SYLLABUS for M. Sc. BIOTECHNOLOGY
Semester Pattern
Kakatiya University, Warangal

Effective from 2014-2015

The syllabus is divided into four semesters. The first three semesters carry four theory papers and two practical papers and a seminar. In the IVth semester only two theory papers and a practical paper is included. An internal project work is required to be completed in the fourth semester. Apart from the project, the student will also have to present a seminar in the fourth semester. Each theory paper is divided into four units and all the units carry equal weightage. All theory and practical papers are compulsory. Each theory and practical papers carries 100 marks. 100 marks are allotted to the project work to be presented at the end of the fourth semester and the projects are compulsory. 25 marks are allotted to the Seminar.

1) **Number of theory and practical periods**: The syllabus is based on 18 theory periods and 16 practical periods per week. Candidates are required to pass separately in theory and practical examination.

2) **Seminars**: In all the semesters every student has to give at least one seminar and submit a written summary of the same.

3) **Project work**: The student will undergo training in any Biotechnology Industry/Institute for 45 days after completion of II semester. An internal group project work is also required to be completed in the fourth semester. The reports will be submitted at the end of the IVth semester. The project reports will be evaluated by the External and Internal (Chairperson, BOS, Biotechnology) examiners at end of the fourth semester, 100 marks are allotted to the project work. The project is compulsory.

4) **Study tour**: Students of M. Sc. Biotechnology are encouraged to visit some research institutes of national and international repute during the two-year course.

5) **Distribution of theory/practical/seminar/project marks**:

<table>
<thead>
<tr>
<th>M. Sc. Biotechnology</th>
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<tbody>
<tr>
<td><strong>Semester I</strong></td>
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<tr>
<td>SUBJECTS</td>
<td>PAPER</td>
<td>Internal Marks</td>
<td>Examination</td>
<td>CREDITS</td>
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<td></td>
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<td></td>
<td>Max Marks</td>
<td>Pass Marks</td>
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<tr>
<td>BT-101: Biomolecules</td>
<td>I</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-102: Microbiology and Biodiversity</td>
<td>II</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-103: Cell Biology and Genetics</td>
<td>III</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-104: Biophysical and Biochemical Techniques</td>
<td>IV</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BTP-101: Biomolecules, Microbiology and Biodiversity</td>
<td>I</td>
<td>--</td>
<td>100</td>
<td>40</td>
<td>04</td>
</tr>
<tr>
<td>BTP-102: Cell Biology, Genetics, Biophysical and Biochemical Techniques</td>
<td>II</td>
<td>--</td>
<td>100</td>
<td>40</td>
<td>04</td>
</tr>
<tr>
<td>SEMINAR/TUTORIALS</td>
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<td>25</td>
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<td>01</td>
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<tr>
<td>SUBJECTS</td>
<td>PAPER</td>
<td>Internal Marks</td>
<td>Examination</td>
<td>CREDITS</td>
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<tr>
<td>BT-201: Biochemistry and Enzymology</td>
<td>V</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-202: Immunology and Immunotechnology</td>
<td>VI</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-203: Molecular Biology</td>
<td>VII</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BT-204: Bioinformatics and Biostatistics</td>
<td>VIII</td>
<td>20</td>
<td>80</td>
<td>32</td>
<td>04</td>
</tr>
<tr>
<td>BTP-201: Biochemistry, Enzymology and Immunotechnology</td>
<td>III</td>
<td>--</td>
<td>100</td>
<td>40</td>
<td>04</td>
</tr>
<tr>
<td>BTP-202: Molecular Biology, Bioinformatics and Biostatistics</td>
<td>IV</td>
<td>--</td>
<td>100</td>
<td>40</td>
<td>04</td>
</tr>
<tr>
<td>SEMINAR/TUTORIALS</td>
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<td>25</td>
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</tbody>
</table>
A) Pattern of Question Paper
1. There will be four units in each paper.
2. Question paper will consist of five questions.
3. First question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Maximum marks of each paper will be 80.
6. Each paper will be of 3 hours duration.
7. Projects shall be evaluated by both internal and external examiners.
8. Practical/laboratory examination of 100 marks.
9. Minimum passing marks in each head (theory & practical) will be 40%.

B) Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)
1. On clearing a paper, based on the cumulative score (out of 100) in that paper a student will be given GRADE POINT AVERAGE (maximum of 10, and minimum of 4) for that paper on the following basis. The description for each of the grades is as follows:

<table>
<thead>
<tr>
<th>SCORE (out of 100)</th>
<th>Grade</th>
<th>Grade Point Average (Out of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-85</td>
<td>O: Out Standing</td>
<td>10</td>
</tr>
<tr>
<td>84-70</td>
<td>A: Very good</td>
<td>9</td>
</tr>
<tr>
<td>69-60</td>
<td>B: Good</td>
<td>8</td>
</tr>
<tr>
<td>59-55</td>
<td>C: Average</td>
<td>7</td>
</tr>
<tr>
<td>54-50</td>
<td>D: Satisfactory</td>
<td>6</td>
</tr>
<tr>
<td>49-40</td>
<td>E: Pass</td>
<td>5</td>
</tr>
<tr>
<td>Below 40</td>
<td>F: Fail</td>
<td>4 or Fail</td>
</tr>
</tbody>
</table>

2. On clearing all the papers in a semester, a student will be allotted a Semester Grade Point Average (SGPA) for that particular semester. As the pattern given above does not have differential weights for papers, the SGPA of a student for a particular semester will be calculated as per the following computation.

\[
SGPA = \frac{C_1 \times G_1 + C_2 \times G_2 + \cdots + C_n \times G_n}{C_1 + C_2 + \cdots + C_n}
\]

Where \( C_1 = \text{Credit of individual Theory / Practical} \) \( G_1 = \text{Corresponding Grade Point obtained in the Respective Theory/ Practical} \)

3. A student will be allotted a Cumulative Grade Point Average (CGPA) after clearing all the four semesters. Again as there is no differential weight system for semesters, the CGPA of a student will be the average of the four SGPA’s of that student. The CGPA would be as follows:
<table>
<thead>
<tr>
<th>CGPA</th>
<th>Final Grade</th>
<th>Equivalent Class/Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.00-10.00</td>
<td>O</td>
<td>First Division with Distinction (Outstanding)</td>
</tr>
<tr>
<td>8.00-8.99</td>
<td>A</td>
<td>First Division with Distinction (Excellent)</td>
</tr>
<tr>
<td>7.00-7.99</td>
<td>B</td>
<td>First Division with distinction</td>
</tr>
<tr>
<td>6.00-6.99</td>
<td>C</td>
<td>First Division</td>
</tr>
<tr>
<td>5.00-5.99</td>
<td>D</td>
<td>Second Division</td>
</tr>
<tr>
<td>4.00-4.99</td>
<td>E</td>
<td>Pass Division</td>
</tr>
<tr>
<td>Below 4.00</td>
<td>F</td>
<td>Fail</td>
</tr>
</tbody>
</table>

4. The computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) of an examinee shall be given below:

   a. The marks will be given in all examinations which will include the internal assessment marks, and the total marks for each Theory/ Practical shall be converted into Grades as per above table. SGPA shall be calculated based on Grade Points corresponding to Grade as given in above table and the credits allotted to respective Theory / Practical shown in the scheme for respective semester.

   b. SGPA shall be computed for every semester and CGPA shall be computed only after IV semester. The CGPA will be calculated based on SGPA of all four semesters as per following computation:

\[
CGPA = \frac{(SGPA) I \times (Cr) I + (SGPA) II \times (Cr) II + (SGPA) III \times (Cr) III + (SGPA) IV \times (Cr) IV}{(Cr) I + (Cr) II + (Cr) III + (Cr) IV}
\]

