

**Shikshan Haach Dharma
Shri. A.P.D. Jain Pathashala's
(Jain Minority Institute)**

**Walchand College of Arts & Science, Solapur
(Autonomous College)**

(Affiliated to P.A.H. Solapur University, Solapur)



Estd. 1962

Name of Faculty: Science & Technology

New Choice Based Credit System (CBCS)

(According to NEP-2020)

B.Sc. Part-I

Subject: Biotechnology

w.e.f. 2023-24

Walchand College of Arts & Science, Solapur

(Autonomous)

About National Education Policy (NEP) - 2020

With the directions and guidelines issued by **Government of Maharashtra resolution dated 20th April 2023 and 16th May, 2023** regarding the implementation of NEP at UG and PG level, the Walchand College of Arts & Science (Autonomous), Solapur has taken decision to implement NEP 2020 with Choice Based Credit System (CBCS) at Undergraduate level and Post Graduate level. This has been done to achieve the goals and objectives set in NEP-2020 such as- worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate and post-graduate degree.

The CBCS provides an opportunity for the students to select from the prescribed courses comprising core, elective/minor or skill based. 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. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

Outline of NEP:

The structure of the Three/Four-year bachelor's degree programme allows the opportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning in different institutions. The structure allows students to learn various components like:

(a) Major (Core) Subject (DSC): This comprises of Mandatory and Elective Courses that require students to achieve:

- Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses are offered in all four years;
- 2 credit course on Major Specific IKS shall be included under Major;
- Elective courses of Major will be offered in the third and/or final year;

- Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects are related to Major

(b) Minor Subject (18-20 Credits)

- The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether;
- The credits of Minor subjects shall be completed in the first three years of UG Programme

(c) Generic/ Open Elective Courses (OE) (10-12 credits)

- GE/OE are to be offered in I and/or II year;
- Faculty-wise baskets of OE shall be prepared by Autonomous College.
- OE/GE is to be chosen compulsorily from faculty other than that of the Major or as per the directions issued by NEP-Steering Committee

(d) Vocational and Skill Enhancement Courses (VSEC)

i) Vocational Skill Courses (VSC): (8-10 credits): Includes Hands on Training corresponding to the Major and/or Minor Subjects:

- To be offered in first three years;
- Wherever applicable vocational courses will include skills based on advanced laboratory practical's of Major

ii) Skill Enhancement Courses (SEC): (06 credits)

- To be offered in I and II year;
- To be selected from the basket of Skill Courses approved by Autonomous College

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): (14 Credits)

i) AEC: (08 credits)

- To be offered in I and II year
- English: 04 Credits
- Modern Indian Language: 04 credits
- To be offered from the Basket approved by Autonomous College;

The focus for both languages should be on linguistic and communication skills.

ii) IKS: (2 Credits)

- To be offered in I Year
- Courses on IKS to be selected from the basket of IKS courses approved by Autonomous College

iii) VEC: 04 Credits

- To be offered in I year
- Value Education Courses (VEC) such as Understanding India, Environmental Science/Education, and Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

- Internship/Apprenticeship corresponding to the Major (Core) Subject: (8 Credits)
- Field Projects/Community Engagement and Service (CEP) corresponding to the Major (Core) Subject (minimum 4-6 credits)
-To be offered in II and III years of UG Degree Programmes.
- Co-curricular Courses (CC) such as Health and Wellness, Yoga education, sports and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts: (8 credits)
-To be offered in I and/or II year
- Research Projects: (12 credits)
-To be offered in the final year for 4 year Honours with Research UG Degree.

➤ **CREDIT:**

- Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. 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.
 - **Theory:** '15 contact hours' for theory course constitute 'one credit'.
 - **Practical/Tutorial:** '30 contact hours' for practical course constitute 'one credit'.
 - **Workshop based activities/Skill based activities:** Minimum 30 contact hours per credit in a semester is required.
 - **Internship/On-Job Training:** '30 contact hours' per credit in a semester is required (1 credit/week).
 - **Community Engagement and Service-CEP/Field Project:** '30 contact hours' per credit in a semester is required.
- **Credit Framework under Three/Four Years UG Programme with Multiple Entry and Multiple Exit Options:**

The minimum and maximum credit structure for different levels under three or four year UG programme with multiple entry and multiple exit options are as given below:

Levels	Code	Qualification Titles	Credit Requirements		Semester	Year
			Minimum	Maximum		
4.5	100-199	UG Certificate	40	44	2	1
5.0	200-299	UG Diploma	80	88	4	2
5.5	300-399	Three Year Bachelor's Degree	120	132	6	3
6.0	400-499	Bachelor's Degree Honours OR Bachelor's Degree-Honours with Research	160	176	8	4
	500-599	First Year PG & or PG Diploma				
6.5	600-699	PG Degree	80	88	4	2

Multiple Exit Options

Year	Exit Option	Re-entry
First Year	Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor	Students opting for exits at any level 'will have the option to re-enter' the programme from where they had left off, in the same or in different higher educational institution 'within three years of exits' and complete the degree program within the stipulated maximum period of 07 years from the date admission of first year of UG.
Second Year	Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor	
Third Year	Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor	
Fourth Year Honours	Four Year UG Honours Degree in Major and Minor with 160-176 credits	
Fourth Year Honours with Research	Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits	
Post-Graduation Degree		
Post-Graduation: First Year	PG Diploma (44Credits) after Three Year UG Degree	Re-entry to complete the PG degree after taking exit option will be

		permissible up to 5 years from the date admission to PG programme
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➤ **Academic Bank of Credit (ABC):**

It is mandatory for all admitted students to get enrolled on ABC Portal and create ABC- ID and share ABC-ID with academic institutions where they are enrolled. Credits earned by the students will be reflected in the students ABC account. This will allow students smooth transition during multiple entry and exit.

Program outcomes:

Subject Biotechnology has immense scope for job opportunities:

- a) Students will be able to demonstrate their knowledge of biotechnology concepts.
- b) Students will possess hands on technical skills necessary for supporting biotechnology research activity.
- c) Students will be able to identify the agricultural, medical, environment and industrial relevant researchable issues based on survey of literature, formulate a proposal and analyze complex problems for arriving substantiate conclusions using integrated approach.
- d) Students will be able to attain the capability to employ in independent and life-long learning in the broadest context socio-technological changes and use recent techniques betterment of mankind.

Program Specific Outcomes:

1. A student specializing in Biotechnology is expected to learn fundamentals and understand the nature and basic concepts of cell biology, taxonomy, genetics, ecology, animal and plant development, Biostatistics, computer science, Biochemistry and metabolism, chemical and physical science, microbiology, Ayurveda.
2. Acquaint the students with new techniques in the field of animal and plant, microbial genetics and basic immunology and immune-techniques.
3. Acquaint the students with biochemical techniques used to isolation, screening and characterization used in plant and animal extract.
4. Understand the applications of Biotechnology and genetics in agriculture and pharmaceutical, medicine, food industries, apiculture, sericulture, poultry, dairy, fishery, goat and reproductive biology.
5. Acquaint the students with the process and standard procedures in the industries.

