Solapur University, Solapur

Faculty of Science

B.Sc. Part-II Biotechnology Syllabus

(ENTIRE)

Choice Based Credit System (CBCS)

(w.e.f. June, 2017-18)

Solapur University, Solapur

Faculty of Science

Choice Based Credit System (CBCS)

(w.e.f. June 2017-18)

Choice Based Credit System: With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate degree, Solapur University has implemented Choice Based Credit System CBCS) at Undergraduate level.

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates.

Outline of Choice Based Credit System:

1. **Core Course*:*** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; Environmental Science. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, Competencies, skills, etc.

Credit: Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. In most of the

Universities 15 contact hours constitute one credit. The contact hours are transformed into credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 30 marks and University Evaluation for 70 marks. It is 70+30 pattern of evaluation. It is applicable for theory and practical as well. The details regarding this evaluation system are as under.

SOLAPUR UNIVERSITY, SOLAPUR

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• Title of the Course: B.Sc. Part-II

• Subject: Biotechnology

• Introduction:

This course provides a broad overview of biotechnology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using biotechnology. The course structure is technology-centric where students basically learn technology and are taught necessary basic subjects for that purpose.

Objectives of the course: The objectives of B. Sc. Biotechnology (Entire) course are

- To provide an intensive and in-depth learning to the students in field of Biotechnology.
- Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing business world.
- To develop awareness & knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.
- To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

- **Advantages of the Course:** Biotechnology has tremendous job potential. The successful students will be able to establish trading, industrial and consultancy organizations in pharmaceuticals, paper, fermentation, food processing & preservation, agriculture,

environment protection and also their own industry for micropropagation of commercially important plants in vitro, transgenic plants, vaccine production, clinical pathology, genetic counseling, human karyotyping etc.

- Multinational companies dealing with production of tissue cultured and genetically modified plants, food products, leather, dairy, beverages, pharmaceutical, chemical Industries, agribusiness, Environment protection.
- Medical & Scientific Research Organizations.
- Universities in India & aboard.

• **Eligibility and Admission:** A Candidate passing 10+2 with biology as one of the subject and passed from state syllabus / CBSE / equivalent with minimum passing percentage of 45% aggregate for open category and 5 % relaxation in the aggregate for all reserved categories candidates as per the government rules and regulations. Admission is based on first come first serve basis.

• **Duration:** The duration for this program is of 3 years with semester pattern (06 Semesters)

• **Medium of Instruction:** English

• **Syllabus Structure:**

• The University follows semester system.

• An academic year shall consist of two semesters.

• Each B.Sc. course shall consist of three years i.e. six semesters.

• B.Sc. Part-II Biotechnology shall consist of two semesters: Semester III and Semester IV.

In semester III, there will be three core subjects. Each subject is having two paper of 100 marks. Similarly in Semester IV there will be three core subjects. Each subject is having two papers of 100 marks. There shall be six papers of 100 marks for each. There shall be six papers in subject and Environmental Studies paper compulsory for every student in semester IV.

The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B.Sc. Part-II Biotechnology Sem III & IV the internal assessment will be based on

Internal tests, Home assignment, Viva, Seminar, Group discussion etc. as given below. Practical course examination of 200 marks for each course shall be conducted at the end of IV th semester. The practical examination of 200 marks shall also consist of 140 marks for University practical Assessment and 60 marks for College internal Assessment for each practical course.

For University practical examination out of two examiners, one examiner will be internal and another examiner will be External. Both examiners will be appointed by the University. The internal practical assessment shall be done as per scheme given below.

• **Scheme of Evaluation**

As per the norms of the grading system of evaluation, out of 200 marks, the candidate has to appear for college internal assessment of 60 marks and external evaluation (University assessment) of 140 marks. The respective B.O.S. may decide the nature of College internal assessment after referring to scheme given below or may be used as it is.

Semester – III

Theory: (100 marks)

University Examination (70 marks): No. of theory papers: 6

Internal Continuous Assessment: (30 marks)

Scheme of marking: 15 marks – Internal test

15 marks – Home assignment / seminars / viva/ industry visit/group discussion.

Semester – IV

Theory: (100 marks)

University Examination (70 marks): No. of theory papers: 6

Internal Continuous Assessment: (30 marks)

Scheme of marking: 15 marks – Internal test

15 marks – Home assignment / seminars / viva/ industry visit/group discussion.

Practical Examination: (200 marks) for each practical course

University Examination (140 marks): No. of practical course: 3

Internal Continuous Assessment: (60 marks) for each practical course

Scheme of marking: 40 marks – Internal test on any two practicals

20 marks – Lab Journal / Viva, attendance, attitude etc.