Where,

\( (SGPA) I = \) SGPA of I Semester; \( (Cr) I = \) Total Credits for I Semester;
\( (SGPA) II = \) SGPA of II Semester; \( (Cr) II = \) Total Credits for II Semester;
\( (SGPA) III = \) SGPA of III Semester; \( (Cr) III = \) Total Credits for III Semester;
\( (SGPA) IV = \) SGPA of IV Semester; \( (Cr) IV = \) Total Credits for IV Semester
Kakatiya University, Warangal
M. Sc. BIOTECHNOLOGY
(SEMESTER SYSTEM)
(Effective from 2014 -2015)

SYLLABUS

SEMESTER - I

BT-101: BIOCHEMISTRY

Unit I

1. Buffers and measurement of pH.
3. Carbohydrates - Classification and properties of carbohydrates, mono (glucose, galactose, fructose), di (lactose, maltose, sucrose) and poly (starch, glycogen, cellulose) saccarides. Chemical and enzymatic methods for structural elucidation of starch and mucopolysaccharides.

Unit II

1. Naturally occurring peptides (glutathione, bradykinin, kallikrien, tyrocidin). Peptide synthesis by solid-phase technique.
2. Proteins - Classification, Isolation and purification of proteins, criteria of homogeneity.
3. Primary structure of proteins and its sequence determination.

Unit III

1. Secondary (Ramachandran plot), tertiary and quaternary structural features of proteins, Protein folding (Alfensen’s experiment on ribonuclease).
3. Denaturation and renaturation of proteins
4. Structure and functions of glycoproteins and lipoproteins.

Unit IV

1. Nucleic Acids - Structure of purines, pyrimidine, nucleosides, and nucleotides.
2. Structure, Properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA. Three dimensional structure of RNA.
3. Isolation of nucleic acids, Denaturation and renaturation of nucleic acids,
4. Chemical synthesis of DNA. DNA constancy & C-Value paradox
BT-102: MICROBIOLOGY AND BIODIVERSITY

Unit-I

1. Systematic position of microorganisms in living world, classification of microorganisms: Hackle’s three kingdom concept, Whittaker’s five kingdom concept, three domain concept of Carl Woese
2. Historical account of bacterial classification, detail account of bacterial classification according to the 1st edition of Bergey’s manual of systematic bacteriology (up to sections). Detail account of bacterial classification according to the 2nd edition of Bergey’s manual of systematic bacteriology (up to orders)
3. General characters, thallus organization, cell structure, reproduction and classification of fungi, nutrition, reproduction and parasexuality, structure, reproduction and molecular and biotechnological aspects of yeasts.
4. History, general properties and structure of viruses: Viruses related agents (viroids & prions), nomenclature and classification of viruses, auto virus infection, and persistent viruses. General features of virus reproduction, replication of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) viruses, bacteriophages, transmission of viruses, and management of viruses.

Unit-II

2. Microbial Diversity: Bacteria, Archea and their broad classification eukaryotic microbes, Yeast, Fungi, moulds and Protozoa; Viruses and their diversity.

Unit-III

1. Biodiversity: Definition, levels, organization, uses, and valuing biodiversity
Unit-IV


3. IUCN categories. Rare and endangered categories and extinct animals of India. Trends of extinction rates. Wildlife Act of India and CITES.

4. Biodiversity Conservation: Principles and rationale. *Ex situ* and *In situ* conservation strategies (incl. sperm/seed banks, cryopreservation, embryo collection and freezing creation of parks, wildlife sanctuaries, botanical gardens, etc.)

BT-103: CELL BIOLOGY AND GENETICS

Unit I

1. Nucleus - Ultra structure of nucleus and nuclear envelope.


3. Cell cycle - Overview of eukaryotic cell cycle, regulation of cell cycle by cell growth and extra cellular signals, Cell cycle check points, Regulators of cell cycle progression - MPF, cyclins and cyclin-dependent kinases.