Walchand College of Arts & Science, Solapur (Autonomous)

Faculty of Science: Choice Based Credit System (CBCS)

(w.e.f. 2023-24)

Preamble:

This course provides a broad overview of Biotechnology and to produces expert hands that would have sufficient knowledge, practical skills and expertise to solve the urgent problems of the society by using Biotechnology. The course structure is based on basic and applied subjects of science and technology which ensures the enhancement of the pupil's knowledge and hands-on practical skills.

Objectives of the program:

The objectives of B. Sc. Biotechnology course:

- 1) 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 world.
- 2) To develop awareness & knowledge of different organization requirement and subject knowledge through varied branches, emerging areas and research methodology in students.
- 3) To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

Eligibility and Admission:

A Candidate passing 10+2 with biology, MLT, Dairy Science, Fisheries, Agricultural science as one of the subject and passed from state syllabus / CBSE / ICSE equivalent with minimum passing percentage as per the directives of the higher education.

Duration:

The duration of the B.Sc.-I course is of 1 year (comprising 2 semesters) and the B.Sc. entire program is of 3 years (06 Semesters) and/or 4 years (08 semester comprising Bachelors Degree-Honours and/or Bachelors Degree-Honours with Research degree) with multiple entry and exit options.

Medium of Instruction: English

Pattern of the Course: The autonomous college follows semester pattern

Structure of Course for B.Sc.-I Biotechnology according to NEP

(Semester-I & II)

Choice Based Credit System (CBCS) Structure (2023-24)

(Theory and Practical)

w. e. f. 2023-24

B.Sc. Biotechnology				
SEMESTER-I				
Subject	Paper Title	Credits	Hours/week	Total Contact Hours
Biotechnology-Major (Mandatory)	Cell Biology	4	4	60
Biotechnology-Major Practical (Mandatory)	Major Practical-I: Cell Biology	2	4 (hours/week/batch)	60
Biotechnology: GE-I/OE-I Any One	Chemical Science OR Biophysics	2	2	30
	OE-Practical - I Chemical Science OR Biophysics	2	4 (hours/week/batch)	60
Biotechnology: VSC- I	VSC-I : Plant Tissue Culture I	1	1	15
	VSC Practical- I- Plant Tissue Culture I	1	2 (hours/week/batch)	30
Biotechnology: SEC- I	Animal Tissue Culture I	1	1	15
	SEC Practical – I- Animal Tissue Culture I	1	2 (hours/week/batch)	30
AEC-I	English-I	2	2	30
Biotechnology: VEC- I	Epidemiology	2	2	30
Biotechnology: IKS	IKS: History of Biotechnology: Indian Context	2	2	30
Biotechnology: CC- I	CC-I:Health & Wellness I : Introduction to Ayurveda	1	1	15
	CC Practical –I- Introduction to Ayurveda	1	2 (hours/week/batch)	30
SEMESTER-II				
Biotechnology-Major (Mandatory)	Biochemistry and Metabolism	4	4	60
Biotechnology-Major (Mandatory)	Major Practical-II: Biochemistry and Metabolism	2	4 (hours/week/batch)	60
Microbiology Minor- I	Microbiology Minor- I : Fundamentals of	2	2	30

OR Genetics Minor- I OR Nanotechnology Minor- I OR Agriculture Biotechnology Minor- I	microbiology OR Genetics - Minor- I: Concepts of Genetics OR Nanotechnology- Minor- I: Introduction to Nanotechnology OR Agriculture Biotechnology -Minor- I :Soil Science			
Biotechnology. OE-II (Any one)	GE-II/OE-II: Mammalian Physiology OR Plant Physiology	2	2	30
Biotechnology OE Practical -II	OE-Practical-II: Mammalian Physiology OR Plant Physiology	2	4 (hours/week/batch)	60
Biotechnology: VSC- II	VSC- II: Plant Tissue Culture II	1	1	15
	VSC -Practical – II : Plant Tissue Culture II	1	2 (hours/week/batch)	30
Biotechnology: SEC II	SEC- II : Animal Tissue Culture II	1	1	15
	SEC- Practical – II : Animal Tissue Culture II	1	2 (hours/week/batch)	30
AEC-II	English-II	2	2	30
Biotechnology: VEC-II	VEC-II: Conservation Biotechnology	2	2	30
Biotechnology: CC- II	CC- II-Health & Wellness II: Medicinal plants	1	1	15
	CC- Practical -II: Health & Wellness II: Medicinal plants	1	2 (hours/week/batch)	30

OUTLINE OF EXAMINATION

THEORY:

1) **Internal Evaluation (IE):** Internal evaluation will consist of **40 % marks** per semester per paper. It may be held as **per the following scheme** per semester (**Annexure: I & II**)

Credits	Marks for Attendance	Classroom Test	Home Assignment	Marks for Presentation/Group Discussion/ Participation/Field work/Study visit	Total Marks
02	05	10	05	---	20
04	05	20	05	10	40

2) **End Semester Examination (ESE):** The detailed question paper pattern (**60 % marks per paper**) is given as in **Annexure- IV; Annexure- V and Annexure- VI**

PRACTICAL:

1) **Internal Evaluation (IE):** Internal evaluation will carry **40 % marks** and may consist of:

Credits	Marks for Attendance	Internal Practical Exam	Journal	Total Marks
02	05	10	05	20

2) **End Semester Examination (ESE):** Practical examination **60 % marks** shall be conducted at the end of each semester. The detailed scheme is given in **Annexure- VII and Annexure- VIII.**

Walchand College of Arts and Science (Autonomous), Solapur
(CBCS)Theory Syllabus

B.Sc. I-Biotechnology (Semester-I)

w. e. f. 2023-24

SEMESTER I

Biotechnology-Major (Mandatory) Cell Biology Theory		
Marks: 100		Credits: 04 (Contact Hours-60)
UNIT	Content	Contact Hrs
I	Cell: Discovery of Cell, Cell theory, Introduction and Classification of Organisms by Cell Structure, Cytosol, Ultrastructure of Eukaryotic cell, Structural Organization and Functions of Cell wall and Plasma Membrane. Cell Membrane and Permeability: Chemical components of biological membranes, Organization and Fluid Mosaic Model, Membrane as a dynamic entity, Cell recognition and Membrane transport.	15
II	Structure and function of Cell Organelles: Cytosol, Endoplasmic Reticulum, Golgi Complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus, Nucleolus, Vacuole and Membrane Vacuolar system, Cytoskeleton and Cell motility cytoskeletal structures (microtubules, microfilaments and intermediate filaments).	15
III	Chromosomes And Cell Division: General Introduction, Discovery, Morphology and Structural organization – Centromere, Secondary constriction, Teleomere, Chromosome, Euchromatin and Heterochromatin, Chemical composition, Karyotype, Nucleosome models. Cell cycle, Phases of cell division- Mitosis and Meiosis, Cell cycle checkpoints, Enzymes involved in regulation, Significance of cell cycle	15
IV	Extracellular Matrix: Composition, Molecules that mediate cell adhesion, Membrane receptors for extra cellular matrix, Macromolecules, Regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, Agents promoting carcinogenesis, Characteristics and molecular basis of cancer.	15
<p>About the Course: Cell Biology Course That Will Introduce and Explore Basic Concepts and Theories Of Cell Biology With An Emphasis On its Application In Understanding Human Health. Topics Include an Introduction To Cell Structures Cellular Organelles, The Chemical Composition Of Cells, Cellular Functions and Cell Division and Carcinogenic Agents and Cancer along with its Treatments.</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> •Describe Cytological, Biochemical, Physiological and Genetic Aspects Of The Cell, Including Cellular Processes Common To All Cells. 		