For Environmental Studies there shall be theory examination of 70 marks (UA) and 30 marks (CA) internal assessment. Internal assessment for Environmental Studies shall be based on internal test/Tutorial/home assignment of 10 marks and project work report of 20 marks.

• **Passing Standard**

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in Internal assessment and passed in University examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same 70 marks of external examination and his performance shall be scaled to 100 marks.

• **ATKT**

Candidate passed in all papers except 6 (six) papers combined together of semester III and IV of B.Sc. Part-II Biotechnology examination and clearly passed in B.Sc. Part-I Biotechnology shall be permitted to enter upon the course of Semester IV of B.Sc. Part-III Biotechnology

Solapur University, Solapur
Faculty of Science: Choice Based Credit System (CBCS) (w.e.f.2017-18)

Structure for B. Sc-II Biotechnology

Subject/ Core Course	Name and Type of the Paper Type	Name	No. of papers/ Practical	Hrs/week L	T	P	Total Marks per paper	UA	CA	Credits
Class :SY	**B.Sc.- II**			**Semester - III**						
	Core	BT201	Paper I:Inheritance Biology	3	--	--	100	70	30	3
			Paper II: Basics of Molecular Biology	3	--	--	100	70	30	3
	Core	BT202	Paper I :Biophysical Instruments	3	--	--	100	70	30	3
			Paper II :Animal Tissue Culture	3	--	--	100	70	30	3
	Core	BT203	Paper I: Bioenergetics and Enzymology	3	--	--	100	70	30	3
			Paper II :Fundamentals of Immunology	3	--	--	100	70	30	3
Grand Total				**18**	--	--	**600**	**420**	**180**	**18**
Class :SY	**B.Sc.- II**			**Semester - IV**						
	(AECC)	Environmental Science		4			100	70	30	4
	Core	BT204	Paper I:Cytogenetics and Population Genetics	3	--	--	100	70	30	3
			Paper II: Mechanisms in Molecular Biology	3	--	--	100	70	30	3
	Core	BT205	Paper I: Analytical Techniques	3	--	--	100	70	30	3
			Paper II: Plant Tissue Culture	3	--	--	100	70	30	3
	Core	BT206	Paper I:Metabolism	3	--	--	100	70	30	3
			Paper II: Mechanisms in Immunology	3	--	--	100	70	30	3
Total Theory				**22**	--	--	**700**	**490**	**210**	**22**
	Core	Lab. Course V	Based on BT 201 and BT 204	--	--	8	200	140	60	8
	Core	Lab. Course VI	Based on BT 202 and BT 205	--	--	8	200	140	60	8
	Core	Lab. Course VII	Based on BT 203 and BT 206	--	--	8	200	140	60	8
Total (Practicals)						**24**	**600**	**420**	**180**	**24**
Grand Total				**22**		**24**	**1300**	**910**	**390**	**46**

AECC-Ability Enhancement Course

Semester -IV

Summary

Class	**Semester**	**Total Marks**	**Total Credits**
B.Sc. II	III (Theory)	**600**	**18**
	IV (Theory)	**700**	**22**
	Practical	**600**	**12**
Grand Total		**1900**	**52**

Abbreviations:

L: lectures, **T**: tutorials, **P:** practicals; UA: University Assessment by End Semester Examination; **CA**: College Assessment by Internal Continuous Examination.

UA (University Assessment): University Theory paper shall be of 70 marks for 3:00 hrs duration CA (College Assessment): The internal examination for theory and practical course.

B. Sc. II Biotechnology

Semester- III (Theory Syllabus)

BT201

Paper I : Inheritance Biology

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Mendelism** Introduction, Mendel's experiment, Monohybrid and Dihybrid crosses, Genotypic and phenotypic ratio, Law of Dominance, Law of segregation and Law of independent Assortment, Back cross and test cross. Modifications of Mendelian ratios: Co-dominance, Incomplete dominance, Interaction of complementary genes, supplementary gene, inhibitory gene, epistasis.	10L
II	**Genetic Linkage and Chromosome Mapping** Linkage – Definition, types of linkage, significance of linkage. Crossing-over– theories, types and mechanism. Gene Mapping – physical map and genetic map (by three-point test crosses), Mapping by tetrad analysis – the analysis of unordered and ordered Tetrads.	10L
III	**Extra chromosomal inheritance and alleles** Genetic system in mitochondria, chloroplast, and plasmid. Definition of Alleles. Multiple alleles – ABO blood groups in human, fur colour in rabbit, self incompatibility in plants, and eye colour in *Drosophila*. Pseudo alleles, Complementation test.	10L
IV	**Sex linked Inheritance** Structure of Sex Chromosomes. Complete and incomplete sex linked genes. Inheritance of XY linked genes, Y linked genes, X linked genes. Sex determination with examples.	07L
V	**The Genetics of Bacteria** The Genetic Organization of Bacteria (folded fiber model), Bacterial Recombination – transformation, conjugation and transduction. F Plasmids	08L

