The B. Sc. (Honours) course in Biochemistry & Molecular Biology shall consist of total **4000 marks (40 units, 160 Credits)**. There shall be theoretical, practical, viva voce, class assessment/ tutorial/ terminal/ home assignment, project/ in-plant training and related subjects. The related course shall have to be completed in the first and second year of the programme. In addition a non-credit English language course for Scientific/ Technical terminologies and its applications shall be offered in the first year of the programme.

An Honours student, for obtaining the degree, shall have to pass all the examinations within 6 (six) academic years from the date of his/ her first admission and shall not be allowed to stay for more than 2 (two) academic years in each of his/ her first, second, and third year honours classes. The non-credit English course shall have to be passed in 4 (four) academic years from the date of his/ her admission.

The duration of examination of the theory courses shall be 3 and 4 hours for 0.50 and 1.00 unit courses, respectively. The duration of practical examination shall be 6-12 and 12-24 hours (4-6 hours per day) per 0.50 and 1.00 unit practical courses, respectively. For other fractions of a unit, proportionality shall be applied.

The year-wise distribution of marks among the theory, practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment, thesis/ dissertation/ project/ in-plant training, etc. are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Full marks</th>
<th>Unit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB – 101</td>
<td>Basic Biochemistry</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 102</td>
<td>Bioorganic Chemistry</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 103</td>
<td>Biophysical Chemistry</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 104</td>
<td>Physiology-I</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – Bot-105/</td>
<td>Botany / Zoology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB(R)–105</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB – 106</td>
<td>Basic Statistics</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB(R)–107</td>
<td>Computer Fundamentals</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB(R)–108</td>
<td>Computer practical</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – Eng-109</td>
<td>English (noncredit)</td>
<td>100</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>BMB – 110</td>
<td>Laboratory work</td>
<td>200</td>
<td>2.0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>[Practical + class assessment] (140 + 60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB –111</td>
<td>Viva-voce</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB –112</td>
<td>Tutorial</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total =</strong></td>
<td></td>
<td><strong>950</strong></td>
<td><strong>9.5</strong></td>
<td><strong>38</strong></td>
</tr>
</tbody>
</table>
### B.Sc. Honours Part-II Examination, 2015

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Full marks</th>
<th>Unit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB – 201</td>
<td>Molecular Biology-I</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 202</td>
<td>Human nutrition</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 203</td>
<td>Enzymes</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 204</td>
<td>Metabolism-I</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 205</td>
<td>Microbiology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB-Bot-206/</td>
<td>Botany/Zoology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB-Bot-</td>
<td>Botany/Zoology Practical</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>207/Zoo-207</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB – Biostat-208</td>
<td>Biostatistics</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – Biostat-209</td>
<td>Biostatistics Practical</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 210</td>
<td>Laboratory work</td>
<td>200</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>[Practical + class assessment] (140 + 60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB –211</td>
<td>Viva-voce</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB –212</td>
<td>Tutorial</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total = 950** 9.5 38

### B.Sc. Honours Part-III Examination, 2016

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Full marks</th>
<th>Unit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB – 301</td>
<td>Molecular Biology-II</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 302</td>
<td>Cell Biology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 303</td>
<td>Physiology-II</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 304</td>
<td>Endocrinology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 305</td>
<td>Protein Technology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 306</td>
<td>Basic Immunology</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 307</td>
<td>Clinical Biochemistry</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 308</td>
<td>Metabolism - II</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 309</td>
<td>Bioenergetics</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 310</td>
<td>Laboratory work</td>
<td>200</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>[Practical + class assessment] (140 + 60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB –311</td>
<td>Viva-voce</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB –312</td>
<td>Tutorial</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total = 1050** 10.5 42

### B.Sc. Honours Part- IV Examination, 2017

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Full marks</th>
<th>Unit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMB – 401</td>
<td>Molecular Biology &amp; Genetic Engineering</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 402</td>
<td>Advanced Metabolism</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB – 403</td>
<td>Biotechniques</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB – 404</td>
<td>Industrial Biotechnology</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB– 405</td>
<td>Plant Biotechnology</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB– 406</td>
<td>Pharmaceutical Biochemistry</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB– 407</td>
<td>Advanced Immunology</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB– 408</td>
<td>Oncology-I</td>
<td>100</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>BMB– 409</td>
<td>Neurochemistry</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB– 410</td>
<td>Laboratory work</td>
<td>200</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>[Practical + class assessment] (140 + 60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMB– 411</td>
<td>Viva-voce</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB– 412</td>
<td>Tutorial</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>BMB– 413</td>
<td>Project work/ In-plant training</td>
<td>50</td>
<td>0.5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total = 1050** 10.5 42
A candidate shall not be allowed to continue the B.Sc. Honours programme if he/she fails to obtain the letter grade (LG) “S” in the English course in 4 (four) academic years from the date of admission. The letter grade “S” corresponds to at least 30% marks.

2 30% of the total practical marks shall be allotted for continuous laboratory assessment.

3 20% of the assessment marks shall be awarded for attendance in the class on the basis of the following table:

<table>
<thead>
<tr>
<th>Attendance</th>
<th>Marks</th>
<th>Attendance</th>
<th>Marks</th>
<th>Attendance</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-100%</td>
<td>20%</td>
<td>90-92%</td>
<td>18%</td>
<td>85-87%</td>
<td>16%</td>
</tr>
<tr>
<td>80-82%</td>
<td>14%</td>
<td>75-77%</td>
<td>12%</td>
<td>70-72%</td>
<td>10%</td>
</tr>
<tr>
<td>65-67%</td>
<td>8%</td>
<td>60-63%</td>
<td>6%</td>
<td>&lt;60%</td>
<td>00%</td>
</tr>
</tbody>
</table>

Theoretical course(s) may be offered instead, if a department desires.

Eligibility for Examination:
Percentage of Attendance: In order to be eligible for taking up the B. Sc. Honours examinations, a candidate must have pursued a regular course of study by attending not less than 75% of the total number of classes held (theoretical, practical, class assessment etc.) provided that the academic committee of the department on special grounds and on such documentary evidence as may be necessary, may condone the cases of shortage of attendance not below 60%. A candidate, appearing at the examination under the benefit of this provision shall have to pay in addition to the examination fees, the requisite fee prescribed by the syndicate for the purpose.

Candidates having less than 60% attendance shall not be allowed to fill up the examination form.

Readmission: A candidate, who failed to appear at the examination or fails to pass the examination, may on the approval of the relevant department be readmitted to the immediate following session in the first, second, third or fourth year of the programme. A readmitted candidate shall have to reappear at all course examinations.

Medium of Questions and Answers:
Questions shall be made in English. The medium of answers in the examination of all courses shall be either English or Bangla as directed by the department. However, a mixing of English and Bangla shall never be allowed in an answer-script.

Award of degree: The degree of Bachelor of Science with Honours in Biochemistry and Molecular Biology shall be awarded on the basis of CGPA obtained by a candidate in B. Sc. Honours Part-1, Part-2, Part-3 and Part-4 examinations. In order to qualify for the B. Sc. Honours degree a candidate must have to obtain the followings within 6 (six) academic years from the date of admission:

(i) a minimum CGPA of 2.50,

(ii) a minimum GPA of 2.00 in the practical courses in each of Part-1, Part-2, Part-3 and Part-4 examinations,

(iii) a minimum TCP of 144, and

(iv) “S” letter grade in English course (in 4 academic years from the date of admission).

The result shall be given in CGPA with the corresponding LG (Table of LG, GP and CP) in bracket. For instance, in the example cited above the result is “CGPA=3.09 (B)”.

Promotions: In order to be eligible for promotion from one class to the next higher Honours class, a candidate must secure

(i) at least 2.00 GPA in his/her Part-1, 2.25 in Part-2 and 2.50 in Part-3 examinations,

(ii) at least 2.00 GPA in each of his/her Part-1, Part-2 and Part-3 practical course examinations, and

(iii) 34 Credit for each of Part-1 and Part-2 and 38 Credit in Part-3 examinations.

Course Improvement: A promoted student earning a grade less than 2.75 in individual courses shall be allowed to improve the grades on courses, not more than two full unit courses of Part-1, Part-2 and Part-3 examinations or their equivalent courses (in case of changes in the syllabus), defined by the departmental academic committee, through the regular examination of the immediate following batch. No improvement shall be allowed in practical course examinations/ viva-voce/ class assessment/ tutorial/ terminal/ home assignment and thesis/ dissertation/ project/ in-plant training courses. If a candidate fails to improve his/her course grade, the previous grade shall remain valid. If a readmitted candidate fails to appear at the regular class assessment/ tutorial/ terminal/ home assignment and thesis/ dissertation/ project/ in-plant training courses, his/her previous grades shall remain valid.
**Result Improvement:** A candidate obtaining a CGPA of less than 2.75 at the end of the Part-4 examinations, within 6 (six) academic years, shall be allowed to improve his/her result, on up to a maximum of 4 (four) full units of the Part-4 theoretical courses in the immediate next regular examination after publication of his/her result. The year of examination, in the case of a result improvement, shall remain same as that of the regular examination. His/her previous grades for practical courses/ viva-voce/class assessment/tutorial/ terminal/home assignment, thesis/dissertation/project/in-plant training courses shall remain valid. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

**Pass Degree:** Candidates failing to obtain required GPA,
(i) for promotion in Honours Part-3 examination in 4 (four) academic years, in case of readmission in Part-3 course year, or 5 (five) academic years, with no readmission in Part-3 course year from the date of admission,
or
(ii) for Honours degree in Honours Part-4 examination in 6 (six) academic years from the date of admission, but secure
(a) a CGPA of at least 2.00 up to Honours Part-3 examination and (b) a minimum TCP of 80% of the total and (c) a LG of “S” in the English Course, shall be awarded a B. Sc. Pass degree. Such candidates shall not be allowed to improve on the B.Sc. Pass degree.

**Dropping out:** Candidates failing to earn the yearly required GPA after completing regular examinations and subsequently failed again after taking readmission in 1st, 2nd or 3rd year, or to clear “F” grades in the stipulated period, shall be dropped out of the programme.