•Explain Cellular Processes and Mechanisms That Lead To Physiological Functions As Well As Examples Of Pathological State.

Suggested Readings:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Roberti's, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
3. Cooper, G.M. and Haussmann, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press& Sunderland, Washington, D.C.; Sinecure Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Biotechnology-Major (Mandatory) Practical I: Cell Biology
Practical**

Marks: 50

Credits: 02 (Contact Hours- 60)

Sr. No.	Content
1	Study of structure of any Prokaryotic and Eukaryotic cell.
2	Cell division in onion root tip/ insect gonads.
3	Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.
4	Study of effect of Temperature and Organic solvents on Semi -Permeable membrane.
5	Meiosis in Flower Buds of Allium cepa-Acetocarmine Stain.
6	Isolation of Chloroplast from spinach leaves and assay of Hill's reaction by Spectrophotometer.
7	Study of Plasmolysis and De-Plasmolysis.
8	Demonstration of Osmosis.

**Biotechnology: GE-I/OE- I: Chemical Science
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	<p>Types of Bonds in Biomolecules and Hybridization: Definition and Formation of Ionic and Covalent Bond with Examples. Covalent Bond (Glycosidic, Peptide, Phosphodiester, Disulphide Bonds), Non Covalent Bond (Hydrogen, Vander Waals, Hydrophobic). Concept of Hybridization: Sp, Sp², Sp³ Hybridization With Respect to C₂H₂, C₂H₄, CH₄. Mole Concept: Definition & Introduction to Molarity, Normality, Molality, Percentage with Examples.</p>	15
II	<p>Solutions, pH And Buffers: Solutions, Types of Solutions, Solubility & Factors Affecting Solubility; Colligative Properties: Definition, Osmosis, Osmotic Pressure and Reverse Osmosis. Concept of Chemical Equilibrium, pH And Buffers: pH And pOH, Buffer Capacity. Henderson's Equation for Acidic and Basic Buffers with Derivation. Applications Of Buffers And Solutions-Maintenance Of Life (Biochemical Process And Body Buffers), Biochemical Assay, Textile, Cosmetic, Brewing And Laundry Detergent Industries.</p>	15

About the Course:

The Course makes the detail description to understand the concept of atoms, molecules and matter, how they react together their properties and reactions, it deals with study of theoretical chemistry which is challenge to experimental investigations. Also, to provide the key knowledge base in chemical sciences to prepare students for further study.

Learning Outcomes:

After successfully completing the course, the student will be able to

- Understand the particulate nature of matter and how the chemical reaction is occurs by the formation of bonds and behind chemistry.
- Know the theoretical chemistry, which can follow the proper procedures and regulations for safe handling when using chemicals.
- Understand and apply calculations needed in the chemical sciences for preparing and analysing solutions and samples.

Suggested Readings:

1. University General Chemistry by C.N. R. Rao, Macmillan
2. Principles of Physical Chemistry, 4th edition by S.H. Marron and C.F. Prutton
3. Essentials of Physical Chemistry by B.S. Bahel and G.D. Tuli
4. College Chemistry by Linus Pauling
5. Concise Inorganic Chemistry by J. D. Lee 5th Edition
6. Basic Inorganic Chemistry by Cotton and Wilkinson

Biotechnology: GE-I/OE- I: Biophysics Theory		
Marks: 50		Credits: 02 (Contact Hours- 30)
UNIT	Content	Contact Hrs
I	<p>Biophysics of Water: Molecular structure, Association of water through H-bonding, Nature of hydrophobic interactions, Physicochemical properties of water.</p> <p>Solutes: Hydrophiles and Hydrophobes, The Influence of Ions on water: Structure-Making and Structure-Breaking. Protein Hydration: Specific role of Water in Structure and Function, Secondary Structure, Protein-Protein Interactions, Involvement of Bound Water in Catalytic Action, Water and Nucleic Acids.</p>	15
II	<p>Laws of thermodynamics: Concept of free energy, Unavailable energy & Entropy, Enthalpy, Negative entropy change in living system, Heat content of food, Bomb calorimetry, Energy generation & energy transfer processes in biochemical reactions.</p> <p>Protein Interactions: Binding of small molecules by polymer, identical and Independent sites model, Scatchard plot, interaction between binding sites, MWC model, Sequential model.</p>	15
<p>About the Course: The Course gives the detailed description to understand the application of physics to biological systems which finds applications in bioelectronics, medicine/ health.</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to 3</p> <ul style="list-style-type: none"> • To explain the models of biological systems to solve qualitative and quantitative problems. • Communicate at the advanced level results of both theoretical and experimental work in various forms. 		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Ackerman E. A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc. 2. Barrow. C. (1974), Physical Chemistry For Life Sciences, McGraw-Hill. 3. Berns M.W. (1982), Cells, Holt Sounders International Editors. 4. Bloomfield V. A. and Harrington R.E. (1975), Biophysical chemistry, W. A. Freeman and CO. 5. Bulter I.A.V. and Noble D. Eds. (1976), Progress in Biophysics and Molecular Biology (all volumes) pergamon, Oxford. 6. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A. Freeman and Co. Casey E.J. (1967), Affiliated East west press 		

Biotechnology: GE-I/OE-I: Practical I- Chemical Science	
Practical	
Marks: 50	Credits: 02 (Contact Hours- 60)
Sr. No.	Practical
1	Preparation of Molarity solutions.
2	Preparation of Normality solutions.
3	Preparation of Percentage solutions.
4	Preparation of buffers (Phosphate buffer, acetate buffer)
5	Identification of functional groups in organic compounds
6	Determination of carbohydrates in given food sample.
7	Determination of Fats in given food sample.
8	Determination of Proteins in given food sample.