References

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlet Publishers.
2. Experiments in Plant Hybridization – G. Mendel; Prentice Hall, New Jersey.
3. Genetics – B. D. Singh; Kalyani Publication
4. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
5. Molecular Biology – P. K. Gupta
6. Genetics – M. W. Strickberger; Macmillan Publication
7. Heterochromatin Science – S. W. Brown
8. The Theory of Gene – T. H. Morgan; Yale University press; New Haven, Conn.
9. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
10. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London

BT201

Paper II: Basics of Molecular Biology
(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Central Dogma** The Central Dogma, Mischer to Watson and Crick historic perspective; DNA structure; Salient features of double helix, Types of DNA	08 L
II	**Structure of Genetic Elements** DNA as genetic material, Molecular nature of Gene, Genetic code – evidences and properties. Denaturation and renaturation of DNA; cot curves; DNA topology-linking number, topoisomerases; Organization of DNA in Prokaryotes, Viruses, Eukaryotes; RNA Structure; Organelle DNA – mitochondria and chloroplast DNA.	11 L
III	**Replication of DNA in Prokaryotes** General principles - bidirectional replication, Semiconservative, Semi discontinuous; RNA priming;Enzyme involved in DNA replication of prokaryotes – DNA polymerases, DNA ligase, Primase, and other accessory proteins; Initiation, elongation and termination of replication, Various models of DNA replication including rolling circle, Θ (theta) mode of replication, replication of linear ds-DNA.	10 L
IV	**Replication of DNA in Eukaryotes** D-loop (mitochondrial) replication model; DNA polymerases of eukaryotes; Initiation, elongation and termination of replication.	08 L
V	**Mutability and Repair of DNA** DNA damage; DNA Repair- Photoreactivation, Mismatch, Excision, Recombination, SOS repair mechanisms and disorders.	08 L

References

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication

BT202

Paper I : Biophysical Instruments

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Spectroscopy** Electromagnetic wave, Electromagnetic spectrum. Introduction to molecular energy levels – excitation, absorption, emission. Instrumentation & applications of – Colorimetry, UV–Visible Spectroscopy, turbidometry, IR spectroscopy, Atomic absorption spectroscopy	10L
II	**pH Meter and Centrifugation** **pH meter:** - Measurements of pH – pH indicators, pH paper, pH meter glass electrode, operation and calibration of pH electrode, errors in pH measurements. **Centrifugation:-** Introduction, Sedimentation and Relative Centrifugal Force. Rotor Types**:** Swinging-Bucket Rotors, Fixed-Angle Rotors, Vertical Rotors. Types of Centrifugation – differential, rate-zonal, isopycnic, ultracentrifugation.	10L
III	**Microscopy:** Introduction, optical principles of microscopy. Image formation in light and electron microscopy. Types of Microscopes – Dark field, Fluorescence, Compound, Inverted, Transmission Electron Microscope and Scanning Electron Microscope	09L
IV	**Radioactivity:** Introduction, Nature of Radioactivity – atomic structure, atomic stability, types of radioactive decay, radioactive decay energy, rate of radioactive decay, units of radioactivity, Interaction of radioactivity with matter. Radioactivity detection techniques – Ionization chamber,Proportional counters, Geiger Muller counter, Scintillation counter. Hazards biological effect of radiation, Safety measures. Biological Applications of Radioisotope.	10L
V	**Molecular Characterization:** Introduction, Principle, working and application of the following Instruments: Circular Dichroism and Optical Rotatory Dispersion, X-ray Diffraction, Flow Cytometry, NMR	06L

References

1. Instrumental Methods of Chemical Analysis – G. R. Chatwal, S.K.Anand
2. Handbook on Analytical Instruments –R. S. Khandpur. (Mc Graw Hill).
3. Biophysical Chemistry - Upadhyay, Nath, Upadhyay (Himalaya Publishing House).
4. Practical Biochemistry –Wilson & Walker.
5. Biophysics– Dr. Mohan P. Arora