**The Grading Systems:**
(a) **Credit Point (CP):** The credit points achieved by an examinee for 0.50 and 1.00 unit courses shall be 2 and 4, respectively. For other fractions of a unit, proportionality should be applied.

(b) **Letter Grade (LG) and Grade Point (GP):** Letter Grades, corresponding Grade Points and Credit Points shall be awarded in accordance with provisions shown below:

(i) Table of LG, GP and CP for credit courses

<table>
<thead>
<tr>
<th>Numerical grade</th>
<th>LG</th>
<th>GP / Unit</th>
<th>CP / Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% or its above</td>
<td>A’ (A plus)</td>
<td>4.00</td>
<td>4</td>
</tr>
<tr>
<td>75% to less than 80%</td>
<td>A (A regular)</td>
<td>3.75</td>
<td>4</td>
</tr>
<tr>
<td>70% to less than 75%</td>
<td>A (A minus)</td>
<td>3.50</td>
<td>4</td>
</tr>
<tr>
<td>65% to less than 70%</td>
<td>B’ (B plus)</td>
<td>3.25</td>
<td>4</td>
</tr>
<tr>
<td>60% to less than 65%</td>
<td>B (B regular)</td>
<td>3.00</td>
<td>4</td>
</tr>
<tr>
<td>55% to less than 60%</td>
<td>B (B minus)</td>
<td>2.75</td>
<td>4</td>
</tr>
<tr>
<td>50% to less than 55%</td>
<td>C’ (C plus)</td>
<td>2.50</td>
<td>4</td>
</tr>
<tr>
<td>45% to less than 50%</td>
<td>C (C regular)</td>
<td>2.25</td>
<td>4</td>
</tr>
<tr>
<td>40% to less than 45%</td>
<td>D</td>
<td>2.00</td>
<td>4</td>
</tr>
<tr>
<td>Less than 40%</td>
<td>F</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>Incomplete</td>
<td>I</td>
<td>--</td>
<td>0</td>
</tr>
</tbody>
</table>

Absence from the final examination shall be considered incomplete with the letter grade “I”.

(ii) Table of LG, GP and CP for non-credit courses

<table>
<thead>
<tr>
<th>Numerical grade</th>
<th>LG</th>
<th>GP / Unit</th>
<th>CP / Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30% and above</td>
<td>S</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Less than 30%</td>
<td>U</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Here S and U refer to “satisfactory” and “unsatisfactory”, respectively.
Course: BMB-101  
Basic Biochemistry  
Full Marks- 100, Credit: 4, Lecture Hours: 60


2. Life and living processes: Concept and identifying characteristics of living matters.

3. Carbohydrates: Occurrence, nomenclature, biological importance, chemical characteristics, and classification of carbohydrates.  
   (i) Monosaccharides and disaccharides: Structure, optical and chemical properties, characteristic tests, aminosugars and glycosides.  
   (ii) Polysaccharides: Occurrence, composition, structures and properties of starch, glycogen, cellulose, other polysaccharides of biological interest, their chemical tests and biological importance, analysis of carbohydrates.

4. Lipids: Nomenclature, classification, general reaction of fat and fatty acids and sterol, structure and biological functions of different classes of lipids, hydrolysis of lipids, fats and oils, animal fat, vegetable oils, phospholipids and non-phosphorylated lipids, isolation of cholesterol and phospholipids from natural sources.

4. Amino acids, peptides and proteins:  
   (i) Amino acids and Peptides: Definition, source, classification, structural features, physicochemical properties of amino acids and peptides, essential and non-essential amino acids, peptide bonds, oligopeptides and polypeptides, identification of N-terminal and C-terminal residue of peptide, and synthesis of peptides.  
   (ii) Proteins: Introduction, physicochemical properties, classification and biological function, primary, secondary, tertiary and quaternary structure of proteins, Protein domain and subunit.  
   (iv) Globular Proteins: Tertiary structure of globular proteins, distinctive tertiary structure of myoglobin and hemoglobin.

5. Nucleic acid: General structure of nucleosides and nucleotides, chemistry of DNA, base pair rule, double helical structure, chemistry of RNA, types and function of DNA and RNA, physicochemical properties, denaturation and renaturation of nucleic acids.

6. Vitamins: Definition, classification, chemistry, sources, biological and biochemical functions, daily requirements.

Books Recommended:
4. Fundamentals of Biochemistry Dr. A. C. Deb.

Course: BMB- 102
Bioorganic Chemistry
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Organic Reactions and their Mechanism: The classical structural theory, electron displacement effects, bond fission, attacking reagents and their role, electrophiles, nucleophiles, carbonium ion, carbanions, types of reaction mechanism, substitution reactions (S_N2 and S_N1), elimination reactions (E_1 and E_2).

2. Stereochemistry: Definition, classification of isomerism, asymmetric carbon atom, asymmetric and dissymmetric molecules, chirality, criterion of enantiomerism, Fischer projections, absolute and relative configuration, R and S system, optical isomerism in compound with more than one asymmetric carbon atom, isomerism of tartaric acid, racemization, asymmetric synthesis, Walden inversion.

Aliphatic compounds:
3. Alcohols: Occurrence, structure, nomenclature, isomerism, synthesis, physical and chemical properties (reactions involving -OH, -CO-, -COOH and alfa-carbon), testes of monohydric alcohols.

4. Carboxylic acids: Occurrence, structure, nomenclature, isomerism, synthesis, acidity, physical and chemical properties (reactions involving O-H bond, unshared electrons of oxygen and rupture of C-O bond) of monocarboxylic acids.

5. Amines: Nomenclature, structure, synthesis, isomerism, methods of preparation of primary, secondary and tertiary amines, separation, physical and chemical properties.

Aromatic compounds:
6. Benzene: Aromaticity, structure, nomenclature, general synthesis, physical and chemical properties and uses.

7. Heterocyclic compounds: Definition, nomenclature, preparation, properties and uses of furans, thiophene, pyrrole, pyridine, pyrimidine and quinoline.


Books Recommended:
1. Organic Chemistry by Gillman
2. Organic Chemistry by Ficser and Fisser
3. Organic Chemistry by Morrison & Boyed
1. a) **Atomic Structure**: Fundamental particles, atomic models (wave mechanical approaches). Compton’s effects, photoelectric effect, wave nature of electrons (Devisor and Germer’s experiment, Thomsons and Reid’s experiment, de-Broglie’s equation, Schrodinger wave equation, Plank’s quantum theory), Heisenburg uncertainty principle, Pauli’s exclusion principle, electronic configuration; Modern periodic table (ionization potential, electron affinity and electronegativity).


2. **Thermodynamics**: Definition, basic concepts (system, surrounding, state, state function, enthalpy, entropy, molar heat capacity, work function, free energy etc), laws of thermodynamics (First and second laws). Change of entropy in various process, variation of free energy with temperature and pressure Gibbs-Helmoltj equation, Clapeyron-Clausius equation, application of thermodynamic in Biochemistry, biochemical relevance of classical thermodynamics, open system, high energy compound.

3. **Solution of nonelectrolytes**: Concentration units, chemical potential, Henry’s law, ideal and non-ideal solution, activity and activity coefficient, osmotic pressure, semi-permeable membrane theory.

4. **Phase rule**: Definition of phase, components and degree of freedom/variants, phase rules and its application, phase diagram of water, relation between triple points and sublimation, theory of freezing mixture, phenol-water system, theory of fractional and azeotropic distillation.

5. **Colloid**: Definition, classification, preparation, purification and properties of colloids, origin of colloidal charge, protection of colloids, gel, suspension, emulsion, use of colloids.


   **Salt Hydrolysis**: Definition, Bronsted-Lowry concept of hydrolysis, types of hydrolysis, quantitative aspect of hydrolysis, determination of degree of hydrolysis, solubility product and common ion effect on ionization.

7. **Adsorption**: Definition, adsorbate, adsorbeent, causes of adsorption, types of adsorption, classical adsorption isotherms (Friedundlisch’s and Langmuir’s), applications, adsorption of solid from liquid.

8. **Distribution law**: Introduction, Nernst distribution law, solubility and distribution law, distribution law and molecular state.


10. **Radiochemistry**: Discovery of radioactivity, isotopes, isobars, isotones, properties of alpha, beta and gamma rays, units of radiation, law of radioactive disintegration, group displacement, half-life calculation, specific activity, radio-labeling, detection of radioactivity, auto radiography, separation of radioisotopes, nuclear transmutation, artificial radioactivity, nuclear reactions, nuclear binding energy, nuclear forces, nuclear fission and fusion, uses of radioisotopes.

**Books Recommended**:

1. Modern Inorganic Chemistry, R.D. MADAN.
5. Physical Chemistry, N. KUNDU & S.K. JAIN
6. A text book of physical chemistry, K.K. SHARMA & L.K. SHARMA.
7. Essential of physical chemistry, B.S. BAHL & G.D. TULI.
8. Physical chemistry, V.M. KHANNA, M.M. KAPUR, & V.P. SHARMA
9. Radiochemistry, V.M. KHANNA, M.M. KAPUR, & V.P. SHARMA
10. Radiochemistry, V.M. KHANNA, M.M. KAPUR, & V.P. SHARMA
11. Radiochemistry, V.M. KHANNA, M.M. KAPUR, & V.P. SHARMA
Course: BMB – 104
Physiology-I
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. **Cell:** Structure, function, isolation, and separation of sub-cellular organelles (cell membrane, endoplasmic reticulum, mitochondria, golgi body, nucleus, etc.)

2. **Respiratory system:** Anatomy of the respiratory tract and lungs, physiology of respiration, lungs volume and lungs capacity, carries of oxygen and carbon dioxide, chloride shift, mechanism of breathing and common respiratory diseases (bronchitis, asthma, common cold, tuberculosis).

3. **Digestive system:** Anatomy and function of digestive system, digestive enzymes, mechanism of secretion of gastric acid, physiology of digestion and absorption of foods. Diseases of the gastro-intestinal tract (diarrhoea, gastritis).

4. **Muscular system:** Classification, structure and function of muscle, muscle protein and mechanism of muscle contraction.

5. **Excretory system:** Kidney - Structure and function of nephron, glomerular filtration rate, selective reabsorption & secretion, endocrine function of the kidney, the role of kidney - water, electrolyte and acid base balance of the body.