Biotechnology: GE-I/OE-I: Practical I- Biophysics	
Practical	
Marks: 50	Credits: 02 (Contact Hours- 60)
Sr. No.	Practical
1	Measurement of viscosity by Ostwald's viscometer.
2	Temperature measurement by RTD
3	Denaturation & Renaturation of DNA.
4	Study of interaction of acridine orange with DNA.
5	Study of Lambert's & Beer's law.
6	Surface tension measurement by Jaegers method.
7	Study of UV spectra of protein/DNA
8	Study of UV spectra of DNA

Biotechnology-VSC-I : Plant Tissue Culture I Theory		
Marks: 25		Credits: 01 (Contact Hours-15)
UNIT	Content	Contact Hrs
I	<p>Introduction: History and Scope of Plant Tissue Culture. Concept of growth and development</p> <p>Aseptic techniques: Sterilization of glassware, Media and Plant material / Explant, laboratory fumigation, surface disinfection.</p> <p>General laboratory setup: Laboratory Infrastructure, Significance and importance of laboratory equipments, Instruments, glassware and other requirements in plant tissue culture laboratory.</p>	15
<p>About the Course: The course goal of plant tissue culture Techniques is for students to acquire the necessary practical skills for the isolation of animal cells and plant cells for in vitro studies, maintenance of cells in vitro, manipulation of cells in vitro. These techniques will play an important role in micro- propagation of microbial-free plants and regeneration of endangered species as well as species difficult to regenerate with the traditional ways and application of molecular techniques to in vitro situations.</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> • Grow, maintain, and propagate specific cell in a sterile environment. • Handle, store and identify cells in culture. • Count, identify and assess viability of cells by microscopic examination. 		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1) Introduction to plant tissue culture- M. K. Razdan 2) Plant tissue culture-Theory & practice-S.S.Bhojwani&M.K.Razdan 3) Plant tissue culture-Kalyankumar De 		

Biotechnology-VSC I Practical- I- Plant Tissue Culture I Practical	
Marks: 25	
Credits: 01 (Contact Hours-30)	
Sr. No.	Practical
1	Introduction to plant tissue culture laboratory setup
2	Laboratory Fumigation.
3	Contamination and decontamination measures.
4	Washing of glassware & sterilization techniques

Biotechnology-SEC- I Animal Tissue Culture I Theory		
Marks: 25		Credits: 01 (Contact Hours-15)
UNIT	Content	Contact Hrs
I	Introduction: History, Laboratory Design, safety measures, Characteristics of animal Cell in Culture, Substrate for cell growth. Equipment's required for animal cell culture- laminar air flow, CO2 incubator, Micropipette, Hot air Oven, Autoclave, Inverted Microscope, Sterilization of apparatus, flow cytometry.	15
<p>About the Course: The goal of this course is to acquire the necessary practical skills for the isolation of animal cells for in vitro studies, maintenance of cells in culture for genetic manipulation.</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> • Grow, maintain, and propagate specific cell in a sterile environment. • Handle, store and identify cells in culture. • Count, identify and assess viability of cells by microscopic examination. <p>Suggested Readings:</p> <ol style="list-style-type: none"> 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. Segal&R.L.Press 8. Animal cell culture and technology by Michael Buttler 		

Biotechnology-SEC- I- Practical- I- Animal Tissue Culture I Practical	
Marks: 25	
Credits: 01 (Contact Hours-30)	
Sr. No.	Practical
1	Introduction to Animal Tissue Culture Laboratory Setup.
2	Laboratory Sterilization.
3	Sterilization of Glasswares.
4	Instrumentation in Animal Tissue Culture.

**Biotechnology-VEC-I- Epidemiology
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	Introduction of epidemiology: Objectives, History and Purpose & uses of epidemiology, Concept of Health & well-being, Disease causation- Definition, causes of disease, Disease prevention- Natural history of disease, Levels of disease prevention. Infectious diseases- Definition, Components of Infectious Process, Types of Epidemiology-Descriptive & analytical, Morbidity & Mortality and its measurements.	15
II	Epidemic investigation & epidemiological surveillance: Sources of Data, Methods of Data collection, Epidemic- Definition, Types, Steps in Epidemic Investigation, Epidemic Management. Epidemiological Surveillance- Definition, Types of surveillance, their advantages & disadvantages, Activities of surveillance, Good surveillance system. List of priority disease & pathogens in India	15

About the Course:

This subject will familiarize the students about basic concepts of Epidemiology, levels of prevention, Infectious diseases Epidemiology, morbidity and mortality. It will help students to understand the actual importance of epidemic investigation and surveillance.

Learning Outcomes:

After successfully completing the course, the student will be able to

- Gain knowledge about basic principles of Epidemiology.
- Understand the public health important diseases.
- Describe the application of epidemiological research.
- Understand the methods of field investigation.

Suggested Readings:

1. Mausner and Bahn. Introductory text of epidemiology. Second Edition. W. B. Saunders
2. Shiferaw M and Fenta H. Epidemiology - A manual for students and health workers in Ethiopia.
3. Fletcher M. Principles and practice of Epidemiology.
4. John M. Last. A Dictionary of Epidemiology, Fourth Edition Oxford University Press, 2001.
5. Spasoff R.A. Epidemiologic Methods for Health Policy. New York, Oxford University Press, 1999.

Biotechnology-IKS: History of Biotechnology: Indian Context Theory		
Marks: 50		Credits: 02 (Contact Hours- 30)
UNIT	Content	Contact Hrs
I	Old and New biotechnology: Definitions of biotechnology, History of Biotechnology, Scientific Foundation of Biotechnology, Commercialization of Biotechnology, Contribution of biotechnology, National institutes of biotechnology in India. Biotechnological milestones- Green, White, Blue, Yellow, Grey revolution.	15
II	Biotechnology and Interdisciplinary scope: Chemical science, Physics, Mathematics, Statistics, Computer application, Pharmacy, Remote sensing, Robotics, Artificial Intelligence, Nanotechnology	15
<p>About the Course: Bachelor course in biotechnology offers the synergism of basic concepts of biology, biotechnology, molecular biology, genomics, Recombinant DNA technology, microbiology, biochemistry and bioinformatics with technological applications. Develop proficiency in application of current aspects of biotechnology, molecular biology, Recombinant DNA technology, bioinformatics and genomics</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> • Understand basic concept about biotechnology, contribution of biotechnology towards society. • Describe applications of biotechnological techniques in various industrial sectors, research field. 		
<p>Suggested Readings: 1. Genetics by B. D. Singh 2. Molecular biology by P.K. Gupta</p>		

Biotechnology-CC-I: Health & Wellness 1 : Introduction to Ayurveda Theory		
Marks: 25		Credits: 01 (Contact Hours-15)
UNIT	Content	Contact Hrs
I	<p>History and Basics of Ayurveda: Introduction to ayurveda, laws and rules of ayurveda, vatadosha, pitta dosha, kaphadosha, prakruti analysis; The disease process: Vikruti-The Nature of Imbalance, The Six Stages of Disease, Accumulation of Doshas, Aggravation of Doshas, Ayurvedic Tongue Analysis, Ayurvedic Stool Analysis;</p> <p>Ayurvedic Dietetics: The Science of six Tastes, The principles of Ayurvedic Dietetics, Foods for the three Doshas. Importance of Ayurveda.</p>	15
<p>About the Course: This course is designed to educate students to develop a preventive lifestyle and give an invaluable insight into how to change diet and lifestyle habits for better health</p> <p>Learning Outcomes: After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> To apply the fundamentals of Ayurveda in their daily lives. This places great emphasis on prevention and encourages the maintenance of health through close attention to balance in one's life. This course will help to the students to understand the disease process as per Ayurveda and the principles of ayurvedic dietetics, and all about mindful eating. 		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> Shastri ,Chaukumba Sanskrit Samsthan, Varanasi. Charakasamhita ,Vidhyothini Hindi Commentary, Author Name : Agnivesha, Hindi Commentary by Kashinath Shastri & Dr Gorakha Nath Chaturvedi, Chaukhambha Bharati Academy CharakaSamhita – Dalhana Commentary. samhita by Agnivesha, Revised by Charaka and Dridhabala, Edited : Vaidyjadavaji Trikamji Acharya, Satyabhamabai Panduranga, Bombay. Text book of physiology – Guyton 		