BT202

Paper II : Animal Tissue Culture

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Introduction:** History. Laboratory design, Characteristics of animal cell in culture, substrate for cell growth, Equipments required for animal cell culture – Laminar air flow, CO2 incubator, Centrifuge, Inverted microscope etc. Sterilization of apparatus.	09L
II	**Media** Culture media: – Natural media, synthetic media – serum containing media, serum free media, balanced salt solution, and complete media. Physicochemical properties of media, Sterilization of media.	09L
III	**Culture techniques:** Primary cell culture: Cell Separation – Mechanical, Enzymatic. Criteria for subculture, Types of organs culture, **Cell synchronization-** Cell separation by physical means and chemical blockade	09L
IV	**Establishment of cell lines-** Cell lines selection and routine maintenance of cell lines, Cell counting and monitoring, Indirect methods of cell determination – Protein, DNA, LDH, and Glucose determination. Cell line Identification: Tests of identification – Karyotyping, Isozymes, Labeled antibodies and DNA fingerprinting. Analysis of the cell cycle – Tritiated thymidine pulse method, Flow cytometry	09L
V	**Genetic engineering & Applications of animal cell culture-** **Genetic engineering of animal cells in culture:** Gene transfer into mammalian cells – Transfer of naked DNA, DNA transfer using viruses.. **Applications:** Monoclonal antibodies. Viral vaccines – production of viruses & cell lines for vaccine production, Glycoprotein from mammalian cells – Interferons, Plasminogen activators, Blood clotting factors and Erythropoietin. Cells as a product – Artificial skin, Organs,	09L

References

1. Animal Tissue culture : J. Paul
2. Culture of animal cell 3rd edition-R Ian Freshney
3. Animal cell culture- R.W.Masters
4. Animal biotechnology-M.M.Ranga
5. Animal biotechnology-R.Sasidhara
6. Animal cell culture technique-Ed. Martin Clynes Springer
7. Cell growth & division a practical approach-Ed. R. B. Sega& R.L.Press

BT203

Paper I: Bioenergetics and Enzymology

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Principles of Thermodynamics :** Thermodynamic systems; First and second law of thermodynamics; Free energy concept; Biological standard state; Standard free energy change; Mass action ratio of reaction; Determination of free energy change of reaction; Relationship between equilibrium constant and standard free energy change	08L
II	**Biochemical Reactions :** Introduction to aldol condensation, claisen condensation, internal rearrangement, isomerization, elimination, free radical reactions; Group transfer reactions (phosphate group transfer), free energy of hydrolysis of ATP,ATP as universal currency of free energy in biological system; Biological Oxidation reduction reactions, Biological half reactions, Redox potential and measurement	10L
III	**Fundamentals of Enzymology :** Introduction – definition, apoenzyme, coenzymes, holoenyme, prosthetic group, cofactors; Classification of enzymes with two examples of each class;IUB nomenclature and numbering of enzymes; concept of activation energy in enzyme catalyzed reaction; Unit of enzyme activity, specific activity and turnover number; Active site of enzyme and its features; Lock and key mechanism; Induced fit hypothesis; Types of enzyme specificity	09L
IV	**Enzyme Kinetics :** Factors affecting enzyme activity – pH, temperature, substrate concentration, product concentration, inhibitors and activator; Derivation of Michaelis-Menten equation for single substrate; Significance of Km and Vmax; Lineweaver Burk plot and limitations; Enzyme inhibition with kinetics-irreversible, competitive, uncompetitive and non competitive inhibition.	10L
V	**Advances in Enzymology :** Isoenzymes of LDH and their clinical importance; Allosteric enzymes – allosteric modulator; Regulation of enzyme in living system (allosteric regulation, activation of latent enzymes, control of enzyme synthesis, enzyme degradation, isoenzymes); Abzymes; Non protein enzymes – ribozymes; Biological role of enzymes	08L

References

1. Lehninger's Principles of Biochemistry –Nelson & Cox, 5th Edition, W.H. Freeman and Company, New York.
2. Fundamentals of Biochemistry – J. L. Jain, S. Chand & Company Ltd, New Delhi.
3. Fundamentals of Biochemistry – Voet & Voet, 3rd Edition, W.H. Freeman and Company, New York.
4. Biochemistry – U. Satyanarayan, 3rd Edition, Books and allied (P) Ltd.