Unit II

1. Cell Communication - General principles, Cell surface receptors (ion channel linked, G-protein linked and enzyme-linked receptors) and intracellular receptors,


Unit III

1. Introduction to genetics: Mendel’s principles, Gene interaction & Modified ratios,
2. Multiple alleles, multiple factor inheritance, Extra chromosomal inheritance
3. Linkage and crossing over and genetic mapping: sex-linked inheritance, cytological evidence of crossing over in maize, crossing over frequency and map distances, recombination models: maize, yeast and Neurospora.
4. Population genetics: Hardy -Weinberg’s law, factors influencing the equilibrium

Unit IV

2. Phage Genetics: Gene fine structure, concepts of cistron, muton & recon, r II locus
3. Molecular mechanisms of mutations, Ames test for mutagenesis, DNA damage and repair,
4. Mutations: Chromosome variations in number and structure, Role of mutations in crop improvement

BT-104: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

Unit I

2. cytophotometry and flow cytometry, fixation and staining.
4. Applications in determination of molecular weight, purity and detection of conformational changes in macromolecules.

Unit II

1. Separation methods - General principles and definitions, Paper chromatography, adsorption chromatography (thin-layer chromatography), gas-liquid chromatography,
2. Methods based on size: Principle of Gel filtration, methodology and applications. Dialysis, ultra filtration
Unit III

1. Electrophoresis: General principles and definitions. PAGE-Native-PAGE, SDS-PAGE,
2. Iso-electric focussing, 2D electrophoresis, identification of novel proteins in 2D gels, capillary electrophoresis.
3. Agarose gel electrophoresis: Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications, recovery of DNA from agarose gels.
4. Pulse-field gel electrophoresis: principle, methodology and applications in separation of large DNA fragments.

Unit IV

2. Raman spectroscopy, flame photometer, atomic absorption, plasma emission, mass ESR and NMR spectrometry, MALDI-TOF, ESI MS.
4. Preparation of label compounds: Pulse chase studies and tracer techniques, isotopes used in biology, safety methods in handling radioisotopes.
BT-201: ENZYMEOLOGY AND PLANT BIOCHEMISTRY

Unit I

1. Enzymes: Definitions and nomenclature (EC recommended).
2. Mechanisms of enzyme action, active site and its location, binding site, chymotrypsin, ribonuclease, carboxyl peptidase as models.
3. Enzymes kinetics, derivation of Michaelis-Menten constant, determination of V-max and Km, enzyme inhibition: competitive and non-competitive inhibition.
4. Regulation of enzyme activity: allosteric enzymes, models explaining allosteric behaviour-KMF, MWC models, feed back inhibition in metabolism.

Unit II

1. Concept of free energy: Energy metabolism, Thermodynamic principles in biology, Energy rich bonds, weak interactions,
2. Coupled reactions and oxidative phosphorylations, group transfer, biological energy transducers, bioenergetics. Glycolysis and TCA cycle, HMP shunt, Gluconeogenesis, Energy derivations in fermentation, aerobic and anaerobic respirations.
3. Glyoxylate cycle, Components and organization of mitochondrial electron transport system

Unit III

1. Chloroplast as an energy transducing organelle.
4. Photorespiration. Fatty acid oxidation (β-oxidation). Biosynthesis of fatty acids, triglycerides and cholesterol, ketone bodies synthesis.

Unit IV

2. Organization, regulation and expression of Nif genes,
   1. Nod genes, principles of food preservation
3. role in nodulation,
4. Photoreceptor phytochrome- Phytochrome regulated gene expression
BT-202: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Unit I

1. Phylogeny of immune system. Types of immunity - innate and acquired.
2. Cells of the immune system - B-cells, T-cells, phagocytes, inflammatory cells, antigen presenting cells.