6. **Eye:** Anatomy and function of eye, refractive media of eye ball, error of refraction, visual pathway, photochemical change in rods and cones, visual pigments, dark and light adaptation, colour vision and physiology of vision.

7. **Blood:** Composition of blood and its functions (blood corpuscles and plasma protein etc.), blood cells & plasma, total count (TC), differential count (DC), coagulation, blood grouping (types) and cross matching, blood diseases (anemia, leukemia, thalassemia etc).

**Books Recommended:**
1. Review of Medical Physiology, W. F. Ganong
2. Human Physiology, C. C. Chaterjee
3. A Text Book of Medical Physiology. Gyton
4. Human Physiology, Chakrabarti, Ghos and Sahana

Course: BMB – Bot-105
Botany
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Concept of living world and nonliving environment, plant world, origin and distribution of plants in association with animals.

2. Classification of plant kingdom, different major taxa of plants, flowering and non -flowering plants, vascular and non-vascular plants, embryo bearing plants.

3. Lower groups, taxons included in lower groups, classification range of structure and modes of reproduction in the major taxa.

4. Life histories of typical members of each major taxa :
   (a) Algae: Volvox, Ulothrix, Chleochaete,
   (b) Fungi: lower and higher penicillium, and Agaricus
   (c) Bacteria: A general account.
   (d) Bryophytes: Riccia and Moss.
   (e) Pteridophyte: Equisetum and a fern.
   (f) Virus. (g) Myxomycetes. (h) Actinomycetes.

5. Role of lower plants in maintaining the environment and their economic importance, plant diseases caused by fungi, one important disease each of rice, jute, sugarcane and potato.

6. **Higher Plants:** angiosperms and gymnosperms, diversity in angiosperms, reproduction and embryology, gametophyte formation and fertilization.

7. Classification of angiosperms, systems of classification, Benthem and Hookers system, Engler and Prentil
system, study of the following families: Nymphaeose, Cruciferae, Leguminosas, Solanaceae, Labiats, Apocynaceae, Malvaceae, Compositae, Palmae and Graminae.

Books Recommended:

Course: BMB-Zoo-105
Zoology
Full Marks- 100, Credit: 4, Lecture Hours: 60

(Introduction to animal kingdom, Embryology, Anatomy, Evolution and Ecology)


2. Classification of the following animals (within 500 words): Paramecium, Scypha, Jellyfish, Balanoglossus, Ascidia Laben Lizard, Pigeon, Guineapig, Prawn, Bee, Spider and Peripetus.


4. Anatomy: General organization of the system and their function.

5. Evolution: Evidence, theories with modification, evolutionary history of man, Evolutionary change of organism along with their organ system.

6. Ecology: Environment and its components, concept of ecosystem, energy flow, biogeochemical cycle, habitat adaptation and adaptability, environmental pollution, conservation of environment with social emphasis on biological resources, zoo-geological regions, food chain, food energy transfer.

Course: BMB-Biostat-106
Basic Statistics
Full Marks- 50, Credit: 2, Lecture Hours: 30


2. Analysis of Statistical Data: Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment, Cumulants and Practical examples.


5. Bivariate Distribution: Bivariate data, Scatter Diagram, Marginal and conditional Distribution, Correlation, Rank correlation, Partial and Multiple correlation, Contingency, Analysis and Practical applications.


7. Test of Significance: Basic idea of Null hypothesis, Alternative hypothesis, Type-I error Type-II error, level of significance Degree of freedom, Rejection region and Acceptance region. Test of Single
mean, Single variance, Two sample means and Variances. Test for 2×2 contingency tables, Independence test and Practical examples.

Books Recommended:

Course: BMB(R)-107
Computer Fundamentals
Full Marks- 50, Credit: 2, Lecture Hours: 30


2. **Computers Hardware and Peripherals**: Basic Units of computer Hardware, Processing Devices, Input Devices (like Keyboard, Mouse, Scanner etc), Output Devices (like Monitor, Speaker Printer etc), Different types of Monitors, Power supply, Different parts of system unit, Internal structure of CPU, Memory Devices and Functions of RAM, ROM and Cache memory, Storage Devices, Basic function mechanism of FDD, HDD and CD-ROM.

3. **Information and Data processing**: Data organization, Types of data processing, Data processing cycle, Data processing system, Database concepts, Database management system, working with database, Querying a database.

4. **Software**: Classification of software, System software, Operating system concepts and importance, Types of operating system, Components and basic function of disk operating system (DOS), Windows/Windows-NT/Windows-XP, Working with Application software, Graphics software, Multimedia systems, Network operating system, Enhancing an operating system with utility.

5. **Networking**: Basic concepts of computer networks and its goals, Network structure, Concept on LANs, WANs, MANs, CANs and HANs, Network topologies and protocols, Data communication with telephone lines and modems, Digital data connection, The Internet’s history, Internet system and its services, E-mail, E-commerce, World Wide Web (WWW), Searching the web, Search Engine.

Books Recommended:
1. Introduction to Computers by Peter Norton

Course: BMB(R)-108
Computer Practical
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Introduction of operating system.
2. Windows system.
3. Windows XP
5. Basic printer system
6. Introductory Window process, MS word, etc.
7. Basic prate, table
8. Introduction of XL, chart drawing.
Course: BMB- Eng.-109
English (Non-credit)
Full Marks- 100, Credit: 0, Lecture Hours: 60

1. **Functional English** (50 marks)
   i) Basic rules of English grammar.
   ii) Sentences.
   iii) Tense.
   iv) Change of Voice
   v) Appropriate preposition.
   vi) Completing & combining of sentences.
   vii) Correction of sentence.
   viii) Translation.
   ix) Situational writing (posters, slogans, notices, memo, advertisement, reports & press release etc.)
   x) Comprehension
   xi) Paragraph
   xii) Dialogs

2. Spoken skill using TOEFL/ELTS material. (25 marks)
   i) Demonstrate using (audio/visual system)

3. **Scientific Writing:** (25 marks)
   Definition, organization, preparation of scientific article; title, abstract, introduction methods & materials,
   results, discussion, acknowledgement reference, abbreviations.
   i) Writing tables and Illustrations.
   ii) Preparation of poster / slides & oral presentation.
   iii) Writing a protocol.
   iv) Publishing an article.

**Books Recommended:**
1. Planning Research & Writing research papers SY, M. Jasim Uddin
2. Write How to and publish a Scientific paper By Bibert A. Day (oryx press)
3. Degree general English S.C. Chakravorty

Course: BMB - 110
Laboratory work
Full marks – 200, Credit: 8
(PRACTICAL 140 marks + CLASS ASSESSMENT 60 marks)

1. Use of analytical balance.
2. Preparation of standard solutions.
4. Acid base titration:
   a) Titration of a mixture of a strong acid with a weak acid.
   b) Titration of a strong acid with a strong base.
   c) Titration of a weak acid with a strong base.
5. Estimation of acetic acid content of vinegar.
7. Identification of organic compounds.
8. Determination of lactose content of milk.
10. Determination of coefficient of viscosity of some organic samples.
11. Qualitative test of carbohydrate, lipid and protein.
12. Determination of Na$_2$CO$_3$ content of washing soda.
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Full marks</th>
<th>Unit</th>
<th>Credit</th>
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<td>Molecular Biology-I</td>
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<td>BMB –212</td>
<td>Tutorial</td>
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<td><strong>950</strong></td>
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Course: BMB – 201  
Molecular Biology-I  
Full Marks-100, Credit: 4, Lecture Hours: 60  

1. **Molecular Biology**: Definition, scope, historical background, interrelationship with other disciplines, future prospect and importance.  

2. **Nucleic acids**: Isolation, purification and molecular weight determination of nucleic acids, physico-chemical properties of DNA, Tm value, Cot value, different conformation of DNA, DNA-DNA, DNA-RNA hybridization, tandem repeat sequence, palindromic sequence and cruciform structure.  

3. **Nonenzymatic transformations of Nucleic acid**: Chemical agents that cause DNA damage, nonenzymatic reactions (deamination, depurination), formation of pyrimidine dimmers induced by UV light.  

4. **Mutation**: Definition and classification, physical and chemical mutagens, inherited mutational diseases. Mutation in human, deleterious and recessive, Mutation and carcinogenesis  

5. **DNA as genetic material**: Experimental evidences.  

6. **Plasmids**: General properties, types, isolation, transfer of plasmid DNA, role of plasmids in biotechnology.  

7. **Restriction enzymes**: Source, specificity of restriction and other enzymes involved in recombinant DNA technology; digestion of DNA fragments by restriction enzymes, host-controlled restriction and modification, mechanism of methylation modification sites, demethylation & its application.  

8. **Introduction to molecular cloning**: Cloning of DNA fragments, preparation of cloning vectors, PCR, cloning of PCR products.  

9. **Genomes and chromosomes**: Bacterial and viral genomes.  

10. **Molecular organization of chromosomes**: Molecular concept of genes and chromosomes, centromere, telomeres, nucleosome and its organization in eukaryotic chromosomes, histone and nonhistone proteins, DNA-histone octamer and super coiling of DNA.  

**Books Recommended:**  
1. Principles of Biochemistry – Lehninger, Nelson and Coxs  
3. Biochemistry - Stryer  
4. Genes VI and VII – Benjamin and Lewin  
5. Molecular cell biology – Darnell J.; Loddis H. and Baltimore D.
1. **Classification and functions of essential nutrients, components of an adequate diet:** Carbohydrate, fat, protein, vitamins and minerals in diet, interrelationship between fat, protein and carbohydrate metabolism.

2. **a) Role of carbohydrates in nutrition.**
   
   **b) Role of proteins in human nutrition,** essential amino acids, limiting amino acid and natural supplementation, protein quality and its evaluation.
   
   **c) Fats and oils in human nutrition:** Saturated, monounsaturated and polyunsaturated fatty acids, essential fatty acids.

3. **Vitamins:** Co-enzyme activity, and mode of action, hypervitaminosis, deficiency diseases.