BT203
Paper II: Fundamentals of Immunology
(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Hematopoisis**: Introduction, factors involved in hematopoisis, programmed cell death and Homeostasis. **Cells of immune system**: B lymphocytes, T lymphocytes, Natural Killer Cells, Mononuclear phagocytes, Dendritic cells, Follicular dendritic cells. **Organs of immune system**: Structure and functions of primary lymphoid organs (Thymus, Bone marrow, and Lymphatic system), secondary lymphoid organs (Lymph nodes, Spleen), and Mucosa Associated Lymphoid Tissue, Cutaneous Associated Lymphoid Tissue	10L
II	**Native or Innate immunity**: Introduction, First line of Defense – Physical and Chemical barriers at the portal of entry. Second line of Defense – Cellular Processes in nonspecific defense mechanism	08L
III	**Antigen**: Introduction, immunogenicity, antigenicity, types of antigens, Haptens, properties of immunogen, role of biological system in immunogenicity (genotype of animal, immunogen dosage, route of Administration), adjuvant, epitope. **Major Histocompatibility Complex**: Introduction, classes – structure and function. **Cytokines**: Introduction, properties, function, Cytokine receptors.	10L
V	**Antibody**: Introduction, History of Antibody invention, basic structure and biological function of antibody classes, antigenic determinants.	07L
I	**Antigen antibody interactions**: Principles and applications of interaction, strength of interactions, cross-reactivity, features of interactions, measurement of antigen-antibody. Reactions of antigen-antibody complex – precipitation, flocculation, agglutination, complement fixation. Immunodiffussion, Immunoelectrophoresis, Electroimmunodiffussion, Complement Fixation Test, Immunofluorescence Test, Radioimmunoassay, ELISA.	10L

References

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.
6. Basic and Clinical Immunology- Fundenberg H.
7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard

B. Sc. II Biotechnology Syllabus

Semester IV

BT204

Paper I : Cyto-Genetics and Population Genetics

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Chromosome** Structure, Morphology, Organization, Heterochromatin and euchromatin, Lampbrush chromosome, polytene chromosome, Sex chromosomes, Role of chromosome in heredity. Mitosis, Meiosis. Karyotyping	08L
II	**Mutation** Spontaneous and induced mutation. Chemical, physical and biological mutagenic agents. Effect of mutation and detection of mutants. Chromosomal abrasion – deletion, duplication, inversion, translocation. Numerical alteration in chromosome – polyploidy, aneuploidy, euploidy	10L
III	**Transposable elements** Terminology, insertion sequences, types of bacterial transposons. Transposition – structure of transposons and target sites, replicative and nonreplicative transposition. Eukaryotic trasnsposable elements – DNA transposases, retroposes (LINES, SINES), Satellite DNA (mini & micro).	08L
IV	**Population Genetics** Introduction, Hardy-Weinberg law, gene frequency, factors affecting gene frequency- migration, selection, genetic drift, inbreeding and Mutations. Significance of population genetics. Genetic basis of evolution, evolutions in some crop plants and animals	10L
V	**Quantitative Genetics** Introduction, Multiple factor hypothesis, Transgressive segregation, Handling of quantitative data: mean, range, Variance, Standard deviation, Coefficient of Variation. Effects of the environment on quantitative traits.	09L

References

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlet Publishers.
2. Genetics – B. D. Singh; Kalyani Publication
3. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
4. Molecular Biology – P. K. Gupta
5. Genetics – M. W. Strickberger; Macmillan Publication
6. Heterochromatin Science – S. W. Brown
7. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
8. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London
9. Gene VII; Benjamin Lewin; W. H. Freeman & Company.
10. Molecular Basis of Mutation: J. W. Drakey; Holdan Day, San Francisco

BT204

Paper II: Mechanisms in Molecular Biology
(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Transcription** RNA polymerase and the transcription unit; Initiation, elongation and termination of transcription in Prokaryotes and Eukaryotes	08 L
II	**Transcription Regulation in Prokaryotes** Principles of transcriptional regulation; Operon concept; Repression and induction of genes; Regulation of operon : Lac operon and Trp operon.	08 L
III	**Transcription Regulation in Eukaryotes** Regulatory Sequences- Promotors and Enhancers, Eukaryotic Activaters, Repressors, Transcriptional Regulatory Protein, Regulation of Transcription by Non-Encoding RNA signal integration, Signal Transduction in Regulation [Ex. Auxin]	08 L
IV	**RNA Modification** Split genes, concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport	08 L
V	**Translation (Prokaryotes and Eukaryotes)** Ribosome structure and assembly; various steps in protein synthesis; Charging of tRNA, amino acyl tRNA synthetases; Proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Regulation of translation-Translation dependent regulation of mRNA and Protein Stability, Post translational modifications.	13 L

References

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication
5. Life-The Science of Biology; David Sadava; 9th Edition; W. H. Freeman & Company