Biotechnology-CC-I Practical- I- Health & Wellness 1 : Introduction to Ayurveda Practical	
Marks: 25	
Credits: 01 (Contact Hours-30)	
Sr. No.	Practical
1	Various methods of cooking-Ayurveda and modern dietetics
2	Preparation of manda.
3	Preparation of peya.
4	Preparation of vilepi
5	Preparation of odhana

Walchand College of Arts and Science (Autonomous), Solapur
(CBCS)Theory Syllabus
B.Sc. I-Biotechnology
w. e. f. 2023-24
SEMESTER II

Biotechnology-Major (Mandatory) Biochemistry and Metabolism		
Theory		
Marks: 100		Credits: 04 (Contact Hours-60)
UNIT	Content	Contact Hrs
I	<p>Amino acids and proteins: Structure and properties of Amino acids, Classification of Proteins, Different level of structural organization of proteins, Enzymes: Nomenclature and Classification of Enzymes, Holoenzyme, Apoenzyme, Cofactors, Enzyme Specificity.</p> <p>Carbohydrates: Structure, Function and Properties of Monosaccharide's, Disaccharides and Polysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.</p>	15
II	<p>Lipids: Structure and Functions–Classification, Nomenclature and Properties of fatty acids, Essential fatty acids. Phospholipids, Sphingolipids, Glycolipids, Cerebrosides, Gangliosides, Cholesterol.</p> <p>Nucleic acids: Structure and functions: Nucleosides & Nucleotides, Purines & Pyrimidines, Double helical model of DNA, Denaturation and Renaturation of DNA, Types of RNA.</p>	15
III	<p>Carbohydrates Metabolism: Reactions, Energetics and Regulation- Glycolysis, Fate of pyruvate under aerobic and anaerobic conditions, Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and Glycogen synthesis, TCA cycle.</p> <p>Oxidative phosphorylation: Membrane arrangement of respiratory chain system and Electron transport mechanism of oxidative phosphorylation, ATP synthase complex.</p>	15
IV	<p>Nucleotide and Lipid metabolism: Sources of the atoms in the purine and pyrimidine molecules. Outline of biosynthesis and degradation of purine and pyrimidines. Biosynthesis of saturated and unsaturated fatty acids, β oxidation of saturated fatty acids.</p>	15
<p><u>About the course:</u> The course aims to introduce the theories and concepts of biomolecules, provide an advanced understanding of the core principles and topics of biomolecule metabolism and their experimental basis and to enable students to acquire a specialized knowledge and understanding of energetic and reactions of biochemical pathways.</p> <p><u>Learning Outcomes:</u> After successfully completing the course, the student will be able to</p> <ul style="list-style-type: none"> • Gain knowledge about the chemical constituents of cells, the basic units of living 		

organisms

- Explain various types of weak interactions between the biomolecules.
- Understand how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids, nucleic acids. Correlate the structure-function relationship in various biomolecules

Suggested Readings:

1. Principles of Biochemistry, Lehninger C Rs. Publ. 8th edition.
2. Biochemistry, L. Stryer, W.H. Freeman, San Francisco (2008).
3. Schaum's Outline Series of Theory and Problems of Biochemistry, Philip W. Kuchel and G.B. Ralston. Int. Ed., McGraw-Hill Book Co.
4. Problem Approaches in Biochemistry. Wood and Hood.
5. Biochemistry by Voet and voet, 4th edition (2010). 6. Biochemistry by Zubay (1997).

Biotechnology-Major (Mandatory) Practical I- Biochemistry and Metabolism Practical	
Marks: 50	Credits: 02 (Contact Hours-60)
Sr. No.	Content
1	Qualitative tests for Carbohydrates.
2	Separation of amino acids by Paper Chromatography.
3	Estimation of Protein by Lowry's method.
4	Estimation of blood glucose by folin-Wu method.
5	Estimation of DNA by DPA method.
6	Estimation of acid value of lipids.
7	Estimation of RNA by Orcinol method
8	Qualitative tests for Lipids.

**Microbiology Minor I : Fundamentals of Microbiology
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	<p>History of Microbiology: Development of microbiology as a discipline, Spontaneous generation Vs. biogenesis, Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Paul Ehrlich, Alexander Fleming, John Tyndall, Edward Jenner, Elie Metchnikoff. Role of microorganisms in fermentation, Germ theory of disease. Contributions of Martinus W. Beijerinck and Sergei N. Winogradsky in soil microbiology. Harmful and Beneficial activities of Microorganisms</p>	15
II	<p>General characters of different groups of microorganisms :Cellular microorganisms: Bacteria- Size, Shape, arrangement of bacteria Structure of typical Bacterial cell, Structure and function of Cell Wall, Cell Membrane, Capsule & Slime layer, Flagella and pili. General characters, structure, and economic importance of– Algae, Fungi and protozoa. Acellular microorganisms: Definition, General properties of Viruses. viroid and prions. General characteristics of various microorganisms : Archaeobacteria, Rickettsia, Actinomycetes, Chlamydia, Mycoplasma.</p>	15

About the course: The course is aimed to provide knowledge history, types, morphology and cytology of microorganisms.

Learning outcomes

After successfully completing this course, the students will be able to:

- Gain basic knowledge of microorganisms
- Develop understanding on the diversity of microorganisms

Suggested Readings:

1. Pelezar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. General Microbiology Vol I and II –Pawar and Dagainawala
4. Dubey, R.C and Maheswari, D.K. (2000) General Microbiology. S. Chand, New Delhi
5. Atlas RM (1997): Principles of Microbiology; 2nd edition W.M.T. Brown Publishers

**Genetics Minor I : Concept of Genetics
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	<p>Mendelian Genetics: Biography of Mendel and his experiments: Law of Segregation: Monohybrid cross, back cross and Test cross, Genetic Problems related. Law of Independent Assortment: Dihybrid cross, Back cross and Test cross, Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems related. Gene Interactions: Deviations from Mendelism: Incomplete inheritance and co-dominance, Complementary gene interaction (9:7), Supplementary gene interaction(9:3:4), Recessive Epistasis, Non-Epistasis (with an example for each trait)</p>	15
II	<p>Linkage and Crossing Over: Linkage definition, cis and trans arrangement of genes, Linkage group in Drosophila and man. Types of linkage – complete and incomplete linkage map. Linkage map – E.g. Drosophila, construction of linkage maps. Crossing over - Types, mechanism of crossing over, interference and coincidence, Factors affecting linkage and crossing over, significance of linkage and crossing over.</p>	15

About the course:

Genetics course will enable students to study a discipline of fundamental importance to all branches of modern biology, from evolutionary biology to medicine, extending into practical areas such as biotechnology and agriculture. Students will discover the principles of heredity and evolution and learn how we can map genes, and understand their function.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Study historical overview and laws Inheritance and Understand Mendel's principles and deviations.
- Gene interactions and their outcome through gene mapping.