4. **Mineral and trace elements:** Occurrence and role of Ca, Na, Fe, Cu, P, I, Zn, Mg, Mn, Se in nutrition (absorption, excretion, daily requirements, deficiency symptoms), interrelationship between vitamins and minerals. Metal toxicities (Hg, Pb, AS, Cd, Ni)

5. **Energy metabolism:** Energy requirement and energy expenditure, obesity, basal metabolic rate, specific dynamic action of foods, respiratory quotients.

6. **Malnutrition:** Under-nutrition and over-nutrition, PEM (Kwashiorkor, Marasmus and their management).

7. **Balanced diet:** Diet in altered physiological conditions (pregnant and lactating mothers), diet for adult, growing children, therapeutic diets.

8. Assessment of nutritional status of a population, nutritional problems of Bangladesh and their possible remedies.

**Books Recommended:**
1. Trace elements in Human and animal nutrition: Underwood
2. The vitamins: Sebrell and Harris
3. Chemistry and physiology of the vitamins: Rosenberg
4. The biochemistry of B-vitamins by Williams
5. Human nutrition and dietetics: Davidson and Passmore
6. Newer methods of nutritional biochemistry: Albanese
7. Proteins and amino acids in nutrition: Albanese
8. Vitamins and coenzymes L. Wegner and Folker
7. **Enzyme regulation:**
   i) Allosteric enzymes-cooperativity, special characteristics, Monod and Koshland models. Some examples of enzymes- aspartate transcarbamoylase, phosphorylase.
   ii) Covalent modification of enzymes-phosphorylation-dephosphorylation, reversible covalent modification. Some examples of enzymes- pyruvate dehydrogenase, phosphofructo kinase, lactate dehydrogenase, hexokinase.

8. **Coenzymes:** Definition, chemistry, synthesis and functions of TPP, NAD +, NADP +, FMN, FAD, CoA, PLP

9. **Mechanism of enzyme action:** Evidence for enzyme transition state complementarity, structure-activity, transition-state analog, chymotrypsin, lysozyme, ribonuclease A, carboxypeptidase.

**Books recommended:**
1. Enzyme structure and mechanism, Alan Fersht
2. Biochemistry, Lehninger
3. Enzymes, Malcom Dixon and Edwin C. Webb
4. Enzymatic reaction mechanisms, Christopher Walsh

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**Course:** BMB - 204  
**Metabolism - I**  
**Full Marks- 100, Credit: 4, Lecture Hours: 60**

1. **A survey of intermediary metabolism:** Flexibility and economy of intermediary metabolism, multienzymes systems, catabolic, anabolic and amphibolic pathways, energy cycles of cells, metabolic turnover, experimental approaches to intermediary metabolism.

2. **Carbohydrate metabolism**
   a) **Glycolysis:** Aerobic and anaerobic fate, regulation of glycolytic pathway, metabolism of disaccharides, pentoses, hexoses other than glucose, physiological importance of aerobic and anaerobic glycolysis, allosteric and hormonal regulation of both aerobic and anaerobic glycolysis, fructose intolerance, anaerobic glycolysis and tumour cell.
   b) **Tricarboxylic acid cycle** (cycle overview, discovery of the TCA cycle, amphibolic nature of the cycle, regulation of TCA cycle, and glucose-6-phosphate dehydrogenase deficiency.
   c) Other pathways of carbohydrate degradation: The pentose phosphate pathway, the glyoxylatic pathway, glucose-6-phosphate dehydrogenase deficiency.
   d) **Glycogen metabolism:** Glycogenolysis, glycogenesis, and control of glycogen metabolism.
   e) **Biosynthesis of carbohydrate:** Gluconeogenesis, and its regulation, biosynthesis of di, oligo and polysaccharides, glycoproteins, proteoglycan, sugar interconversions.

3. a) **Lipids:** Digestion, mobilization and transport of fatty acids, oxidation of fatty acids (saturated and unsaturated), propionate metabolism, regulation of fatty acid oxidation, utilization of fatty acid, for energy production, functional role of polyunsaturated fatty acids and ketone bodies.
   b) **Disorders of lipid metabolism:** Stress, fatty acids and myocardial infarction, genetic deficiencies in carnitine or Carnitine palmitoyl transferase, Sudden infant death syndrome (SIDS), Ret sums disease, respiratory distress syndrome.

4. **Proteins:** Pathways of amino acids degradation-decarboxylation, oxidative deamination, transamination, and metabolic fates of amino groups, urea cycle, toxicity of ammonia (hyperammonemia), deficiencies of the urea cycle enzymes.

5. **Biosynthetic pathway:** One carbon metabolism, biosynthesis of fatty acids (saturated and unsaturated), biosynthesis of plasma lipoproteins (LDL, HDL), cholesterol, regulation of cholesterol biosynthesis, uses of cholesterol, biological significance of HDL and LDL, β-carotene, and triglycerides, steroid hormones, prostaglandins, prostacycline, thromboxane, leuko-triienes, phospholipids.

6. **Special nitrogen metabolism:** Introduction, non-protein amino acids, amines (aliphatic monoamines), glucosinolates, auxins, cytokinins and ethylene (biosynthesis and function).

**Books Recommended:**
1. **Introduction to the microbial world**: The scope of microbiology, history of microbiology, characteristics, classification and identification of microorganisms, general features of prokaryotic & eukaryotic cells, microscopy: bright-field microscopy, dark-field microscopy, phase-contrast microscopy, fluorescent microscopy, and electron microscopy.

2. **Origin of life**: Spontaneous generation and chemical evolution.

3. **Bacteria**: Morphology, structure, staining, classification, growth and growth curve, nutritional requirement, culture methods, identification, taxonomy, reproduction, bacterial genetics, pathogenicity and infection, antimicrobial therapy, laboratory diagnosis of bacterial diseases, economic importance of bacteria.

4. **Fungi**: Classification, general organization and ultra-structure of fungal cells, cell wall structure, growth, nutritional requirement, and metabolism, reproduction, fungal diseases, economic importance of fungus.

5. **Viruses**: The nature and general properties of viruses, their classification, culture and assay of viruses, effect of chemical and physical agents on viruses, virus-host interaction, plant and fungal viruses. General studies on viruses and bacteriophage, lytic cycle and lysogeny, plasmid and interferon.

6. **Role of microorganisms**: a) in cyclic changes of matter; carbon, nitrogen and sulfur cycles; b) in brewing and milk products; production of beer, cheese and yogurt.

7. **Microbes and diseases**: Natural resistance, pathogenicity and virulence, microbial toxins, transmission and prevention of common infectious diseases (Cholera, tuberculosis, tetanus).

**Books Recommended**:  
1. Microbiology-Application and Concept- Pelczar, Chan and Crieg  
2. Microbiology-- Pelczar, Chan and Crieg  
3. Microbiology – Prescott, Haley and Klein  
4. General Microbiology - Stainer  
5. Fundamentals of Microbiology - Frobisher  
6. Prescott and Dunn’s Industrial Microbiology

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**Course: BMB-Bot-206**  
**Botany**  
**Full Marks- 100, Credit: 4, Lecture Hours: 60**

1. **Economic Botany**: Sources, method of cultivation, processing and use of oil, fibre, tea and medicinal items, tobacco, sugar, pulses and fruit. Importance of (all with particular reference to Bangladesh) plants in maintaining the balance of nature.

2. **Anatomy**: Cell, cell types, tissue, and tissue system, structure of primary stem and root, normal secondary growth.

3. **Plant physiology**: Osmosis, absorption of water, role of nutrients, transpiration, types and factors affecting transpiration, photosynthesis, mechanism in C-3 and C-4 plants, factors affecting the rate of photosynthesis; respiration, types, mechanisms of anaerobic and aerobic respiration, enzymes, physicochemical nature, nomenclature and classification, germination of seeds and viability of seeds.

4. **Ecology**: Ecosystem, components of ecosystem, ecosystems in Bangladesh, edaphic micro and macro climatic and biotic factors in relation to growth, development and distribution of plants, plant succession, xer and hydro-sere, adaptation of mesophytes, xerophytes of hydrophyces, distribution, ecological condition and floristic composition of major forests of Bangladesh.

5. **Cytology and Genetics**: Cell and its organelles, cell divisions, physical and chemical structure of chromosomes; Mendel's laws of inheritances, linkage and crossing over, mutation, polyploidy.
Books Recommended:
1. Introductory Mycology by C. J. Alexopoulos and C. W. Mims
5. Pandey, S. N. & Sinha, B. K. Plant Physiology.

Course: BMB-Zoo-206
Zoology
Full Marks- 100, Credit: 4, Lecture Hours: 60
1. **Cell Biology**: Ultra-structure of cell, cell division, chromosome chemistry, chromosomal aberration, & tissue system.
2. **Genetics**: Laws of heredity and their division, linkage, determination of sex, genetics and heredity, physiological abnormalities.
3. **Biometry**: Population, sample, random variables, collection and presentation of statistical data, frequency diagrams and histogram, location and dispersion and their measures, probability, study of binomial and normal distribution, simple correlation and regression, measurement of association, Chi-square test of goodness of fit, t-test, analysis of variance corresponding to one way and two way classification.

Course: BMB -Bot-207
Botany Practical
Full Marks- 50, Credit: 2
1. Study of different cell type, anatomy.
2. Microscopic examination of water, curd and cheese.
3. Simple stain, gram stain.
4. Study of slime would (somatic and reproductive structure).
5. Identification of plants permanent slides.
6. Class records.
7. Botany practical courses will include the item included in syllabus of Botany minor 101, 201.

Course: BMB-Zoo-207
Zoology Practical
Full Marks- 50, Credit: 2
1. Identification of animals;
2. Bones and histology;
3. Dissection; Mammals (rat, guinea-pig);

Course: BMB-Biostat-208
Biostatistics
Full Marks- 50, Credit: 2, Lecture Hours: 30
3. **Hypothesis Testing**: Basic concept, simple hypothesis, composite hypothesis, critical region, best critical region, most powerful test, uniformly most powerful test. Likelihood ratio test and examples.
5. **Non-parametric Test**: Sign test, Run test and Rank Sum test. examples.
**Books Recommended:**

**Course-BMB-209**  
Biostatistics Practical  
Full Marks- 50,  Credit: 2

1. Construction of frequency table, drawing histogram, frequency polygon, frequency curves and ogive curve.
2. Computation of mean, median and mode, graphical representation of median and mode.
3. Computation of variance, standard deviation, co-efficient of variation, skewness and kurtosis.
4. Computation of simple correlation coefficient and simple regression lines.
5. Test of significance concerning mean, variance, proportion, correlation and regression coefficients.
6. Analysis of complete randomized design, randomized block design and latin square design.