BT205

Paper I : Analytical Techniques (45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Electrophoresis:** Basic principle of electrophoresis, support media, theory and application of moving boundary, starch gel, paper, agarose, native and denaturing PAGE, isoelectric focusing. Blotting techniques – Southern, Northern and Western blotting. Autoradiography.	10L
II	**Chromatography** : Introduction, Principle, instrumentation, working and applications of – paper,column, molecular exclusion, ion exchange, affinity chromatography, HPLC,GLC.	10L
III	**Protein Purification Techniques :** Cell disruption techniques – physical and chemical methods. Ammonium sulphate precipitation. Dialysis, Ultrafiltration.	05L
IV	**Biomolecules Estimation**: Principles, applications with limitation and advantages of estimation methods of – 1) Carbohydrates – DNSA, anthrone, resorcinol method. 2) Protein –BCA assay, Bradford assay, Lowery's assay. 3) Lipid – acid value, saponification value, ester value and iodine number. 4) Nucleic acids – DPA method, orcinol method and spectrophotometer method.	10L
V	**Tools in Proteomics**: Introduction, Sample Taking, 2D Gel Electrophoresis, Mass Spectroscopy of Peptides and Proteins, Mass Spectrometers, Sample Preparation for MALDI, The Possibilities of MALDI – TOF. Micro sequencing – Preparing the Protein, Edman Degradation, Carboxy terminal Sequencing.	10L

References

1. Protein purification –Robert Scoopes
2. Instrumental Methods of Chemical Analysis – Gurudeep R. Chatwal, Sham K. Anand (Himalaya Publishing House).
3. Handbook on Analytical Instruments –R. S. Khandpur. (Mc Graw Hill).
4. Biophysical Chemistry - Upadhyay, Nath, Upadhyay (Himalaya Publishing House).
5. Practical Biochemistry –Wilson & Walker.
6. Biophysics– Dr. Mohan P. Arora

BT205

Paper II: Plant Tissue Culture

(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Introduction and Infrastructu:** History and scope of plant tissue culture with timeline. Aseptic techniques in preparation, packing and sterilization of glassware, Maintainance of aseptic conditions and practices in plant tissue culture laboratory : laboratory fumigation, surface disinfection.General laboratory setup, Significance and importance of laboratory equipments, instruments, glassware and other requirements in plant tissue culture laboratory. Levels of safety	10L
II	**Culture Techniques** Concept of totipotency , Culture media, media composition with significance and preparation. Culture techniques – callus, suspension, organ culture, Endosperm culture, Nucellus culture.	10L
III	**Protoplast culture:** Protoplast isolation, gene transfer in protoplast, fusion, cell wall regeneration & culture. Production of hybrids & cybrid. **Somaclonal variation:** Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism	8L
IV	**Clonal Propagation** **Micropropagation**: Stages, Micropropagation through callus, Axillary Branching, Adventitious buds, Factor affecting, Limitations & Applications of micropropagation. Organogenesis, somatic embryogenesis, factors affecting somatic embryogenesis.Plant hardening, Artificial seed production.	10L
V	**Cryopreservation:** Defination, Selection of plant materials, Techniques of cryopreservations: Freezing treatment, Long term cold storage, Thawing, Viability test, Plant regeneration. Cryopreseravtive agents, Advantages of cryopreservation.	7L

References

1. Introduction to plant tissue culture- M.K. Razdan
2. 2.Plant tissue culture-Theory & practice-S. S. Bhojwani & M.K. Razdan
3. Plant tissue culture-Kalyankumar Dey
4. Biotechnology- B.D. Singh
5. A text book of Biotechnology- R.C. Dubey
6. Biotechnology- H.S. Chawla

BT206

Paper I : Metabolism
(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Carbohydrate metabolism** Glycolysis and its energetics, gluconegenesis, reciprocal regulation both cycles, lactic acid and ethanol fermentation; TCA cycle its regulation and energetic; Glycogenesis and glycogenolysis; Reactions and physiological significance of pentose phosphate pathway.	08L
II	**Oxidative phosphorylation** Ultra structure of mitochondria; Components of respiratory chain, membrane arrangement of respiratory chain and electron transfer; Q cycle; mechanism of oxidative phosphorylation (Chemiosmotic coupling hypothesis); ATP synthase complex and ATP generation; Inhibitors of electron transport chain and ATP synthase complex; Uncouplers	10L
III	**Brief overview of Photosynthesis** Location; light harvesting in green plants; Photosystem I & II; Z scheme of non-cyclic photophosphorylation; Cyclic photophosphorylation; Dark reactions – C3 and C4 pathway; Rubisco enzyme	08L
IV	**Amino Acid and Nucleotide Metabolism** General reactions of amino acid metabolism – Transamination, deamination and decarboxylation; Urea cycle; Degradation and biosynthesis of amino acids, glycogenic and ketogenic amino acids; Nucleotide Metabolism –Sources of the atoms in the purine and pyrimidine molecules; Outline of biosynthesis and degradation of purine and pyrimidines (Structures not required).	10L
V	**Lipid Metabolism** Hydrolysis of triacylglycerols; Transport of fatty acid into mitochondria; β oxidation of saturated fatty acids, Oxidation of unsaturated and odd chain fatty acids; Biosynthesis of saturated and unsaturated fatty acids.	09L

