

## Paper-I

### Course Title: Bioorganic and Medicinal Chemistry

| Programme: Certificate in Bioorganic and Medicinal Chemistry   | Year: 1  | <b>SEMESTER - II</b> |
|--|--|----------------------|
| Subject: Chemistry   |  |                      |
| Course Code: B020201T  | <b>Course Title: Bioorganic and Medicinal Chemistry</b>  |                      |
| <p><b>Course outcomes:</b> Biomolecules are important for the functioning of living organisms. These molecules perform or trigger important biochemical reactions in living organisms. When studying biomolecules, one can understand the physiological function that regulates the proper growth and development of a human body. This course aims to introduce the students with basic experimental understanding of carbohydrates, amino acids, proteins, nucleic acids and medicinal chemistry. Upon completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.</p> |  |                      |
| Credits: 4   | Elective   |                      |
| Max. Marks: 25+75  | Min. Passing Marks:.....   |                      |
| Total No. of Lectures = 60   |  |                      |
| Unit   | Topics   | No. of Lectures      |
| <b>I</b>   | <p><b>Chemistry of Carbohydrates</b> : Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down (Ruff's &amp; Wohl's methods) of aldoses; end-group-interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose.)</p> | 10                   |
| <b>II</b>  | <p><b>Chemistry of Proteins:</b> Classification of <i>amino acids</i>, zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection &amp; C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions).</p>  | 10                   |
| <b>III</b>   | <p><b>Chemistry of Nucleic Acids:</b> Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (<b>nomenclature</b>), Synthesis of nucleic</p>  | 05                   |

|             |   |    |
|-------------|---|----|
|             | acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA ( <b>types of RNA</b> ), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation   |    |
| <b>IV</b>   | <b>Introductory Medicinal Chemistry</b> : Drug discovery, design and development; Basic Retrosynthetic approach. 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. Mechanism of action of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), HIV-AIDS related drugs (AZT- Zidovudine  | 10 |
| <b>V</b>    | <b>Solid State</b><br>Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry .X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (powder method).   | 05 |
| <b>VI</b>   | <b>Introduction to Polymer</b><br>Monomers, Oligomers, Polymers and their characteristics, Classification of polymers : Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (M <sub>n</sub> ) and Weight average molecular mass (M <sub>w</sub> ) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging.<br><b>Silicones and Phosphazenes</b> –Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes. | 10 |
| <b>VII</b>  | <b>Kinetics and Mechanism of Polymerization</b><br>Polymerization techniques, Mechanism and kinetics of copolymerization, Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers, Condensation or step growth-polymerization, Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.  | 05 |
| <b>VIII</b> | <b>Synthetic Dyes:</b> Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.   | 05 |

**Suggested Readings:**

1. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
2. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Patrick, G. L. *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 2013.
7. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi, 2012.
8. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry Ed.*, Oxford University Press 13 (2006).
9. Ball, D. W. *Physical Chemistry Thomson Press, India (2007)*.
10. Castellan, G. W. *Physical Chemistry 4th Ed. Narosa (2004)*.
11. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
12. G. Odian: *Principles of Polymerization*, 4<sup>th</sup> Ed. Wiley, 2004.
13. F.W. Billmeyer: *Textbook of Polymer Science*, 2<sup>nd</sup> Ed. Wiley Interscience, 1971.
14. P. Ghosh: *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991

**Note:** For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

**Suggested online links:**

<http://heecontent.upsdc.gov.in/Home.aspx>  
<https://nptel.ac.in/courses/104/105/104105124/>  
<https://nptel.ac.in/courses/103/106/105106204/>  
<https://nptel.ac.in/courses/104/105/104105034/>  
<https://nptel.ac.in/courses/104/103/104103121/>  
<https://nptel.ac.in/courses/104/102/104102016/>  
<https://nptel.ac.in/courses/104/106/104106106/>  
<https://nptel.ac.in/courses/104/105/104105120/>

**This course can be opted as an elective by the students of following subjects: Chemistry in 12<sup>th</sup> Class**

**Suggested Continuous Evaluation Methods:**

|   |            |
|---|------------|
| Assessment and presentation of Assignment   | (10 marks) |
| 04 Unit tests (Objective): Max marks of each unit test = 10<br>(average of all 04 unit tests) | (10 marks) |
| Overall performance throughout the . ( Discipline, participation in different activities)     | (05 marks) |

**Course prerequisites:** To study this course, a student must have Passed Sem-I, Theory paper-1

Suggested equivalent online courses:

Further Suggestions:

## Paper-II (Practical) Course

### Title: Biochemical Analysis

| Programme: Certificate in Bioorganic and Medicinal Chemistry  | Year: 1   | <b>SEMESTER - II</b> |
|---|---|----------------------|
| Subject: Chemistry  |   |                      |
| Course Code: B020202P   | <b>Course Title: Biochemical Analysis</b>   |                      |
| <b>Course outcomes:</b><br>This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries. |   |                      |
| Credits: 2  | Elective  |                      |
| Max. Marks: 25+75 = 100   | Min. Passing Marks:   |                      |
| <b>Practical</b>  |   | <b>60-h</b>          |
| Unit  | Topics  | No of Lectures       |
| <b>I</b>  | <b>Qualitative and quantitative analysis of Carbohydrates: .</b><br>1. Separation of a mixture of two sugars by ascending paper chromatography<br>2. Differentiate between a reducing/ nonreducing sugar<br>3. Synthesis of Osazones.   | <b>15</b>            |
| <b>II</b>   | <b>Qualitative and quantitative analysis of Proteins, amino acids and Fats</b><br>1. Isolation of protein.<br>2. Determination of protein by the Biuret reaction.<br>3. TLC separation of a mixture containing 2/3 amino acids<br>4. Paper chromatographic separation of a mixture containing 2/3 amino acids<br>5. Action of salivary amylase on starch<br>6. To determine the concentration of glycine solution by formylation method.<br>7. To determine the saponification value of an oil/fat.<br>8. To determine the iodine value of an oil/fat | <b>20</b>            |
| <b>III</b>  | <b>Determination and identification of Nucleic Acids</b><br>1. Determination of nucleic acids<br>2. Extraction of DNA from onion/cauliflower  | <b>12</b>            |
| <b>IV</b>   | <b>Synthesis of Simple drug molecules</b><br>1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.<br>2. Synthesis of barbituric acid<br>3. Synthesis of propranolol  | <b>13</b>            |

**Suggested Readings:**

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education.
3. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
4. Vogel, A.I. *A Textbook of Quantitative Analysis*, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
6. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press
7. Cooper, T.G. *Tool of Biochemistry*. Wiley-Blackwell (1977).
8. Wilson, K. & Walker, J. *Practical Biochemistry*. Cambridge University Press (2009).
9. Varley, H., Gowenlock, A.H & Bell, M.: *Practical Clinical Biochemistry*, Heinemann,

**Note:** For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

**Suggestive digital platforms web links**

1. <https://www.labster.com/chemistry-virtual-labs/>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>
3. <http://chemcollective.org/vlabs>

**This course can be opted as an elective by the students of following subjects: Chemistry in 12<sup>th</sup> Class**

**Suggested Continuous Evaluation Methods:**

|                     |            |
|---------------------|------------|
| Viva voce           | (10 marks) |
| Mock test           | (10 marks) |
| Overall performance | (05 marks) |

**Course prerequisites:** To study this course, a student must have Opted Sem-II, Theory Paper-1.

Suggested equivalent online courses:

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Further Suggestions:

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