DEPARTMENT OF BIOCHEMISTRY

SYLLABI FOR COMPLEMENTARY COURSE FOR MODEL III INDUSTRIAL MICROBIOLOGY AND ZOOLOGY & MODEL III BIOTECHNOLOGY AND BOTANY PROGRAMMES
(with effect from 2015 admissions)

St Berchmans College
Autonomous
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101
DEPARTMENT OF BIOCHEMISTRY

Syllabi for Complementary Course for
Model III Industrial Microbiology and Zoology
&
Model III Biotechnology and Botany
Programmes
(with effect from 2015 admissions)
GENERAL OBJECTIVES

The Course intends to provide students with sufficient knowledge of biomolecular structure to understand the determining properties of biological function at the level of cells and the body. This will allow students at a later stage:

- To understand physiology and physiopathology at the molecular level; the molecular basis of diagnosis, therapeutics, disease prevention and health promotion.
- Become familiar with and understand the basic structures and functions of cells in the human body, applying biomedical concepts and terminology.
- Apply biochemical analysis and reasoning in order to solve problems related to physiology and cellular physiopathology.
- Learn to use a biochemical approach in the study of cellular functions that will provide an understanding of future advances in the molecular bases of physiology, physiopathology, diagnostics, therapeutics, disease prevention, health promotion and the continuous updating of knowledge.

The Course aims to prepare students:

- To acquire and apply the relevant biochemical information in order to solve potential biomedical problems.
- Provide students with basic theoretical and practical knowledge of the principal methodologies and techniques for investigation of biomolecules; operation, potential and limitations and selected personal experiences of laboratory work. Understand the theoretical and practical basis of biochemistry as applied to the investigation and measurement of cell functions.
- Assist students in understanding the scientific method.
- Help students develop observation and critical analysis skills: collection, evaluation and classification of data; deducing conclusions; formulating hypotheses.
- Assist students in developing self-learning and the ability to keep knowledge and skills up to date; team work and communication.
BOARD OF STUDIES

Members

1. Dr. Jose D Kaipallil
   Head, Department of Zoology
   S B College
   Changanassery

2. Dr. Joe Prasad Mathew
   Associate Professor, Department of Zoology
   S B College
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3. Dr. M S Latha
   Professor
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   MG University
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4. Dr. Anie Y
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   Kottayam

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   Associate professor
   Dept. of Microbiology
   Sreesankara College
   Kaladi
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   DDRC SRL Pvt. Ltd
   Ernakulam

7. Mr. V S Sudheesh
   Factory head and HR manager
   Heart Valve Division
   TTK Healthcare Ltd
   Thiruvananthapuram

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   Lecturer
   Dept. of Biochemistry
   S B College
   Changanassery

9. Ms. Ramlath Beegum L
   Lecturer
   Dept. of Biochemistry
   S B College
   Changanassery

10. Ms. Shema Jacob
    Lecturer
    Dept. of Biochemistry
    S B College
    Changanassery
Evaluation of the Courses

1. Evaluation

The evaluation of each course shall contain two parts.

i Internal or In-Semester Assessment (ISA)

ii External or End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA:ESA ratio shall be 1:4, for courses.

1.1 In-semester assessment

The components of the internal or in-semester assessment and their marks are as below.

For all courses with practical

Internal assessment of theory courses

There are three components for ISA of theory courses, which include attendance, assignment/seminar/viva-voce and in-semester examination. All the three components of the internal assessment are mandatory.

<table>
<thead>
<tr>
<th>ISA - Components of Theory</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>2</td>
</tr>
<tr>
<td>Assignment/Seminar/Viva-Voce</td>
<td>3</td>
</tr>
<tr>
<td>In-semester examination (2×2.5 = 5)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Marks for attendance

<table>
<thead>
<tr>
<th>% of Attendance</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 and above</td>
<td>2</td>
</tr>
<tr>
<td>75 - 89</td>
<td>1</td>
</tr>
</tbody>
</table>

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses

The internal assessment of practical courses shall be conducted in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

<table>
<thead>
<tr>
<th>ISA - Components of Practical</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>2</td>
</tr>
<tr>
<td>Lab involvement</td>
<td>2</td>
</tr>
<tr>
<td>Record*</td>
<td>3</td>
</tr>
<tr>
<td>Test (one)</td>
<td>1</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
*Marks awarded for Record should be related to number of experiments/practicals recorded.