Suggested Readings:

1. Pierce, B. A. (2012). Genetics: a conceptual approach. Macmillan publication.
2. Roberts, K., Alberts, B., Johnson, A., Walter, P., & Hunt, T. (2002). Molecular biology of the cell. New York: Garland Science.
3. Lodish, Harvey, et al. Molecular cell biology. Macmillan, 2008.
4. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons.
5. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2011). Lewin's genes X. Jones & Bartlett Learning.

**Nanotechnology Minor I : Introduction to Nanotechnology
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	Introduction to Nanoscience: History, fundamental science behind nanotechnology. Emergence of Nanoscience with reference to Feynman & Drexler. Quantum mechanics and Quantum theory.	15
II	Types of Nanomaterials: Nano-clusters, Nano-wires, Nano-rods, Buckyballs, Thin Films, Nan-composites, Carbon nano- tubes, Dendrimers, Micelles, Liposome. Properties of Nanomaterials: Mechanical properties, Structural Properties, Optical Properties, melting and electric conductivity of nanoparticles.	15

About the course:

To enable the students to understand the science the science of nano materials.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Understand the fundamental science behind nanotechnology.
- To differentiate different types of nano materials.
- Explain the properties of nano materials.

Suggested Readings:

- 1.Nanotechnology: Principles and Practices, Sulbha Kulkarni
- 2.Nanotechnology – A gentle introduction to the next big idea, Mark Ratner & Danier Ratner
- 3.The History of Nanotechnology From Prehistoric to Modern Time, Madhuri Sharon, Willey Publication.

**Agriculture Biotechnology Minor I : Soil Science
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	Introduction to soil: Soil formation, Soil horizons, Classification of soil, Physical, Chemical and Biological properties of soil, Components of soil, Soil mineralogy, Soil fertility and it's management.	15
II	Introduction to Biofertilizers: Definition, Classification, Role in crop production, Nitrogen fixation in soil, AEC and CEC, Techniques for soil analysis, Soil pollution, Remediation/amelioration of contaminated soil	15

About the course:

This course teaches the fundamental concepts of soil science. It includes 8 major topics - soil chemistry, soil mineralogy, soil organic matter, soil physics, soil biology, soil fertility, soil nutrient management, soil genesis & classification. This course will provide a basic understanding of all the key concepts and terminologies of every aspect of soil.

Learning outcome:

After successfully completing this course, the students will be able to:

- Gain knowledge on concepts and principles of Soil Science.
- Understand various soil physical, chemical and biological properties and their impact on plant growth.
- The knowledge gained in this course will be useful in understanding the behavior of soils in crop production and management.

Suggested Readings:

1. Handbook of molecular technologies in crop disease management, Haworth Food & Agricultural Products Press, New York.462 p
2. Taiz and Zeiger, Plant Physiology, 3rd Edition, Panima Publishing Corporation, New Delhi,2003
3. Gatehouse, A. M .R., Hilder, V. A. and Boulter, D., Plant Genetic manipulation for crop protection In: Biotechnology in Agriculture Series (Eds.) Vol. 7 CAB International, Wallingford,UK. 266p. 1992
4. Soil microbiology by Rao Subba, Oxford and IBH Publishing, 30-Mar-2017
5. Symbiotic Soil Microorganisms: Biology and Applications Author: by Neeraj Shrivastava, Shubhangi Mahajan, Ajit Varma

Biotechnology: GE- II/OE- II: Mammalian Physiology**Theory****Marks: 50****Credits: 02 (Contact Hours-30)**

UNIT	Content	Contact Hrs
I	Muscle Physiology: Structure of Cardiac, Smooth & Skeletal Muscle, Threshold Stimulus, Physical, Chemical & Electrical Events of Mechanism of Muscle Contraction. Mechanism of Working of Heart: Cardiac Output, Cardiac Cycle, Origin & Conduction of Heart Beat Cardiovascular System, Circulation: Composition of Blood, Plasma Proteins & Their Role, Blood Cells, Haematopoiesis, Mechanism of Coagulation of Blood	15
II	Nervous Co-Ordination: Structure and Types of Nerve, Mechanism of Generation & Propagation of Nerve Impulse, Structure of Synapse, Synaptic Conduction, Neurotransmitters. Endocrine Coordination: Definition and Types of Hormone, Mechanism of Action of Hormones (Insulin and Steroids). Different Endocrine Glands: Types of Gland, Hypothalamus, Pituitary, Pineal, Thymus, Thyroid, Parathyroid and Adrenals, Hypo & Hyper-Secretions.	15

About the course:

This course is describing to provide students study in mammalian, principally human, systems physiology, building on knowledge of basic physiological principles with comprehensive exposure to the subject of Mammalian physiology. It also provides the knowledge in topics related to measures capacity of muscular systems, cardiac structures, endocrinology, and related disease.

Learning outcome:

After successfully completing this course, the students will be able to:

- Have an enhanced knowledge and appreciation of mammalian physiology.
- Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems.
- Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail.

Suggested Readings:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Herculat Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley& sons, Inc.
3. Lauralee Sherwood. Human physiology – From cells to systems. 7th Edition. Yolanda Cossio Publisher.
4. Christopher D. Moyes, Patrica M. Schulte. Principles of Animal Physiology. 2nd edition. Pearson New International edition.
5. K. Sembulingam, PremaSembulingam. Essentials of Medical Physiology. 6th Edn. Jaypee Publishers Pvt. Ltd.

**Biotechnology: GE-II/OE- II- Plant Physiology
Theory**

Marks: 50

Credits: 02 (Contact Hours-30)

UNIT	Content	Contact Hrs
I	<p>Anatomy: The shoot and Root apical meristem and its histological organization, Simple & complex Permanent tissues. Primary structure of shoot & root, Secondary growth, Growth rings, Leaf anatomy (dorsi-ventral and isobilateral leaf). Plant water relations: Plant water relations: Importance of water for plant life, Mechanism of water Absorption Diffusion, Osmosis, Plasmolysis, Imbibition, Guttation, Transpiration</p>	15
II	<p>Micro & macro nutrients: Micro & macro nutrients: Criteria for identification of essentiality of nutrients, Roles and Deficiency systems of nutrients. Mechanism of Uptake of Nutrients, Mechanism of food transport: source to sink transport. Growth hormones: Physiological role and Mode of action-Auxins, Gibberellins, Cytokines, Abscisic acid and Ethylene.</p>	15

About the course:

This course provides students with comprehensive exposure to the subject of plant physiology. It also provides the knowledge in topics related to water relations, inorganic nutrition, plant growth regulation with emphasis on environmental factors in the physiology of plant.

