine in given tablet using 0.1N NaOH
- To determine normality and dissociation constant of weak acid ( $x\text{NC}_6\text{H}_5\text{COOH}$ ) by pH metry.
- To determine normality each component of mixture of  $x\text{NHCl}+x\text{NCH}_3\text{COOH}$  by pH metry
- **Potentiometry**
  - To determine normality and dissociation constant of benzoic acid used 0.5N NaOH.
  - To determine normality of given acid  $x\text{NHCl}$  using 0.5N NaOH solution. .
  - To determine normality of given acid  $x\text{NCH}_3\text{COOH}$  using 0.5N NaOH solution.
  - To determine normality of given acid  $x\text{N}$  oxalic acid using 0.5N NaOH solution.
  - To determine concentration of  $x\text{N}$  FAS using  $\text{K}_2\text{Cr}_2\text{O}_7$ .
- **Partition Coefficient**
  - To study the distribution of Benzoic Acid between Toluene/Water
  - To study the distribution of Benzoic Acid between Benzene/Water
- **Phase Rule**
  - To construct the phase diagram of two component system forming compound with congruent melting point.
- **Partial Molar Volume**
  - To determine partial molar volume & excess volume of binary mixture.
  - To determine partial molar volume & the composition of unknown mixture.
- **Electroplating**
  - To electroplate copper on given object.
  - To determine the amount of copper sulphate in copper plating bath.
  - To electroplate Nickel on given object.
  - To determine the amount of Nickel in Nickel plating bath.

**Reference Books:**

Hassner, A. (2012, 3<sup>rd</sup> edition) *Organic Syntheses Based on Name Reactions*. Philadelphia: Elsevier Publishing company (ISBN: 978-0-08-096630-4).

1. Jerry R. Mohrig (2010, Third edition) *Techniques in Organic chemistry*. London: W. H. Freeman & Company (ISBN: 1-4292-1956-4).
2. Brian S. Furniss (1989, Fifth edition) *Vogel's Textbook of Practical Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 0-582-462363).
3. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R. C. (1989) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Willey & Sons. (ISBN: 0-582-446937).
4. Svehla, G. (1979, Fifth edition) *Textbook of macro and semi micro qualitative analysis*. London: Logman Publishing group (ISBN: 0-582-44367-9).

**Suggested laboratory experiments:**

- Not applicable

**Laboratory Manual/ Book**

- Practical Physical Chemistry book

**Suggested reading / E-resources**

- Not applicable
- **Suggested MOOCs**
- Not applicable

**Methods of assessing the Course Outcomes**

- Continue Internal Assessment (CIA)
- Semester End Examination (SEE)

**Component of CIA**

<b>Sr. No</b>	<b>CIA Component</b>	<b>Content</b>	<b>Duration</b>	<b>Marks</b>	<b>Total Marks</b>
1	Test	After completion of assessable experiment	6	60 marks (2-exercise of 30 marks)	30
2.	Observation book & Record	-	-	10	10
<b>Grand Total</b>					<b>40 Marks</b>

Note: Any other assessment tools or methods can be adopted as per requirement of the course.



<b>Discipline Specific Elective- DSE-Core-1</b>		
For the students admitted from A.Y. 2021-2022& onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
Semester – IV		
Course Code	Course Title	Course Credit and Hours
	<b>DSE Core Practical-1: Green Methods in Chemistry Practical</b>	<b>1 Credits - 3 hrs./Wk</b>

**Course Description:**

This course gives the understanding about difference in green and non-green methods and also application about green synthesis, green catalyst and solvent less reaction. It also provides applications of microwave irradiation in chemical synthesis for sustainable chemistry. The course aims to address SDG No-4: Quality education, SDG No-7: Affordable and clean energy and SDG No-13: Climate action.

**Course Purpose:**

The main aspect of this practical course is that the students will aware of how green approaches can be help to run in a sustainable way for safe future. This course aims to provide designing new materials and synthesis that can minimize adverse impacts on human and environmental health.

<b>Course Outcomes:</b> Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Understand of green synthesis, green catalyst and solvent less reaction.	K2
CO <sub>2</sub>	Applications of green synthesis, green catalyst and solvent less reaction.	K3
CO <sub>3</sub>	Applications of microwave irradiation in chemical synthesis.	K3

Course Content	Hours
<b>Green chemistry (12 – 14 experiment)</b>	
<ul style="list-style-type: none"> <li>➤ <b>Synthesis of Some organic compound (06)</b> <ul style="list-style-type: none"> <li>• Acetylation of Primary Amine</li> <li>• Nitration of salicylic acid by green method.</li> <li>• Bromination of acetanilide by green method.</li> <li>• Preparation of 1, 1-bis-2-naphthol by radical coupling method.</li> <li>• Synthesis of bio-diesel from vegetable oil.</li> <li>• Synthesis of dihydropyrimidone by green method.</li> </ul> </li> <li>➤ Synthesis of Schiff 's base (Substituted aromatic aldehydes and amines) (03)</li> <li>➤ Synthesis of chalcone (Substituted aromatic aldehydes and acetophenones) (03)</li> <li>➤ Microwave assisted organic synthesis of chalcone (02)</li> </ul>	

**Pedagogic Tools:**

- Chalk and Talk
- Videos
- Group discussion

**Text books:**

1. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST.
2. Fahey, J. T., & Maelia, L. E. (Eds.). (2016). *Green Chemistry Experiments in Undergraduate Laboratories*. American Chemical Society (ISBN: 9780841231764)

**Reference books:**

1. Henrie, S. A. (2015, 1<sup>st</sup> edition). *Green chemistry laboratory manual for general chemistry*. CRC Press. (ISBN: 9781482230208)

**Suggested reading / E-resources:**

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

**Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of Assessment & Tools:**

Components of CIA: **20** marks

Sr. No	CIA Component	Content	Duration	Marks	Total Marks
1	Test	50% to 60 % of Experiment	3 hrs	30	15
2.	Observation book & Record	-	-	05	05
<b>Total</b>					<b>20</b>

Note: Any other assessment tools or methods can be adopted as per requirement of the course.