**Marks for attendance**

<table>
<thead>
<tr>
<th>% of Attendance</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 and above</td>
<td>2</td>
</tr>
<tr>
<td>75 - 89</td>
<td>1</td>
</tr>
</tbody>
</table>

(Decimals shall be rounded off to the next higher whole number)

1.2 **Assignments**

Assignments shall be submitted for every course in the first four semesters. At least one assignment for each course shall be submitted in each semester.

1.3 **In-semester examination**

Every student shall undergo at least two in-semester examinations as class test as an internal component for every course.

1.4 To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement for ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy should be kept in the office of the Head of the Department for at least two years for verification.

1.5 A student who has not secured minimum marks in internal examinations can redo the same before the end semester examination of the semester concerned.

1.6 **End-semester assessment**

The end-semester examination in theory and practical courses shall be conducted by the College.

1.7 The end-semester examinations shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

1.8 The question paper should be strictly on the basis of model question paper set by Board of Studies.

1.9 A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions.
<table>
<thead>
<tr>
<th>Section</th>
<th>Type of Questions</th>
<th>Number of Questions to be answered</th>
<th>Marks</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Very short answer type</td>
<td>8 out of 8</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>B</td>
<td>Short answer type</td>
<td>6 out of 10</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>C</td>
<td>Short essay solving type</td>
<td>4 out of 6</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>D</td>
<td>Essay type</td>
<td>2 out of 4</td>
<td>12</td>
<td>24</td>
</tr>
</tbody>
</table>

|                      |                                  |                                  |       | 60          |

1.10 Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

1.11 Practical examination shall be conducted in each semester. The duration and frequency of practical examination shall be decided by the respective Board of Studies.

1.12 Practical examination shall be conducted by one external examiner and one internal examiner. The question paper setting and evaluation of answer scripts shall be done as per the directions in the examination manual of the College.

1.13 The marks for end-semester theory and practical examinations are given below

<table>
<thead>
<tr>
<th>Course</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses with practical</td>
<td>60</td>
</tr>
<tr>
<td>Practical (assessment in each semester)</td>
<td>20</td>
</tr>
</tbody>
</table>

1.14 For all courses (theory and practical) an indirect grading system based on a ten (10) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

<table>
<thead>
<tr>
<th>Percentage of Marks</th>
<th>Grade</th>
<th>Performance</th>
<th>Grade Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 and above</td>
<td>A+</td>
<td>Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>80 - 89</td>
<td>A</td>
<td>Excellent</td>
<td>9</td>
</tr>
<tr>
<td>70 - 79</td>
<td>B</td>
<td>Very Good</td>
<td>8</td>
</tr>
<tr>
<td>60 - 69</td>
<td>C</td>
<td>Good</td>
<td>7</td>
</tr>
<tr>
<td>50 - 59</td>
<td>D</td>
<td>Satisfactory</td>
<td>6</td>
</tr>
<tr>
<td>40 - 49</td>
<td>E</td>
<td>Adequate</td>
<td>5</td>
</tr>
<tr>
<td>Below 40</td>
<td>F</td>
<td>Failure</td>
<td>-</td>
</tr>
</tbody>
</table>
### OUTLINE OF THE COMPLEMENTARY COURSES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title of the Course</th>
<th>Instructional hours/week</th>
<th>Instructional hours for the course</th>
<th>Credits</th>
<th>ISA</th>
<th>ESA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADBC101</td>
<td>Biophysical Chemistry</td>
<td>2</td>
<td>36</td>
<td>2</td>
<td>10</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>ADBC1P01</td>
<td>Biophysical Chemistry (P)</td>
<td>2</td>
<td>36</td>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td><strong>Semester II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADBC202</td>
<td>Biomolecules</td>
<td>2</td>
<td>36</td>
<td>2</td>
<td>10</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>ADBC2P02</td>
<td>Qualitative Analysis of Biomolecules (P)</td>
<td>2</td>
<td>36</td>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td><strong>Semester III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADBC303</td>
<td>Enzymology and Biological Techniques</td>
<td>3</td>
<td>54</td>
<td>3</td>
<td>10</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>ADBC3P03</td>
<td>Enzymology and Chromatographic Techniques (P)</td>
<td>2</td>
<td>36</td>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td><strong>Semester IV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADBC404</td>
<td>Metabolism</td>
<td>3</td>
<td>54</td>
<td>3</td>
<td>10</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>ADBC4P04</td>
<td>Quantitative Analysis of Biomolecules (P)</td>
<td>2</td>
<td>36</td>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>
SEMESTER I