N. B.: As far as possible examples should be given on Biochemistry related problems.

**Course: BMB – 210**  
Laboratory work  
Marks – 200, Credit: 8  
(Practical 140 marks + Class Assessment 60 marks)

**General Biochemistry:**
1. Physical and chemical characterization of fat and oil. Estimation of Iodine value and saponification value of fat and oil.
2. The estimation of iron content of Mohr’s salt by dichromate method.
3. The estimation of copper iodometrically with sodium thiosulphate solution.
4. Determination of equilibrium constant.
5. Synthesis of aspirin, acetamide and paracetamol.
6. The estimation of glucose from supplied sample.
7. Determination of specific rotation of sucrose and estimation of sugar content of solutions with the help of polarimeter.
8. Preparation of buffer solution and pH measurement.

**Nutrition:**
1. Measurement of body mass index (BMI).

**Molecular Biology:**
1. Detection of nucleic acid in biological sample (Ethidum bromaide staining method)

**Microbiology:**
1. Bacteria: a) Morphology, b) Gram staining, c) Solid and liquid broth culture.
2. Starch hydrolysis.
3. Isolation of bacteria from natural habitat.
4. Fungus: Growth on bread mold and observation under microscope.
Course: BMB – 301  
**Molecular Biology - II**

Full Marks- 100, Credit: 4, Lecture Hours: 60

1. **Central dogma of molecular Biology:**
   a) **DNA replication:** DNA polymerases, mode of DNA replication, DNA synthesis, bacterial and eukaryotic DNA replication, inhibitors of replication.
   b) **Transcription:** Prokaryotic and eukaryotic RNA polymerase, promoter, promoter assay enhancers and terminators, mechanism of transcription, mechanism of RNA splicing, reverse transcription, inhibitors of transcription.
   c) **Genetic code:** Characteristic features of genetic code, Wobble hypothesis with experimental evidence, gene-protein colinearity.
   d) **Translation:** Structure of ribosome, initiation, and elongation and termination of protein synthesis, inhibitor of protein synthesis, post-translational modification, signal hypothesis.

2. **Repair mechanisms of DNA:** Mechanism of different types of DNA repair system in E coli; physical and chemical agent that causes DNA damage.

3. **Mutation:** Different types of mutation (mis-sense, same-sense and non-sense mutation, frame shift mutation etc) Molecular mechanism of mutations, repair mechanism in mutation, mutation rate and its measurement.


**Books Recommended:**
1. Principles of Biochemistry – Lehninger, Nelson and Coxs
3. Biochemistry - Stryer
4. Genes VI and VII – Benjamin and Lewin
5. Molecular cell biology – Darnell J., Loddis H. and Baltimore D.
Course: BMB - 302
Cell Biology
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Cell Structure and Function:
   (a) Mitochondria: Organization, function and genetic system of mitochondria; protein import and mitochondrial assembly.
   (b) Lysosomes: Lysosomal acid hydrolases; endocytosis and lysosome formation; phagocytosis and autophagy.
   (c) The mechanism of vesicular transport: Experimental approaches to understanding vesicular transport; Coat proteins and vesicle budding; vesicle fusion.

2. Methods used to study cells:
   a) Cell isolation and growth in culture: Cell isolation by fluorescence-activated cell sorter, cell grown in culture dish, composition of medium for mammalian cell cultivation, eukaryotic cell line, formation of hybrid cell, hybridoma cell line and monoclonal antibodies.
   c) Visualization of molecules in living cells: Measurement of intracellular ion concentration with light-emitting indicators, study of intracellular dynamics by light-induced activation of “caged” precursor molecule, use of isotope to trace molecules in cells and organisms by autoradiography.

3. Biological membrane and transport:
   a) Biological membrane: Chemical composition of cell membrane, major classes of membrane lipid, lipid bilayers and their common structural theme, membrane proteins, membrane models, membrane carbohydrates
   b) Membrane transport: Various ways of membrane transport. simple diffusion, facilitated diffusions, active transport its types, primary active transport ( Na - K pump ), secondary active transport, glucose - Na cotransport system, active transport of sugars into bacteria by group translocations, carrier proteins such as uniports, coupled transporters, symport and antiports.

4. Cell signaling: Signaling molecules and their receptors; function of cell surface receptors; pathways of intracellular signal transduction; signal transduction and the cytoskeleton; signaling in development and differentiation; signaling in plants.

5. Cell division: Cell Cycle, mitosis - definition, different phases of mitotic cell division, significance of mitosis. meiosis- definition, types, the first meiotic cell division, the 2nd meiotic cell division, synaptonemal complexes, differences between mitosis and meiosis.

Books Recommended:
2. Biochemistry, 3rd edition. By Lubert Stryer
4. Genes VI by Benjamin Lewin.

Course: BMB- 303
Physiology-II
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Liver: Anatomy and function of liver (storage, metabolic, synthetic and secretory function), liver function test, liver diseases (cirrhosis and jaundice).

2. Cardiovascular system: Heart, chambers of heart and its valves: There functions and locations, cardiac tissues, sino atrial node, (SA node), atrio-ventricle node (AV node), Bundle of His. pace maker, artificial and natural cardiac output, systemic pulmonary and coronary blood circulation, blood pressure, structure and function of arteries and veins, systemic cardiovascular diseases (Angina pectoris, Hypertension, MI etc.).

3. Lymphoid system: Lymph and lymph vessels, lymphatic circulation, primary and secondary lymphoid organs and their structure and functions, lymph nodes, spleen, thymus and bone marrow in immunity.
4. Reproductive system:
(a) Male reproductive system: Spermatogenesis, hormone stimulating spermatogenesis, regulation of male reproductive functions by various hormones, impotency.
(b) Female reproductive system: Menstrual cycle, functions of gonadotropic hormones (estrogens, progesterone and luteinizing hormone), ovulation, fertility, functions of placenta, hormonal regulation of pregnancy, lactation, menopause and puberty.

5. Brain: Different parts of brain and their functions, growth characteristics, cell of brain- neuron, ganglia and their structure, hypothalamus, the sense, sense receptors- location and function, speech thought, memory.

Books Recommended:
1. Text Book of Medical Physiology. By Guyton and Hall
3. Human Physiology. By Chakrabarti, Ghosh and Sahana.

Course: BMB – 304
Endocrinology
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Characteristics of hormone system: Introduction, general functions of hormones, major endocrine glands, paracrine, autocrine, juxtacrine and intracrine actions of hormone, hormone receptors and its abnormalities, factors affecting hormonal secretion.
4. Thyroid and parathyroid hormones: Introduction, structure, synthesis, transportation, mechanism of action and pathophysiology.

Books Recommended:
1. Text Book of Medical Physiology by Guyton
2. Text Book of Biochemistry with Clinical Correlation by Thomas M. Delvin
3. Human Physiology by Chakrabarti, Gosh & Sahana
5. Textbook of Biochemistry: A.S. Saini
1. Proteins: Isolation, solubilization and precipitation: Solubilization and stabilization of proteins, cell disruption techniques, precipitation with organic solvent, organic polymers and others affinity precipitation, precipitation by selective denaturation.

2. Purification and Characterization of Proteins:
   (i) Chromatography:
   a) Gel-permeation chromatography: Principle, choice of gel, determination of molecular weight of protein by gel filtration chromatography
   b) Ion-exchange chromatography: Synthetic resins, CM- and DEAE cellulose, sephadex, sephacel and agarose.
   c) Liquid chromatography: HPLC and FPLC.
   d) Adsorption chromatography: Hydroxylapatites, procion dye- ligand agarose.
   e) Hydrophobic chromatography: Theory and application of the true form, mixed function ion-exchange/hydrophobic columns.
   f) Affinity and covalent chromatography: Matrices, attachment of ligands, applications, metal chelate affinity and thiol-thiol interaction.
   g) Purification of Recombinant proteins
   (ii) Polyacrylamide gel electrophoresis (PAGE): Principle, matrix constituents of PAGE, polymerization and pore size, buffer system, PAGE with additives, fixation, staining and destaining of gel, determination of molecular weight of protein by PAGE.

3. Ultracentrifugation: Sedimentation coefficient, Svedberg units, sedimentation equilibrium, density gradient sedimentation, and determination of molecular weight by ultracentrifugation.


5. Sequence determination of proteins: Homologus proteins, folding mechanism of proteins, factor affecting the thermal stability of proteins, structure of myoglobin and ribonuclease.

6. Structural studies of macromolecules by X-ray and neutron diffraction techniques: Crystallizations, X-ray sources and detectors, crystals and their properties, X-ray data collection, theory of X-ray diffraction by a crystal, phase determination by different methods.

Books Recommended:
1. Protein Purification by Robert K. Scopes.
2. Protein purification protocols by Shawn Doonan
3. Protein biochemistry and proteomics by Hubert Rehm.
4. Physical Biochemistry by David Freifelder.
5. Principles of Protein X-ray Crystallography, by Jan Drenthe.
8. Introduction to Chromatography- Subhas Chandra paul.

Course: BMB – 306
Basic Immunology
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Introduction to immunology:
   i) Historical development of immunology, contribution of Edward Jenner and Louis Pasteur in the development of immunology, definition of immunology, immunity, immune system,
   ii) Innate and adaptive immunity, principal components of the innate and adaptive immunity, types of adaptive immune response, active and passive immunity, cardinal feature of adaptive immune response, clonal selection hypothesis, two signal hypothesis of lymphocyte activation, role of costimulator and CD40 in T and B cell activation, proliferation and differentiation of lymphocytes.

2. Cells and tissues involved in immune response: Lymphocytes, classification of lymphocytes, hematopoiesis, maturation stages of B and T lymphocytes, role of thymus in T cell maturation, natural killer cell, antigen-presenting cells, langerhans cell, dendritic cells, mononuclear phagocytes, polymorphonuclear granulocytes (neutrophils, eosinophils, basophils, mast cell), platelets.