References

1. Lehninger's Principles of Biochemistry –Nelson & Cox, 5th Edition, W.H. Freeman and Company, New York.
2. Fundamentals of Biochemistry – J. L. Jain, S. Chand & Company Ltd, New Delhi.
3. Fundamentals of Biochemistry – Voet & Voet, 3rd Edition, W.H. Freeman and Company, New York.
4. Harper's Illustrated Biochemistry – R. K. Murray, 26th Edition, Lange Medical Books/McGraw-Hill, Medical Publishing Division, New Delhi.
5. Biochemistry – Lubert Stryer, 5th Edition, W.H. Freeman and Company, New York.
6. Biochemistry – U. Satyanarayan, 3rd Edition, Books and allied (P) Ltd.

BT206

BT206 Paper II: Mechanisms in Immunology
(45 Lectures = 3 Credits)

Unit	Content	Lectures
I	**Humoral immunity**: Clonal selection Theory, Primary and secondary immune response, Processing of Exogenous Antigens – the Endocytic Pathway, antibody production against T cell dependent and independent antigens, Role of B cells, T cells, B cell receptors. B cell – maturation, activation, differentiation.	10
II	**Complement system**: Introduction, functions, components, general account on complement activation – classical and alternative pathways. **Monoclonal antibodies**: Hybridoma Technology for monoclonal antibody production and applications of monoclonal antibodies.	09
III	**Cell mediated immunity**: Processing of Endogenous Antigens by the Cytosolic Pathway, T cell receptors, types of cells, their role in immunity, T cell – maturation, activation, differentiation.	07
IV	**Hypersensitivity**: Introduction, classification, general mechanisms in Hypersensitivity Type I e.g. Systemic and localized anaphylaxis, Type II e.g. Blood transfusion reaction, Erythroblastosis fetalis and Drug induced anemia, Type III e.g. arthus reaction and serum sickness and Type IV e.g. Dermatitis, TB and Leprosy) **Autoimmunity**: Introduction, general mechanism, classification of autoimmune diseases Hemolytic, organ specific (Hashimoto's disease, Grave's disease, Pernicious anemia, neuro-paralytic accidents, Myasthenia Gravis) and non-organ specific (SLE and RA).	10
V	**Vaccines**: Introduction active and passive immunization, Types of vaccines – Live-attenuated, killed, subunit, conjugate, DNA, recombinant vector vaccines, Vaccination Schedule and traveler vaccines. **Immuno hematology**: ABO and Rh blood group system, applications of blood group, Hemolytic diseases of new born, detection of Rh antibodies, ABO hemolytic diseases.	09

References

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.
6. Basic and Clinical Immunology- Fundenberg H.
7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard

B. Sc. II Biotechnology Practical Syllabus

(Annual)

Practical course V: Techniques in Molecular Genetics
4 Credits
(Based on Based on BT 201 and BT 204)

Sr. No.	Practical Title
1.	Meiosis in Flower Buds of *Allium cepa*-Acetocarmine Stain
2.	Mitosis in Onion Root Tip (*Allium cepa*)
3.	Study of Mendelian Traits
4.	Problem sets in Mendelian inheritance, single point, two point crosses and gene interaction & gene mapping
5.	Induction of Polyploidy
6.	Identification of mutant phenotypes- Body shape / nature of wings / eye colour in *Drosophila*.
7.	Sex-Linked Inheritance in *Drosophila melanogaster*
8.	Preparation of Salivary Gland Chromosomes
9.	Culture maintenance of *Drosophila*
10.	Spontaneous mutation: Fluctuation test – StrR
11.	Examples based on Hardy Weinberg Equilibrium
12.	Isolation of bacterial DNA
13.	Isolation of Plasmid DNA
14.	Isolation of DNA from animal cell / plant cell / yeast cells
15.	Isolation of DNA from yeast cells
16.	Isolation of RNA from yeast
17.	Isolation of RNA from plant cells / tissue
18.	Separation of nucleotides by column chromatography
19.	Isolation of coli phages
20.	Transfer of genetic material - Transformation
21.	Transfer of genetic material – Conjugation
22.	Transfer of genetic material - Transduction
23.	Visit to Molecular Biology Laboratory OR Review of recent advances in Molecular Biology or Molecular Genetics thereby submitting a brief report

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Practical Course VI: Methods in Advanced Biotechnology
4 Credits
(Based on Based on BT 202 and BT 205)