Unit II

1. T-cell receptor - structure and diversity.
2. MHC - Types, structure, distribution, self-restriction, T-and B-cell activation. Maturation of lymphocytes - positive and negative selection, process of maturation.
3. Antigen processing and presentation - cytosolic and endosomal pathways, T and NK cell - mediated lysis of cells, ADCC.

Unit III

1. Hypersensitivity - classification, mediators, mechanism, consequences of hypersensitive reaction.
2. Autoimmunity - concept of tolerance of autoimmune disorders, basis and therapy for autoimmune disorders.
3. Transplantation - transplantation antigens, mechanism of graft rejection, graft versus host reaction, immunosuppressors. Tumor immunity - tumors of immune system, immune responses against tumors.
4. Immunodeficiency - primary and secondary immunodeficiency, combined immunodeficiency, complement deficiency, AIDS.

Unit IV

1. Antigen- antibody interactions - principle, lattice hypothesis. Precipitation reaction - radial immunodiffusion, Ouchyterlony technique, immunoelectrophoresis, counter current and rocket electrophoresis.
3. Hybridoma technology - polyclonals, monoclonals, selection, HAT medium, production of monoclonal antibodies and applications.
4. Vaccines - concept of immunization, routes of vaccination. Types of vaccines - whole organism (attenuated and inactivated) and component vaccines (synthetic peptides, DNA vaccines, recombinant vaccines, subunit vaccines, idiotypic based vaccines, deletion vaccines, glycoconjugate vaccines), Vaccine delivery systems.
Unit I

1. DNA Replication and repair: Modes of replication. Experimental evidences for semi-conservative mode of replication - Meselson-Stahl, and Cairns experiments.
2. Replication fork, continuous and discontinuous DNA synthesis.

Unit II

3. RNA splicing and splicing mechanisms. Splicing of nuclear pre-tRNA, group I and group II introns, and pre-mRNA splicing. Excision of multiple introns. Role of catalytic RNA. Inhibitors of transcription.
4. Posttranscriptional modifications of eukaryotic hnRNA - capping, methylation and polyadenylation,

Unit III


Unit IV

3. Transcriptional control by attenuation in trp-operon. Regulation of gene expression in eukaryotes.
UNIT-I
1. Introduction to Computers: Overview of computer organization and historical perspective, computer applications in various fields of science and management.
   Data representation: Number systems, character representation codes.
2. Binary, hex, octal codes and their interconversions. Binary, arithmetic, floating point arithmetic, signed and unsigned numbers. Data storage: Primary and Secondary storage.
3. Introduction to various computer devices such as keyboard, mouse, printers, disk files, floppies etc. Concept of computing, Operating Systems such as Windows NT, UNIX etc. (only brief user-level description).
4. Introduction to organization and architecture of mainframe, mini and micro systems. Introduction to E-mail, ftp, login and other network services, world wide web, MS-Office.

UNIT-II
1. Biological databases: Basic concepts of databases, bioinformatics and importance of databases, integration of databases and its need.
2. DNA databases, protein-sequencing databases, functional motifs databases, protein-structure databases.
4. Comparative-sequence analysis: Pair-wise sequence alignment, multiple-sequence alignments, methods like BLAST, FASTA. Tools like CLUSTAL. Dynamic programming, similarity algorithms, affina gap penalty.

UNIT-III
2. Genomic studies, 3D structure, and domain structure - DNA binding domains. Molecular modeling.
4. Microarray technology, human genome project and applications.

Unit IV
1. Introduction to biostatistics: Variables, random variables, discrete and continuous variables, population and sample estimate, mean, median, mode, frequency distribution, frequency curve, frequency polygon and histogram.
2. Measures of dispersion: Range, variance, coefficient of variance, standard deviation (SD) and standard error (SE).
4. Test of hypotheses: Students t-test, $X^2$ distribution (Chi-square), correlation coefficient and analysis of variance (ANOVA).