3. Antibodies and antigens: Definition, classification, functions, general and molecular structure of
antibody, theories of antibody diversification, antibody receptors, definition of antigen, determinants (epitopes), hapten, immunogen, structural and chemical basis of antigen binding, structure-function relationship within antibody molecules.

4. **The Major Histocompatibility Complex (MHC):** Discovery of MHC molecules, general features of MHC genes, structure of MHC molecules (class-I and class-II), binding of peptides to MHC molecules.

5. **Antigen processing and presentation of T lymphocytes:** Properties of antigen recognized by T lymphocytes, antigen processing and presentation of antigen to CD4⁺ helper T lymphocytes and CD8⁺ cytolytic T lymphocytes.

6. **Cytokines:** General and functional categories of cytokines, cytokines receptors, role of cytokines in innate and adaptive immunity; development and functions of T₄₁ and T₄₂ subsets of T cells.

**Books Recommended:**
1. Cellular and Molecular Immunology – A. K. Abbas, A. H. Licistman, J. S. Pober
2. Roitt’s Essential Immunology – Ivan Roitt
3. Immunology – Roitt and Brostoff
4. Medical Immunology – Daniel P. Stites, Abba I. Terr, Tristram G.

**Course: BMB – 307**

**Clinical Biochemistry**

Full Marks- 100, Credit: 4, Lecture Hours: 60

1. **Introduction:** Clinical Biochemistry and its relationship with surgery, medicine, clinical pathology etc; hazards in clinical laboratory and preventive measures.

2. **The acquisition and interpretation of biochemical data:** Introduction, pre-analytical factors, analytical factors, the quality of results (normal & abnormal), the interpretation of results and the predictive value of test.

3. **Handling of Specimen:** Collection, storage, handling and processing of blood, CSF, urine, feces and swab samples for clinical tests.

4. **Clinical application of enzymes and isoenzymes:** alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatine Kinase (CK), lactate dehydrogenase (LDH), amylase, acid phosphatase (ACP); alkaline phosphatase.

5. **Clinical Biochemistry in the investigation of acute chest pain and the acute abdomen:** Introduction, chest pain, causes of chest pain, the acute abdomen (acute pancreatitis, acute porphyria, ectopic pregnancy).

6. **Clinical application of metabolites & electrolytes as diagnostic tools:** Metabolites-glucose, bilirubin, blood urea nitrogen (BUN), creatinine and lipids profiles; electrolytes- sodium, potassium, chloride and bicarbonate.

7. **Genetic disorders and their diagnosis:** Genetic basis of biochemical disorders and their transmission, diagnosis and apparent treatment examples; PKU, alkaptonuria; galactosemia, fructose intolerance, lipid storage disease (Gaucher’s, Niemen Pick), hypercholesterolmia, glycogen storage diseases (Gierke’s disease, Pompe’s disease, Curi’s disease), sickle cell anemia, thalassemia, hemolytic anemia.

8. **Biochemistry and dietary management of diseases:** Rheumatoid and osteoarthritis, gout, acidosis and alkalosis, tropical and non tropical sprue and atheroclerosis.

9. ** Diseases of the muscle and their investigation:** Routine biochemical studies, non-metabolic genetically determined myopathies, genetically determined metabolic myopathies (disorders of carbohydrate metabolism, defects of the respiratory chain, defects of fatty acid oxidation).

**Recommended Books:**
1. Clinical Biochemistry, J. MARSHAL & K. BANGERT.
2. Clinical Biochemistry, A. L. LATNER.
3. Practical Clinical Biochemistry, Gowen Lock & Others.
4. Advanced Text Book on Food & Nutrition Vol-I and II, Dr.M. Swaminathan
5. Fundamentals of Biochemistry, Dr. A.C. DEV.
Course: BMB – 308
Metabolism - II
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Amino acid metabolism: Glucogenic and ketogenic amino acids, oxidative degradation of amino acids to specialized products, amino acid biosynthesis, regulation of amino acid metabolism, metabolism of folic acid, glutathione, methylmalonate.


3. Metabolic interrelationship: Overview, starve feed cycle, mechanisms involved in switching the metabolism of the liver between the well fed state and starved state, metabolic interrelationship of tissues in various nutritional and hormonal states, metabolism in exercise.

4. Metabolism of porphyrins, heme and bile pigments:

5. Metabolism of individual tissue (in brief): Skeletal muscle, cardiac muscle, adipose tissue, liver, kidney, nervous tissue, lung, blood cells and skin.

6. Xenobiotics: Introduction, general properties of xenobiotic metabolites, role of liver in such metabolism. Characteristics of P<sub>50</sub>, conjugation, reduction, hydrolysis and oxidation as methods of xenobiotic metabolism.

7. Integration and hormonal regulation of mammalian metabolism: Glucose transporters, glucose uptake through glucose transporters and its regulation by hypothalamus; β-adreno-receptors (β<sub>1</sub>, β<sub>2</sub>, β<sub>3</sub>), β-adreno-receptor-agonists and glucose uptake in peripheral tissues, 2-deoxyglucose method, hormonal regulations of fuel metabolism; signaling by the neuroendocrine system, processing of peptide and catecholamine hormones.


Books Recommended
2. The Pharmacological Basis of Therapeutics by Goodman and Gilman.
3. Biochemistry, 3<sup>rd</sup> edition. By Lubert Stryer
4. Fundamental of Biochemistry. By Dr. A. C. Dev

Course: BMB – 309
Bioenergetics
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Bioenergetics and metabolism: The cycling of carbondioxide and oxygen between autotroph and heterotrophs, cycling of nitrogen in the biosphere, energy relationship between catabolic and anabolic pathways,

2. Bioenergetics and thermodynamics: Biological energy and law of thermodynamic- Free energy, entropy and heat content and their impact on biology, free energy changes and equilibrium constant in biochemical systems, phosphate group transfer and ATP; other phosphorylated compounds and free energy of hydrolysis, utilization of ATP in firefly flashes, assembly of informational macromolecule, active transport and muscle contraction, energetics of glucose and fatty acid metabolism and thermodynamic efficiency, comparison of the energetics of fermentation and respiration.
3. **Biological oxidation-reduction reaction:** Flow of electron and biological work, oxidation-reduction reaction and half reaction, ways of electron transfer from one molecule to another, measurement of reduction potential, relationship of standard reduction potentials with free energy, universal electron carriers.

4. **Oxidative Phosphorylation:** Salient feature of oxidative phosphorylation, structure of mitochondria, redox potential and free-energy change, description of electron transport chain, three dimensional structure of cytochrome c and its structural conservation, the chemiosmotic hypothesis and its evidence, evidence of generation of proton gradient, structure of ATP synthase, binding change mechanism for ATP synthase, glycerol phosphate and malate-aspartate shuttles for entry of electrons from cytoplasmic NADH into mitochondria, function of ATP-ADP translocase, respiratory control, short-circuit of proton gradient, power transmission by proton gradient.

5. **Photosynthesis:** Definition, thylakoid membrane, discovery of basic equation of photosynthesis, trapping of solar energy by chlorophyll, photosynthetic unit, O₂ evolution in photosynthesis, hill reaction, photosystem I and II, mechanism of formation and release of O₂, pathway of electron flow from H₂O to NADP⁺, electron flow in cyclic photophosphorylation, ATP synthase of chloroplast, Calvin cycle, dark and light reaction, C₅ pathway of tropical plants.

**Books Recommended:**
2. Biochemistry by Lubert Stryer.

**Course: BMB – 310**  
**Laboratory work**  
**Full Marks – 200, Credit: 8**  
**(Practical 140 marks+ Class Assessment 60 marks)**

**Basic Biochemistry**
1. Estimation of calcium by titration with potassium permanganate  
2. Isolation of casein by precipitation at its isoelectric point  
3. Identification of amino acids and sugar by paper chromatography.

**Clinical Biochemistry**
2. Estimation of creatinine from supplied and blood serum.  
3. Estimation of blood glucose  
4. Estimation of serum cholesterol

**Enzymology**
1. Determination of Km and Vmax of an enzyme.  
2. Study of salivary amylase

**Hematology**
1. Determination of hemoglobin %  
2. Determination of blood groups  
3. Differential counts of blood cells.  
5. Determination of blood clotting time.  
6. Determination of bleeding time.

**Microbiology**
1. Preparation of bacterial growth media  
2. Isolation of pure culture by serial dilution method.  
3. Determination of bacterial growth curve.  
4. Isolation of lactose fermenting bacteria.
B.Sc. Honours Part- IV Examination, 2017

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<th>Course</th>
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Total = **1050** | **10.5** | **42**

**Course: BMB – 401**

**Molecular Biology and Genetic Engineering**

**Full Marks- 100, Credit: 4, Lecture Hours: 60**

1. Enzymes used in genetic engineering, DNA-polymerases, ligases, reverse-trascriptases, S1 nuclease, exonucleases and endonucleases.

2. Gene linkage and chromosomes mapping, gene mapping of human chromosomes.

3. **Transposons and Retroposons:** Bacterial transposons, definitions, differences among transposons, retroposons and IS elements, general features of transposons, structures of typical transposons (Tn3, Tn9), model for the transposition, transposons in eukaryotes (Ty element in yeast ) mobile elements in eukaryotes (pseudogenes and Alu sequences )

4. **Gene manipulation:**
   a) **Genetic Recombination:** General recombination by base pairing, interactions between complementary strands of two homologous DNA molecules, recA protein.
   b) **Genetic Engineering:** Joining of DNA molecules, cohesive and blunt end joining, addition of linker, adaptors and homopolymers, constructions of genomic and cDNA library, screening, cloning and plaque hybridization, cloning of a particular fragment of gene in different vectors, expression of the recombinant DNA molecules. Applications of genetic engineering in medicine and agriculture (production of insulin, growth hormones and vitamins).

5. **Techniques in Molecular biology:** Polymerase chain reaction (PCR) Sanger's dideoxy chain termination method for DNA sequencing, radio labeling of DNA fragments, agarose & acrylamide gel electrophoresis, southern, northern and western blotting, in vitro mutagenesis, site directed mutagenesis, Mutagenesis of cloned genes, importance of site directed mutagenesis, melds, PCR mutagenesis.