ADBC101: BIOPHYSICAL CHEMISTRY

Total hours of instruction: 36  
Credits: 2

Unit I: Water, Acids, Bases and buffers (14 h)

Unit II: Solutions (6 h)
Meaning of normality, molarity, molality, percentage solution, mole fractions, simple numerical problems from the above, Fundamental principles of diffusion and osmosis, biological importance of osmosis. Isotonic, hypotonic and hypertonic solutions.

Unit III: Colloids (8 h)
Meaning of true solution, colloidal solution, and coarse suspension, distinction between lyophilic and lyophobic sols, Fundamental study of Donnan equilibrium- application in biological system, membrane permeability, methods of preparation of colloidal solution, separation of colloidal solutions, elementary study of charge on colloids, Tyndall effect, emulsion and emulsifying agents, application of colloidal chemistry.

Unit IV: Isomerism and bonding in biomolecules (8 h)
Classification of isomerism, Intra and Intermolecular interactions in biological system: Hydrogen bond, Covalent bond, hydrophobic interaction, disulphide bond, Peptide bonds, glycosidic bond, Phosphodiester linkage, Van der Waal’s forces.

Reference:
PRACTICAL

ADBC1P01: BIOPHYSICAL CHEMISTRY

Total hours of instruction: 36
Credits: 1

1. Preparation of solutions:
   • Percentage solutions
   • Molar solutions
   • Normal solutions
   • Dilution of Stock solutions

2. Bioinstrumentation (Any one to be performed)
   a. Use of pH meter
      • Standardization of pH meter.
      • Measurements of pH of solutions using pH meters.
   b. Colorimetry and Spectrophotometry techniques-Verification of Beer –Lambert’s law

3. Preparation of buffers using the Henderson Hasselbach equation

4. Preparation of Colloidal solutions:
   • Preparation of Colloidal solution of Prussian blue and Arsenious Sulfide by double decomposition
   • Preparation of Colloidal Ferric Hydroxide by Hydrolysis

Reference:


SEMESTER II

ADBC202: BIOMOLECULES

Total hours of instruction: 36  
Credits: 2

Unit I: Carbohydrates (10 h)
Carbohydrates: Classification, monosaccharides, D and L forms of glyceraldehyde, Isomerism of carbohydrates, Structure (linear and cyclic structures) of glucose, galactose, mannose and fructose, epimers and anomers with examples, mutarotation and its explanation by ring structures, reactions of sugars (due to functional groups - hydroxyl, aldehyde and ketone), action of acids and alkali on sugars, Reducing actions of sugars., Structure of methyl α- D glucopyranose, 2- deoxy α- D ribofuranose. Amino sugars, glycosides. Structure and biological importance of disaccharides-sucrose, lactose, maltose, isomaltose, trehalose and cellobiose (elucidation of the structures is not included). Structure and important properties of the following structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen). Glycosaminoglycans - heparin, hyaluronic acid.

Unit II: Lipids (8 h)
Lipids: Definition, basic ideas about the biochemical functions of lipids, classification of lipids with examples, classification of fatty acids, physical and chemical properties of fatty acids, structure of the following fatty acids- stearic acid, oleic acid, linoleic acid, arachidonic acid. Structure of triacylglycerol. Saponification number, acid number and iodine number of fats. Essential and non-essential fatty acids with examples. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids- phosphatidic acid, lecithin, cephalin, and phosphatidyl serine, Functions of Sphingolipids. Steroids: Structure and functions of cholesterol and ergosterol.