Sr. No.	Practical Title
1.	Measurement of pH of any biological sample
2.	Cell disruption by SDS/ Lysozyme
3.	Ammonium sulphate precipitation of proteins
4.	Purification of proteins by dialysis
5.	Immobilization of enzymes / cells
6.	Maltose calibration curve by using colorimeter
7.	Growth curve by turbidimetry
8.	Electrophoresis of RNA/DNA
9.	UV spectra of protein and nucleic acid
10.	SDS-PAGE for protein mol. Wt. Determination
11.	Protein estimation by Lowery Method
12.	Separation of leaf pigment by paper chromatography
13.	Amino acids separation by TLC
14.	Washing of glassware, Sterilization techniques
15.	Plant Tissue Culture Media preparation
16.	Isolation of explants, establishment of Callus
17.	Aseptic seed germination
18.	Initiation and establishment of cell suspension culture
19.	Establishment of Ovule culture
20.	Establishment of Anther culture
21.	Protoplast isolation
22.	Separation of serum and plasma from blood by using centrifugation technique
23.	Animal Cell culture media preparation
24.	Cell separation by Trypsinization
25.	Cell counting
26.	Visit to a Tissue Culture Laboratory OR Review of recent advances in Tissue Culture/Techniques in Biotechnology thereby submitting a brief report

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Practical Course VII: Techniques in Metabolism, Enzymology and Immunology
4 Credits
(Based on BT 203 and BT 206)

Sr. No.	Practical Title
1.	To determine the relative strength of any known redox couple by titration method
2.	To study the factors affecting the amylase enzyme (from any source) activity: a) Presence and absence of activator (chloride ion) & inhibitors (Hg & Cu metal), b) Substrate concentration, c) Temperature, and d) pH
3.	To study induction of invertase enzyme in green gram seeds
4.	To separate the isoenzymes of lactate dehydrogenase by polyacrylamide gel electrophoresis
5.	To estimate the glucose in blood by Folin-Wu method
6.	To isolate the Cytochrome C from goat heart
7.	To isolate chloroplast from spinach leaves and assay of Hill's reaction by spectrophotometer
8.	To estimate chlorophyll from spinach leaves and to separate photosynthetic pigment bypaper chromatography
9.	To estimate the blood urea by DAM method
10.	To determine the acid value of fat
11.	To estimate the blood cholesterol by Zak's method
12.	Determination of blood clotting time
13.	Estimation of Hemoglobin
14.	Total RBC counting
15.	Total Leucocytes counting
16.	Study of differential Leucocytes counting
17.	Latex agglutination test
18.	Coomb's test
19.	Ouchterlony procedure
20.	Counter current immunoelectrophoresis
21.	Rocket immunoelectrophoresis
22.	Widal Test
23.	VDRL Test
24.	Study of malaria parasite
25.	Visit to any recognize Biochemistry and Microbiology (or Pathology lab) laboratory OR Review of recent advances in Techniques in Biochemistry/Immunology thereby submitting a brief report

Examination Pattern (UA - University assessment)
The examination for theory (70 marks) is conducted semester wise by university as per University Time Table.
Nature of Theory question paper for each theory paper.

Solapur University, Solapur
Nature of Question Paper for Semester Pattern
(New C.B.C.S.) w.e.f.2017-18
Faculty of Science
B.Sc. II Biotechnology

Time:- 3 hrs **Total Marks-70**

Q. 1) Multiple choice questions **(14)**
i) ----------
a) **b)** **c)** **d)**
ii)
iii)
iv)
v)
vi)
vii)
viii)
ix)
x)
xi)
xii)
xiii)
xiv)
Q. 2) Answer any seven (out of seven) of the following **(14)**
i)
ii)
iii)
iv)
v)
vi)
vii)
viii)
ix)
Q. 3) A: Answer any two (out of three) of the following **(10)**
i)
ii)
iii)
B: Compulsory **(4)**
Q. 4) Answer any three (out of four) of the following **(14)**
i)
ii)
iii)
iv)
Q. 5) Answer any three (out of four) of the following **(14)**
i)
ii)
iii)
iv)

Nature of Practical question paper for each practical course.

Solapur University, Solapur

Nature of Question Paper for Practical

(CBCS) w.e.f. 2017-18
Faculty of Science
B.Sc. II Biotechnology

Duration:- 2 Days (Each day of 6 hours) **Total Marks-140**

Q. 1 Major Practical performance	**20**
Q.2 Major Practical performance	**20**
Q. 3 Minor Practical performance	**15**
Q.4 Minor Practical performance	**15**
Q. 5 Minor Practical performance	**15**
Q.6 Minor Practical performance	**15**
Q.7 Principle / approach writing (two experiment)	**10**
Q.8 Spotting (five spot)	**10**
Q. 9) Visit report or Review of literature	**10**
Q. 10) a) Journal	**10**