6. **Application of DNA markers:** RFLP, AFLP, SSR, RAPD & SNP (including assay).

7. **Cloning Vectors:** Construction of plasmid vectors, Lambda phage DNA and M13-based expression vectors for eukaryotic expression genomic and cDNA libraries.

**Books Recommended:**

2. Recombinant DNA. By J.D. Watson and M. Zoller
4. Biochemistry - Stryer
5. Genes VI and VII – Benjamin and Lewin
6. Molecular cell biology – Darnell J.; Loddis H. and Baltimore D.
1. **Tissue-Specific Metabolism:** Hypothalamic control of liver, muscle and adipose tissue metabolism, metabolic center of the hypothalamus; metabolic regulation by the VMH-sympathetic and LH-parasympathetic nervous system; reciprocal hypothalamic control of liver metabolism; UCPs, UCP-expression of brown adipose tissue (BAT) and white adipose tissue (WAT); shivering and non-shivering thermogenesis; mechanism of non-shivering thermogenesis in BAT.

2. **Regulation of Body Weight and Energy Expenditure:** Leptin, Leptin-Receptor, ob/ob gene, db/db gene, fa/fa gene. Peripheral and central effects of leptin; Hypothalamic regulation of food intake and energy expenditure by Leptin; role of anorexigenic and orexigenic peptide on body weight regulation and thermogenesis; adiposity signaling by Leptin and Insulin; Melanocortin system; agouti mouse; positive and negative energy balance.

3. **Regulation of Lipid Metabolism:** Lipolysis of brown and white adipose tissue; Hypothalamic regulation of Lipolysis; role of norepinephrine (NE) on Lipolysis. Lipogenesis; role of insulin on Lipogenesis in BAT. Hypothalamic regulation of Lipogenesis. Hypothalamo-BAT axis; Hypothalamic Obesity.

4. **Glucose Metabolism:** Insulin signaling and cellular mechanism of action, diabetes mellitus, Lipoatrophy and Lipohypertrophy; Sulfonylureas.

5. **Polyamine metabolism:** Introduction: Properties and functions of polyamine; Distribution of polyamines in cells; Metabolic and catabolic pathways of polyamine; Regulation of polyamine metabolism; Role of polyamine in signal transduction. Relation of polyamine with cancer cell.

**Books Recommended:**

1. The pharmaceutical basis of Therapeutics. Goodman & Gilman.
2. The hypothalamus and Metabolic Control. Takashi Shimazu.

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**Course: BMB- 403**  
**Biotechniques**  
**Full Marks- 100, Credit: 4, Lecture Hours: 60**

1. **UV and visible spectroscopy:** Principle, instrumentation and application.

2. **Infrared spectroscopy:** Principle of infrared spectroscopy and its instrumentation, the mode of vibration and bending, bond properties and absorption trends, application of IR spectra.

3. **Fluorescence spectroscopy:** Theory of fluorescence, instrumentation for measuring fluorescence, intrinsic fluorescence measurements for studying proteins, extrinsic fluorescence and energy transfer, special uses of fluorescence in biology and biochemistry.

4. **Nuclear Magnetic Resonance:** Principles of NMR, the chemical shift, spin-spin interactions, Instrumentation of NMR, data obtained from an NMR spectrum, assignment of spectral lines of protein and polynucleotides, use of NMR to study protein and polynucleotide structure of biomolecules, spin labeling and Fourier transform NMR

5. **Mass spectroscopy:** Basic principles of mass spectroscopy, instrumentation of MS, production of mass spectra, high resolution mass spectroscopy, mass spectra of purine and pyrimidine bases, application of mass spectrometry of nucleotides.

6. **Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD):** Simple theory of ORD and CD, techniques for measuring ORD and CD, interpretation of ORD and CD curves application of ORD and CD analysis to protein and polypeptide structure.

7. **Nanomolecules:** Definition and classification, applications of Nano-Molecules in biosystems, Nanoscale elements for delivery of materials into cells, Peptides coupled nanoparticles, DNA based artificial nanostructure, Proteins as components in nanodevice.

Books Recommended
1. Introduction to spectroscopy by Donald L. Pavia, Gray M. Lampman, Goerge S. Kriz Jr.
4. Physical Biochemistry by David Freifelder.
7. Molecular spectroscopy by Banwell.
8. Springer Handbook of Nanotechnology by Bharat Bhushan

Course: BMB – 404
Industrial Biotechnology
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Animal cell culture: Animal cell culture technology, requirements for animal cell and tissue culture, culture media, classification, compositions, use of serum in culture media, sterilization of glass ware, equipments and liquids, isolation of animal materials, desegregation of tissue by physical and enzymatic method.

2. Fermentation technology: Definition, industrial fermentation products, microorganisms, prerequisites to practical industrial microbiological processes, criteria for a fermenter design; Batch feed, semi-continuous and continuous feed modes, classification of fermenter, alcohol fermentation, alcoholic contents in some beverages, industrial application of ethyl alcohol, microbial production of antibiotics, L-lysine, microbial insecticides.

3. Biodegradation: Agroindustrial wastes recycling (anaerobic digestion and biogas production, single cell protein production, microbial fertilizer aliphatic and aromatic hydrocarbon transformation.

4. Immobilized cells and enzymes: Immobilized enzymes and cells, processes of immobilization, bioreactor design, applications of immobilized enzymes and cells.

5. Food science:
(a) Definition, objective, interdisciplinary approaches.
(b) Food engineering; pre and post harvest operation of food materials.
(c) Food preservation and processing; preservation by dehydration/drying, low and high temperature, irradiation, preservatives and fermentation.

Books Recommended:
1. Food Science, Norman N. Potter.
2. Immobilization of enzymes and cells, Gordon F. Bickerstaff.
3. Immobilization of enzymes, antigen, antibody and peptides: Preparation and characterization, H.H. Weetall

Course: BMB – 405
Plant Biotechnology
Full Marks- 50, Credit: 2, Lecture Hours: 30

1. Introduction to in vitro culture: History and development, aim and objectives, laboratory techniques, culture media, plant growth regulator- class and their use in-vitro culture, plant tissue culture, culture types, plant regeneration, somatic embryogenesis, organogenesis, single cell culture methods, cytology of callus.

2. Tissue culture techniques and applications: Haploid production, Androgenesis: anther and microspore culture, protoplast isolation and culture, artificial seeds, cryopreservation and germplasm conservation, application of tissue culture.
3. **Plant genetic transformation:**
   a) **Plant genomes:** The organization and expression of plant genes; structure of DNA, chromatin and chromosome; gene structure, regulation of eukaryotic gene expression, implication for plant transformation.

   b) **Techniques for plant transformation:** Agrobacterium mediated gene transfer, Ti-plasmid, process of T-DNA transfer and integration, application, methods of direct gene-transfer such as particle bombardment, microprojectile, electroporation, siliconcarbide fiber, PEG etc.

4. **Binary vector for plant transformation:** Features of plant vectors, Promoters and terminators, selectable markers, reporter genes (gus, gfp, cat, luc, lux), origin of replication, development of vectors.

5. **Genetic manipulation of herbicide and pest resistance:** Herbicide composition, and its use, mechanism of action, engineering of herbicide resistance, pest of major crops and its use, GM strategies resistance for insect resistance; e.g. Bt approach.

6. **The improvement of crop yield and quality:** The genetic manipulation of fruit ripening such as softening, modification of flower color and production of golden rice and other high yielding crops.

**Books recommended:**
1. Adrian Slater, Nigel Scott and Mark Fowler; Plant Biotechnology

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**Course: BMB- 406**

**Pharmaceutical Biochemistry**

**Full Marks- 100, Credit: 4, Lecture Hours: 60**

1. **Pharmacokinetics:**
   a) **Absorption of drugs:** Mechanism of absorption; effect of physiological and formulation factors on gastro-intestinal absorption of drugs.

   b) **Distribution of drugs:** Physical significance of drug concentration in blood, bioavailability, biological half-life.

   c) **Metabolism of drugs:** General pathways of drug metabolism, sites of drug biotransformation, role of cytochrome P-450 monooxygenases in oxidative biotransformation, oxidative reactions, reductive reactions, hydrolytic reactions, phase II or conjugative reaction, factors affecting drug metabolism.

2. **Pharmacodynamics:** Mechanism of drug action, drug receptor, their chemical properties, classification of receptors and drug effects, structure activity relationship and conformation of receptor surface, consequence of drug receptor interaction, relation between drug concentration and response, action of drug not mediated by receptors, effect of protein binding on drug deposition and characteristics.

3. **Histamine and anti-histaminic agents:** Histamine, histamine life cycle, H₁ antagonist, inhibition of histamine release, histamine H₂ receptor antagonist, histamine H₃ receptor ligands.

4. **Cardiovascular drugs:** Drugs used for the treatment of angina; organic nitrates, calcium channel blocker and β-adrenergic antagonist etc.
5. Chemotherapeutic agents:
a) Definition, properties, drug resistance, trimethoprim, quinolone, isoniazid.
b) Sulfur drugs: Synthesis, chemistry, mechanism of action and pharmacological properties.
c) Antibiotics: Definition, classification, mechanism of action of different antibiotics, chemistry, biosynthesis and their therapeutic uses.
   i) Penicillin & Cephalosporin (1st generation, 2nd generation and 3rd generation, 4th generation), chloramphenicol, tetracycline, streptomycin.
   ii) Antifungal antibiotics such as nystatin, griseofulvin.

6. Alkaloids: Sources, classification, isolation, identification, purification, structure determination, biosynthesis of reserpine, atropine, ephedrine, ergot alkaloids and their therapeutic properties, synthesis and therapeutic properties of some important steroids.

Books Recommended:
1. Lippincott’s Illustrated Review: Pharmacology, By Richard A. Harvey and Pamela C. Champe
2. Examinations and Board Review: Pharmacology, By Bertram G. Katzung and Anthony J. Trevor
3. The Pharmacological Basis of Therapeutics, By Goodman and Gilman.
4. Textbook of organic, Medicinal and Pharmaceutical Chemistry, By Wilson and Gisvolds

Course: BMB – 407
Advanced Immunology
Full Marks- 100, Credit: 4, Lecture Hours: 60

1. Effector mechanism of innate immunity: Recognition of microbes by neutrophils and macrophages, recruitment of leukocytes to sites of infection, phagocytosis of microbes, effector functions of activated macrophages, recognition of infected cells by NK cells and effector functions of NK cells.