Unit III: Proteins (8 h)
quaternary structure of proteins, forces stabilizing the structure of protein. Outline of protein sequencing (only basic principles of the methods employed).

**Unit IV: Nucleic acids (6 h)**

Nature of nucleic acids, Structure of purines and pyrimidines, nucleosides, nucleotides, Stability and formation of phosphodiester linkages, Effect of acids, alkali and nucleases on DNA and RNA, Structure of Nucleic acids- Watson-Crick DNA double helix structure, Brief study of: circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids- hyperchromic effect, Tm-values and their significance, Types of RNA and DNA, Unusual bases in nucleic acids. DNA sequencing: Sanger and Dideoxy methods.

**Unit V: Vitamins and Minerals (4 h)**

Vitamins: Definition, classification- fat-soluble and water-soluble: sources, chemical nature (without structure), and functions of vitamins. Minerals: requirements, macro and micro minerals (source and functions).

**Reference:**


PRACTICAL

ADBC2P02: QUALITATIVE ANALYSIS OF BIOMOLECULES

Total hours of instruction: 36  Credits: 1

1. Reactions of Carbohydrates, Amino acids, Proteins, Lipids and Non protein nitrogenous compounds

A. Carbohydrates: (Glucose, fructose, Galactose, Xylose, Maltose, Lactose, Sucrose, Starch, dextrin maybe given for analysis).
   Molisch’s test, Iodine test, Test for reducing sugars (Fehling’s test, Benedict’s test, Barfoed’s test), Seliwanoff’s test, Bial’s test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test.

B. Amino acids: (tyrosine, tryptophan, cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)
   Ninhydrin test, Xanthoproteic test, Isatin test, Pauly’s diazo test, sakaguchi test, Ehrlich’s test, Sodium nitroprusside test, Millon’s test, Sullivan’s test.

C. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).
   Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test, test for inorganic phosphate.

D. Lipids: Fats- tristearin, Fatty acids- palmitic acid, stearic acid, oleic acid, Glycerol,
   Steroids, cholesterol
   Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl’s iodine test, salkowski test, Zak’s test

E. Non protein nitrogenous compounds: (Urea, Uric acid, creatinine)
   Urease test, Phosphotungstic acid test and Jaffe’s test

2. Identification of Monosaccharide, Disaccharide, polysaccharide from a sample following a systematic scheme of analysis (only single component of above mentioned carbohydrates).

3. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given)

4. Identification of lipids following a systematic scheme for analysis (single components only need be given)
5. Identification of NPN following a systematic scheme for analysis (single components only need be given)

Reference:
SEMESTER III

ADBC303: ENZYMOLOGY AND BIOLOGICAL TECHNIQUES

Total hours of instruction: 54
Credits: 3

Unit I: Introduction to enzymes (14h)

Unit II: Enzyme kinetics (14 h)
Elementary study of the following factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH; Km and its significance, Michaelis Menton equation (without derivation), Line weaver- Burk plot, Explanation of competitive and non competitive type of inhibition, their explanation on the basis of double reciprocal plot. Brief study of allosteric regulation with an example. Brief study of the activation of zymogen form of enzymes, covalent modification of enzymes. Isoenzymes- Lactate dehydrogenase and creatine phosphokinase. Elementary study of isolation of enzymes and the criteria of purity.

Unit III: Industrial applications of enzymes (8 h)
Immobilization of enzymes, methods of immobilization, Industrial uses of enzymes: production of glucose from starch, cellulose and dextrains, use of lactase in diary industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes (brief study of name of enzyme and role in diagnosis and therapy)

Unit IV: Biological Techniques (18h)
Chromatography - types of chromatography- adsorption chromatography, partition chromatography, ion exchange chromatography, gel permeation chromatography and affinity chromatography.
Electrophoresis - Principle, procedure and application of Agarose gel electrophoresis, Polyacrylamide gel electrophoresis, Isoelectric focussing, blotting techniques.
Colorimetry and Spectrophotometry: - Principles of colorimetry and spectrophotometry.
Differential Centrifugation
ELISA, Chemiluminescence, Immunofluorescence.