Learning outcome:

After successfully completing this course, the students will be able to:

- Comprehend the fundamental concepts of plant physiology.
- Describe the physiological mechanism of plant growth, function and development.
- Recognize and describe how plants respond to the environment.
- Applied to seed/ seed material seedlings/ soil/ crop residues in order to increase plants or farm yield or plant population.

Suggested Readings:

1. Dickinson,W.C.2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau,K.1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn,A.1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth,J.D.1988 Plant Anatomy. The Benjammin/ Cummings Publisher, USA
6. Nelson,D.L.,Cox, M.M.2004 Lehninger Principles of Biochemistry, 4edition, W.H.Freeman and Company,NewYork,USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L.and Zeiger,E.2006 Plant Physiology,4 edition, Sinauer Associates nc. MA, USA
9. Cantor C.R.and Schimmel P.R.(1980), Biophysical chemistry, W.A.Fremmanand Co.Casey E.J.(1967),Affiliated East-west press

Biotechnology: GE-II/OE-II Practical I: Mammalian Physiology Practical	
Marks: 50	Credits: 02 (Contact Hours-60)
Sr. No.	Practical
1	Determination of blood coagulation time
2	Estimation of Hemoglobin from blood
3	Determination of mammalian RBCs count
4	Separation of serum & plasma from blood by centrifugation technique
5	Determinations of Blood groups.
6	Visit to nearby Pathology Laboratory and prepare a report.
7	Demonstration of glucometer strip for blood glucose detection.
8	Analysis of human blood pressure.

Biotechnology: GE-II/OE-II-Practical I- Plant Physiology Practical	
Marks: 50	Credits: 02 (Contact Hours-60)
Sr. No.	Practical
1	Study the effect of temperature and organic solvents on semi permeable membrane.
2	Demonstration of Osmosis
3	Study of plasmolysis and de-plasmolysis.
4	Cell fractionation and determination of enzyme activity using sprouted seed or any other suitable source.
5	Cell division in onion root tip/ insect gonads
6	Meiosis in Flower Buds of <i>Allium cepa</i> -Acetocarmine Stain
7	Study of transpiration.
8	Isolation of <i>Rhizobium</i> from leguminous plants roots nodules and preparation of biofertilizers from it.

Biotechnology-VSC-II : Plant Tissue Culture II Theory		
Marks: 25		Credits: 01(Contact Hours-15)
UNIT	Content	Contact Hrs
I	<p>Plant Tissue Culture Media :</p> <p>Culture media composition with its significance : Macronutrients, Micronutrients, Amino acid, Sugar source, Solidifying agent, Phytohormones.</p> <p>Culture techniques:</p> <p>Concept of totipotency, differentiation, dedifferentiation and redifferentiation. Callus Culture and its application, Cell suspension culture with its significance.</p>	15
<p>About the course:</p> <p>The course goal of plant tissue culture Techniques is for students to acquire the necessary practical skills for the isolation of animal cells and plant cells for in vitro studies, maintenance of cells in vitro, manipulation of cells in vitro. These techniques will play an important role in micro- propagation of microbial-free plants and regeneration of endangered species as well as species difficult to regenerate with the traditional ways and application of molecular techniques to in vitro situations.</p> <p>Learning Outcomes:</p> <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> • Grow, maintain, and propagate specific cell in a sterile environment. • Handle, store and identify cells in culture. • Count, identify and assess viability of cells by microscopic examination. • Identify the problems associated with growing, storing and identifying a wide range of different cell types. • Describe how cell culture can be used for in vitro studies and commercial applications. <p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Introduction to plant tissue culture- M.K.Razdan 2. Plant tissue culture-Theory & practice-S.S.Bhojwani&M.K.Razdan 3. Plant tissue culture-Kalyan kumar De 		

Biotechnology-VSC-II- Practical- II- Plant Tissue Culture II Practical	
Marks: 25	
Credits: 01(Contact Hours-30)	
Sr. No.	Practical
1	Media preparation
2	Sterilization of plant tissue culture media.
3	Callus culture.
4	Cell suspension culture

Biotechnology-SEC-II- Animal Tissue Culture II		
Theory		
Marks: 25		Credits: 01(Contact Hours-15)
UNIT	Content	Contact Hrs
I	<p>Culture Media: Natural media:</p> <p>Clots, Biological fluids, Serum, Tissue Extract. Synthetic media- Balanced salt Solution, Serum containing media, complete media. Physiochemical properties of media, sterilization of media. Culture Techniques: Primary cell Culture, Cell Separation:Mechanical- Sieve, chopping, pipetting etc. Enzymatic-Trypsinization (Warm & Cold), Collagenase. Criteria for subculture.</p> <p>Methods of organ culture:</p> <p>Plasma clot technique, raft method, agar gel method, Cryopreservation, Cell Synchronization: By physical mean & chemical blockade</p>	15
<p>About the course: The goal of this course is to acquire the necessary practical skills for the isolation of animal cells for in vitro studies, maintenance of cells in culture for genetic manipulation.</p> <p>Learning Outcomes: After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> • Grow, maintain, and propagate specific cell in a sterile environment. • Handle, store and identify cells in culture. • Count, identify and assess viability of cells by microscopic examination. • Identify the problems associated with growing, storing and identifying a wide range of different cell types. • Describe how cell culture can be used for in vitro studies and commercial applications. 		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 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. Segal&R.L.Press 8. Animal cell culture and technology by Michael Buttler 		

Biotechnology-SEC-II- Practical- II- Animal Tissue Culture II	
Practical	
Marks: 25	
Credits: 01(Contact Hours-30)	
Sr. No.	Practical
1	Preparation of Balanced Salt Solution.
2	Separation of serum & plasma from blood by centrifugation.
3	Cell Separation by Trypsinization.
4	Cell Counting.

Biotechnology-VEC- I Conservation Biotechnology

Theory

Marks: 50

Credits: 02(Contact Hours-30)

UNIT	Content	Contact Hrs
I	Introduction : Definition, Significance and application of conservation. Types of conservation of biodiversity- In Situ and Ex situ conservation methodology, Cryopreservation.	15
II	Techniques In Conservation: Germ line conservation, Gene bank, Seed immobilization, Seed conservation, Cell line conservation, Sperm conservation, Embryo conservation – methods and importance	15

About the course:

This course includes importance and significance of conservation which helps in maintaining environmental evolution and also helps to preserve varieties produced by modern biotechnology.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Able to understand importance of conservation.
- Get Familiar with various types of conservation.

Briefly introduced with various techniques of conservation at different levels that is organism, organ, Gene etc.

Suggested Readings:

1. Culture of animal cell 3rd edition-R Ian Freshney
2. Animal cell culture- R.W.Masters
3. Animal biotechnology-M.M.Ranga
4. Animal biotechnology-R . Sasidhara
5. Plant tissue culture-Kalyankumar De

Biotechnology-CC-II: Health & Wellness 2 :Medicinal plants Theory		
Marks: 25		Credits: 01(Contact Hours-15)
UNIT	Content	Contact Hrs
I	<p>History Of Plants As Medicine: Traditional systems of medicine which use medicinal plants and therapeutic uses; Contribution of medicinal plants to alternative and modern medicine</p> <p>Medicinal uses: Plants as ancient and modern medicine for various illnesses (cough, cold, fever, and immunity boosters), digitalis steroids and the drug plants: cannabis, tobacco, opium poppy seeds, coca etc., and Side effects of steroids. Future of medicinal plants</p>	15
<p>About the course: This course is an introduction to medicinal plants and how they can be used to treat illnesses.</p> <p>Learning Outcomes: After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> • Examine both the historical and biochemical aspects of integrating plant based medicine into personal health plan. • Develop an understanding of plants will be useful in treating based on this knowledge. 		
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Taiz and Zeiger, Plant Physiology, 3rd Edition, Panima Publishing Corporation, New Delhi, 2003 2. Bioactive Compounds of Medicinal Plants Properties and Potential for Human Health- Megh R. Goyal, Ademola O. Ayeleso, June 2018 3. The Encyclopedia of Medicinal Plants-Andrew Chevallier 4. Indian Medicinal Plants: P. K. Warrier, V. P. K. Nambiar, C. Ramankutty 		

Biotechnology-CC-II Practical- II- Health & Wellness 2 :Medicinal plants Theory	
Marks: 25	
Credits: 01(Contact Hours-30)	
Sr. No.	Practical
1	To extract essential oils
2	To extract bioactive compounds
3	Preparation of herbal remedies
4	Preparation of creams or ointments
5	To study column chromatography

Annexure: I

**Walchand College of Arts and Science, (Autonomous) Solapur
B. SC. Part – I Semester I & II (w.e.f. July, 2023)**

**Question Paper for Class Room Test (IE)
(02 Credit Theory Course)**

Marks: 10

Q.No.1 Multiple choice questions - 04 marks.

Q.No.2 Attempt any two - 06 marks.

a)

b)

c)

Annexure: II:

**Walchand College of Arts and Science, (Autonomous) Solapur
B. SC. Part – I Semester I & II (w.e.f. July, 2023)**

**Question Paper for Class Room Test (IE)
(04 Credit Theory Course)**

Marks: 20

Q.No.1 Multiple choice questions - 08 marks.

Q.No.2 Attempt any two - 12 marks.

a)

b)

c)

Annexure-III

**Scheme of Marking for Internal Examination (IE)
B. SC. Part – I Semester I & II (w.e.f. July, 2023)
(02 Credit Practical Course)**

Time: 2 hours

Total Marks: 20

Q.1. Proceed to perform _____
10

OR

Q.1. Proceed to perform _____
10

OR

Q.2. Laboratory Record (Certified Journal) 05

Q.3. Attendance 05

Walchand College of Arts and Science (Autonomous), Solapur
Theory question paper Pattern for 4 credit course as per NEP 2020 (ESE)
w. e. f. 2023

Examination: _____

Class: B. Sc.

Subject:

Time: 2.5 hrs

Semester:

Paper:

Marks: 60

Instructions:

1. All questions are compulsory
2. Figures to the right indicate full marks
3. Draw neat labelled drawings wherever necessary

Q. No.1 Choose the correct alternative from the following **08**

- i) a) b) c) d)
- ii)
- iii)
- iv)
- v)
- vi)
- vii)
- viii)

Q. No.2 Answer the following questions (Any six) **12**

- i)
- ii)
- iii)
- iv)
- v)
- vi)
- vii)
- viii)

Q. No.3 Answer the following questions (Any two) **12**

- i)
- ii)
- iii)

Q. No.4 Answer the following questions (Any two) **12**

- i)
- ii)
- iii)

Q. No.5 Answer the following questions (Any two) **16**

- i)
- ii)
- iii)

Walchand College of Arts and Science (Autonomous), Solapur
Theory question paper Pattern for 2 credit course as per NEP 2020 (ESE)
w. e. f. 2023

Examination: _____

Class: B. Sc.

Semester:

Subject:

Paper:

Time: 1.5 hrs

Marks: 30

Instructions:

4. All questions are compulsory
5. Figures to the right indicate full marks
6. Draw neat labelled drawings wherever necessary

- | | |
|--|-----------|
| Q. No.1 Select the correct alternative of the following | 06 |
| i) | |
| a) b) c) d) | |
| ii) | |
| iii) | |
| iv) | |
| v) | |
| vi) | |
| Q. No.2 Attempt the following (Any three) | 06 |
| i) | |
| ii) | |
| iii) | |
| iv) | |
| v) | |
| Q. No.3 Attempt the following (Any two) | 06 |
| i) | |
| ii) | |
| iii) | |
| Q. No.4 Attempt the following (Any two) | 06 |
| i) | |
| ii) | |
| iii) | |
| Q. No.5 Attempt the following (Any one) | 06 |
| i) | |
| ii) | |

Walchand College of Arts and Science (Autonomous), Solapur
Theory question paper Pattern for 1 credit course as per NEP 2020 (ESE)
w. e. f. 2023

Examination: _____

Class: B. Sc.
Subject:
Time: 1.5 hrs

Semester:
Paper:
Marks: 25

Instructions:

1. All questions are compulsory
2. Figures to the right indicate full marks
3. Draw neat labelled drawings wherever necessary

Q. No.1 Select the correct alternative of the following **05**

- i) a) b) c) d)
- ii)
- iii)
- iv)
- v)

Q. No.2 Attempt the following (Any five) **05**

- i)
- ii)
- iii)
- iv)
- v)
- vi)
- vii)

Q. No.3 A) Attempt the following (Any one) **03**

- i)
- ii)

B) Attempt the following (Any one) **02**

- i)
- ii)

Q. No.3 A) Attempt the following (Any one) **03**

- i)
- ii)

B) Attempt the following (Any one) **02**

- i)
- ii)

Q. No.5 Attempt the following (Any one) **05**

- i)
- ii)

Scheme of Marking for End Semester Examination (ESE)
(02 Credit Practical Course)
Semester-I & II

Time: 2 hours**Total Marks: 30**

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

Q.2. Write the principle of _____ 05

OR

Q.2. Write the principle of _____ 05

Q.3. Laboratory Record (Certified Journal) 05

Q.4. Viva Voce 05

Scheme of Marking for End Semester Examination (ESE)

(01 Credit Practical Course for CC)

Time: 1.5 hours

Total Marks: 25

Q.1. Proceed to perform _____ 20

OR

Q.1. Proceed to perform _____ 20

Q.2. Laboratory Record (Certified Journal) 05