2. Effector mechanism of cell-mediated immunity: T-cell mediated macrophage activation, induction of CMI, migration of activated T cells and other leukocytes to site of antigen, activation of macrophages and their functions, cytolytic T lymphocytes and mechanisms of cytolytic T lymphocyte-mediated cytolysis.

3. Effector mechanisms of humoral immunity: Complement system, classical and alternative pathways of complement activation, late steps of complement activation, receptors for complement proteins, regulation of complement activation, function of complements.

4. Regulation of immune response: Regulation of immune response by lymphocytes, antigen and antibody molecules.

5. Monoclonal antibody production: Definition of monoclonal and polyclonal antibody, method for the production of monoclonal antibody, importance of monoclonal antibody.

6. Immunological techniques: Precipitation reaction and techniques, agglutination and techniques, immunodiffusion, radioimmunoassay (RIA), enzyme-linked immunosorbent assay (Direct and indirect), immunofluorescence techniques and complement fixation assay.

Books recommended:
1. Cellular and Molecular Immunology – A. K. Abbas, A. H. Licistman, J. S. Pober
2. Immunology – Roitt and Brostoff
3. Medical Immunology – Daniel P. Stites, Abba I. Terr, Tristram G.
4. Roitt’s Essential Immunology – Ivan Roitt
1. Introduction and overview of cancer:

b) Biology of tumor cell growth: Introduction, nature of tumor growth, growth rate and doubling time, assessment of cell kinetics (tritiated thymidine and autoradiography and flow cytometry techniques).

2. Molecular Biology of Cancer:
   a) Cell cycle and cancer: Mechanism of cell cycle regulation, mammalian cell cycle regulation, cyclin, cyclin dependent protein kinases, inhibition of cyclin dependent kinases, regulation of E2F transcription factors, cell cycle check points, apoptosis (programmed cell death), p53 gene in apoptosis, BCL-2 in apoptosis.

b) Tumor progression and metastasis: Tumor progression, clonal evolution, and molecular genetics of tumor progression, pathogenesis of metastasis and spread of human cancers, molecular mechanism of angiogenesis and metastasis (cell adhesion molecules, signal transduction by integrins, integrins in metastasis, proteolytic enzymes), oncogenes and metastasis, experimental approaches in the study of metastasis.

c) Oncogenes: Oncogenes, protooncogenes, and tumor suppressor genes and hereditary cancer. identification of oncogenes, bioassay for oncogenes in tissue culture systems, functions of oncogenes and tumor suppressor genes (signal transduction, extracellular growth factor, receptor tyrosine kinases, Ras, Fos, Jun and API, CMYC, REL, RBgene p53, ATM)

d) Genetic basis of cancer: Chromosome nomenclature and methodology, terminology and types of chromosome aberration in cancer, chromosome in solid tumor, the mechanism of genetic respectability, relation between cancer incidence and age, cellular and genetic basis of cancer, types of genetic risk factors for cancer, cytogentic of hematological malignancies, cytogentic of solid tumors, heritable cancer (Retinoblastoma and Knudsons hypothesis, the retinoblastoma gene, colon carcinoma, breast carcinoma).

3. Etiology of cancer:
   a) Chemical factors: The nature of chemical carcinogens (chemistry and metabolism), biological process in chemical carcinogenesis (multistep model in carcinogenesis) DNA adducts, and repair, identification of carcinogens.

b) Physical factors: Ionizing radiations, ultraviolet radiation carcinogenesis, asbestos, hypothermia and erythrome, Ab Igne, electric and magnetic field.

c) Viruses: DNA tumor viruses (SV40 virus, human adenovirus, human papiollma virus, Epstein Bar virus, Hepatis B virus), virus and kaposi sarcoma.

d) Viral diseases: Infectivity, mode of gene expression and virus assembly, representative member of each class, herpes virus, papovirus, hepatitis virus, picornavirus, vascular somatititis virus, rabies virus, recovirus, and retrovirus, AIDS.

4. Tumor immunology: Tumor recognition and immune surveillance, human antitumor T-cell response, tumor necrosis factor (TNF) and lymphokine activated killer cells, natural killer cells, tumor antigens.


Books Recommended:
1. The Basic Science of Oncology. Ian F. Tannock; Richard p Hill.
Course: BMB – 409

Neurochemistry

Full Marks- 50, Credit: 2, Lecture Hours: 30

1. **Brain:** Gross and fine structure of the brain.
   Gross structure of the brain: different parts of the brain and their functions.
   Fine structure of brain: structure and functions of neurons and glial cells.

2. **Synapse:** Structure, function, their types, chemical synapse and electrical synapse, signal transmission at chemical synapses

3. **Nerve impulse and its conduction:** Action potential and its ionic basis, sodium channel, potassium channel and calcium channel, conduction of nerve impulse through myelinated and unmyelinated nerve fibers. Physiology and mechanism.

4. **Neurotransmission:** Neurotransmitters, properties of neurotransmitter, their metabolism, molecular mechanism of neurotransmitter secretion, calcium channel and the role of calcium in transmitter secretion, post synaptic receptors their modulation with agonists and antagonists, neuropeptides.

5. **Brain growth and development:** Species, structural and cell type differences, neurogenesis and gliogenesis, neuronal death and nervous system development.

6. **Metabolism of the developing brain:** Lipid, protein, energy metabolism, metabolism of neurotransmitter. Brain development during malnutrition. Malnutrition and brain metabolism associated with mental illness.

7. **Biochemistry of memory:** short- and long- term memory.

8. **Brain diseases:** Parkinson’s disease, Epilepsy, Schizophrenia Alzheimer’s disease, Huntington’s disease.

9. **Neurologic drugs:** Classification, mechanism of action, drug interaction causing neurological problems.

**Books Recommended**
1. Principles of Neural Sciences by Eric R. Kendel, James H. Shwartz
2. Neuroscience by Dale Purves, George J. Augustine
4. Basic neurochemistry: Molecular , cellular and medical aspects, 7thedition, George stegel, R. Wayne Albers, Scott Braady, Donald Price
Course: BMB – 410  
Laboratory work  
Full Marks- 200, Credit: 8  
(Practical 140 marks+ Class Assessment 60 marks)

A. General Biochemistry
1. Estimation of carbohydrates by anthrone method.  
2. Isolation and assay of glycogen from liver and skeletal muscle.  
4. Determination of total fatty acids in a lipid extract.  
5. Determination of brain phospholipids.

B. Clinical Biochemistry
1. Assay of serum SGOT and SGPT activity in mice.  
2. Estimation of bilirubin from supplied sample.  
3. Isolation and determination of cholesterol content of biological samples.  
5. Assay of muscle lactate dehydrogenase activity.  

C. Biochemical Techniques
1. TLC of fruit juice and amino acids.  
2. SDS-PAGE of rat liver protein.  
3. Gel filtration chromatography for separation of known protein and purification of deamidase/protease from germinating seeds.  
4. Identification of albumin, globulin and fibrinogen by paper chromatography.  
5. Ion exchange chromatography of known proteins and checking for separation by gel electrophoresis.

D. Pharmaceutical Estimation
1. Estimation of streptomycin.  
2. Estimation of ampicilin.  
3. The estimation of acetoaminophen and salicylate in serum.  
4. Estimation of serum vitamin-A.  

E. Haematology
1. Determination of ESR.  
2. Total and differential white cell counts.  
4. ELISA for detection of HBsAg.  
5. Assay of human serum immunoglobulins.

F. Molecular Biology and Environmental Biochemistry
1. Isolation of plasmid DNA.  
2. Isolation of DNA from plant tissue.  
3. Isolation of bacteriophage.  
4. Isolation of microbes from natural habitats.  
5. Estimation of DNA, RNA and Oligonucleotides.  
7. PCR/Restriction digestion of genomic DNA.  
9. Determination of dissolved oxygen (DO), and biological and chemical oxygen demand (BOD, COD) of different water samples.  
10. Determination of bacterial load from different environmental samples.
**Book Recommended for Biochemistry & Molecular Biology:**

Textbook of Biophysics: West.
Physical biochemistry: Bull.
Introduction to electrochemistry: Glasstone.
Textbook of physical chemistry: Glasstone
Outlines of physical: Glasstone
Physical chemistry: Daniels and Alberty.
A source book of atomic energy: Glasstone.
Introduction to radiochemistry: Friendlander and Kennedy.
Quantitative chemical analysis: Vogel
A text book of practical organic chemistry: Vogel
Organic chemistry: Fieser and Fieser.
Ionic organic reaction: Alexander.
Organic chemistry: Gram and Hammond.
Hohici’s Yeast, mold and actinomycetes: Skinner and others.
Bacterial chemistry and physiology: Porter.
General bacteriology: Searls.
Introduction to bacteria: Clifton.
Soil microbiology: Waksman.
Textbook of physiology and biochemistry: Bell and other.
Applied physiology: Right.
Human physiology: Chattarjee.
Trace elements in Human and animal nutrition: Underwood.
The vitamins: Sebrell and Harris.
Chemistry and physiology of the vitamins: Rosenberg.
The biochemistry of B-vitamins by Williams
Human nutrition and dietetics: Davidson and Passmore.
Newer methods of nutritional biochemistry: Albanese.
proteins and amino acids in nutrition: Albanese.
The proteins: Fox.
Vitamins and coenzymes: L. Wegner and Folker.
General biochemistry: Fruton and Simmonds.
Dynamic aspects of biochemistry: Baldwin.
Practical physiological chemistry: Hawk, Oser and Summerson.
Principles of biochemistry: Whits, Hankler and Smith.
Enzymes: Summer and Meback.
Textbook of biochemistry: West and Tood.
Metabolic pathways: Greenberg.
Biochemical reaction mechanism: Ingram
Advances in carbohydrate chemistry: Pigman.
The nucleic acids: Chargoff and Davidson
The carbohydrates, chemistry, biochemistry and physiology: Picman.