Reference
• The Tools of Biochemistry (1977) Cooper T.G. John Wiley and Sons, N.Y. USA.
ADBC3P03: ENZYMEOLOGY AND CHROMATOGRAPHIC TECHNIQUES

Total hours of instruction: 36  
Credits: 1

Objective: The objective here is to make the students understand the basic steps involved in extraction and determination of enzymatic activities & Calculation enzymatic activities from experimental data

1. Extraction of enzymes: (Minimum 3 experiments to be done)
   - Acid phosphatase from Fresh Potato (*Solanumtuberosum*)
   - β- amylase from Sweet potato (*Ipomoea batates*)
   - Catalase from Bovine /Porcine liver
   - Urease from Jack bean (*Canavaliaensiformis*)
   - Phytase from Seeds

2. Enzyme Assay: (Minimum 2 experiments to be done, enzymes extracted from above experiment can be used)
   - Acid phosphatase
   - β- amylase
   - Catalase
   - Urease from Jack bean
   - Phytase

3. Biochemical separation techniques- Chromatographic techniques (Any one to be performed)
   - Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)
   - Separation of amino acids and lipids by Thin Layer chromatography
   - Separation of Plant pigments by Column chromatography

References


 SEMESTER IV

ADBC404: METABOLISM

Total hours of instruction: 54

Credits: 3

Unit I: Carbohydrate metabolism (16 h)
Digestion of carbohydrates and absorption of sugars, Reactions of glycolytic sequences with the names of enzymes and intermediates (with structures), Fate of pyruvate in alcoholic fermentation, Substrate level phosphorylation. Glycogenesis and glycogenolysis, Role of cyclic AMP and hormones in glycogen metabolism, Gluconeogenesis and pentose phosphate pathway (with structures of intermediates). Decarboxylation of pyruvate, Reactions of citric acid cycle (with structures of intermediates), Calculation of energy yield (as ATP) of aerobic and anaerobic oxidation of carbohydrates, the mitochondria, arrangement of electron carriers in the electron transport chain: Oxidative phosphorylation, site of ATP formation in the electron transport chain, Chemiosmotic hypothesis.

Unit II: Lipid metabolism (14 h)
Outline study of lipid digestion and absorption. Outline study of β-oxidation scheme (with structures). ATP yield in β-oxidation, Cytoplasmic biosynthesis of fatty acid, elongation and desaturation, Physiological functions of phospholipids, Outline study of cholesterol synthesis (without structure).

Unit III: Protein metabolism (10 h)
Proteolytic enzymes of the gastrointestinal tract and their activation (from zymogen forms), Digestion of proteins, Absorption of aminoacids from the intestine, Decarboxylation, deamination and transamination of aminoacids (without molecular mechanisms), Urea cycle, Fate of carbon skeleton: entry into glucogenic and ketogenic pathways. N₂ fixation (detailed study expected).

Unit IV: Nucleotide metabolism (6 h)
Metabolism of nucleotide: Biosynthesis of purine and pyrimidine nucleotides *de novo* and salvage pathway (no structure required), end products of purine and pyrimidine metabolism.

Unit V: Photosynthesis (8 h)
Light reactions: cyclic and non-cyclic electron transport and photophosphorylation. Dark reactions: the path of carbon- C3 & C4 Pathways (structure not needed), glyoxylate cycle and its significance.
Reference:

A. Estimation of Carbohydrates: (Colorimetric)
   1. Quantitation of total sugars by anthrone method
   2. Determination of reducing sugars by Nelson and Somogyi’s method
   3. Determination of fructose by Roe’s resorcinol method

B. Separation and Estimation of Lipids: (Colorimetric)
   1. Estimation of Cholesterol by Zak’s method
   2. Determination of acid value of fats
   3. Determination of peroxide value of oils

C. Estimation of Proteins and Amino acids: (Colorimetric)
   1. Estimation of protein by Lowry’s method
   2. Determination of protein by Biuret method

D. Estimation of Nucleic acids: (Colorimetric)
   1. Estimation of DNA by Diphenylamine method
   2. Determination of RNA by orcinol method

Reference: