B.Sc. (Botany) CBCS syllabus

(Three years programme)

School of Applied Sciences

Centurion University of Technology & Management

2018

CHOICE BASED CREDIT SYSTEM IN B.Sc.(Honours)

<table>
<tr><th>Semester</th><th>Basket-1</th><th>Basket-2</th><th colspan="2">Basket-3+4</th><th colspan="2">Basket-5</th><th></th></tr>
<tr><th>Sl. No.</th><th>CORE COURSE
(14)
Total 84
Credits</th><th>Ability Enhancement
Compulsory
Course (AECC)
(2)
Total 4 Credits</th><th>Domain** From Same/Related Discipline Minimum 26 Credits</th><th>Non-Domain [Skill Enhancement Course (SEC)-(2)
Minimum 4 Credits
+
Discipline Specific Elective(DSE)-(4)]
Minimum 24 credits</th><th>Non-Domain
Generic
Elective(GE)
(4)</th><th>Domain** from Other Discipline Minimum 26 Credits</th><th>Semester wise Cumulative Credits</th></tr>
<tr><td>I</td><td>C 1
C2</td><td>(English / MIL Communication)/
Environmental Science</td><td rowspan="10">Domain Course of minimum 26 credits
upto a maximum of 36 credits</td><td></td><td>GE – 1</td><td rowspan="10">Domain Course of minimum 26 credits upto a maximum of 36 credits</td><td>Minimum 20
Credits</td></tr>
<tr><td>II</td><td>C 3
C 4</td><td>Environmental Science/(English/ MIL Communication)</td><td></td><td>GE – 2</td><td>Minimum 20
Credits</td></tr>
<tr><td>III</td><td>C 5
C 6
C 7</td><td></td><td>SEC – 1</td><td>GE – 3</td><td>Minimum 26
Credits</td></tr>
<tr><td>IV</td><td>C 8
C 9
C 10</td><td></td><td>SEC – 2</td><td>GE - 4</td><td>Minimum 26
Credits</td></tr>
<tr><td>V</td><td>C 11
C 12</td><td></td><td>DSE – 1
DSE – 2</td><td></td><td>Minimum 24
Credits</td></tr>
<tr><td>VI</td><td>C 13
C 14</td><td></td><td>DSE – 3
DSE (Project)– 4</td><td></td><td>Minimum 24
Credits</td></tr>
<tr><td colspan="7">Total Credits</td><td>Minimum 140</td></tr>
<tr><td colspan="7">* A student can opt more number of Domain /GE courses up to a maximum of 20 credits over the period of six semesters.</td><td>Maximum 160</td></tr>
<tr><td colspan="7">**Each Domain must contain a Skill Component</td><td></td></tr>
</table>

Basket-1

Core Courses (CC)

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1.	BSBO1101	Phycology and Microbiology	Theory + Practice	4-2-0	6
2.	BSBO1102	Biomolecules & Cell biology	Theory + Practice	4-2-0	6
3.	BSBO1201	Mycology & Phytopathology	Theory + Practice	4-2-0	6
4.	BSBO1202	Archegoniate	Theory + Practice	4-2-0	6
5.	BSBO2301	Anatomy of Angiosperms	Theory + Practice	4-2-0	6
6.	BSBO2302	Economic Botany	Theory + Practice	4-2-0	6
7.	BSBO2303	Basics of Genetics	Theory + Practice	4-2-0	6
8.	BSBO2401	Molecular Biology	Theory + Practice	4-2-0	6
9.	BSBO2402	Plant Ecology and Phytogeography	Theory + Practice	4-2-0	6
10.	BSBO2403	Plant Systematics	Theory + Practice	4-2-0	6
11.	BSBO3501	Reproductive Biology of Angiosperm	Theory + Practice	4-2-0	6
12.	BSBO3502	Plant Physiology	Theory + Practice	4-2-0	6
13.	BSBO3601	Plant Metabolism	Theory + Practice	4-2-0	6
14.	BSBO3602	Plant Biotechnology	Theory + Practice	4-2-0	6
	Total				**84**

Basket-2

Ability Enhancement Compulsory Course (AECC)

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSFL1101 OR FCBS0101	English OR Environmental Science	Theory	2-0-0	2

Basket-3+4

Domain / Non Domain Courses

DOMAIN - Herbal Science and Medico Botany

Sl. No	Code	Course Name	Type of Course	T-P-Pr (Credit)	Credits
1	DEHB0401	Medicinal Botany	Theory + Practice	4-2-0	6
2	DEHB0402	Traditional Botany and Phytochemistry	Theory + Practice	4-2-0	6
3	DEHB0403	Advance Pharmacognosy	Theory	4-0-0	4
4	DEHB0404	Standardization and Quality Control of ASU Drugs	Theory + Practice	4-2-0	6
6	DEET0300	Project	Practice	0-0-6	6
				Total	**28**

Note: Any two (for Non-Domain)/any-one or as deemed fit (for Domain) Skill Enhancement Courses to be chosen from the above list.

DOMAIN - Food Preservation and Industrial Microbiology

Sl. No	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	DEFM0401	Fundamentals of Industrial Microbiology	Theory + Practice	4-2-0	6
2	DEFM0402	Basic Microbial Techniques	Theory + Practice	4-2-0	6
3	DEFM0403	Food Microbiology	Theory + Practice	4-2-0	6
4	DEFM0404	Quality Assurance in Food Preservation Methods	Theory	4-0-0	4
6	DEET0300	Project	Practice	0-0-6	6
				Total	**28**

Note: Any two (for Non-Domain)/any-one or as deemed fit (for Domain) Skill Enhancement Courses to be chosen from the above list.

Non Domain Courses (DSE Courses)

Sl.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSBO3503	Analytical Techniques in Plant Sciences	Theory + Practice	4-2-0	6
2	BSBO3504	Biostatistics	Theory + Practice	4-2-0	6
3	BSBO3603	Bioinformatics	Theory + Practice	4-2-0	6
4	DEET0300	Project	Practice	0-0-6	6

Skill Enhancement Courses

Sl. No.	Code	Subject Name	Type of course	T-P-Pr (Credit)	Credits
1	BSLS2001	Techniques in Bio-fertilizer	Practice	0-2-0	2
2	BSLS2002	Skill in Apiculture	Practice	0-2-0 0-2-0	2
3	BSLS2003	Herbal Technology	Practice	0-2-0	2
	BSLS2004	Techniques in Medical Diagnostics	Practice	0-2-0	2
5	BSLS2005	Tools and Techniques in Bioscience	Practice	0-2-0	2
6	BSLS2006	Vermicomposting	Practice	0-2-0	2
7	BSLS2007	Food Processing	Practice	0-2-0	2
8	BSLS2008	Mushroom Cultivation	Practice	0-2-0	2
9	BSLS2009	Plant Tissue Culture	Practice	0-2-0	2
10	BSLS2010	Nursery and Gardening	Practice	0-2-0	2

Note: Any two (for Non-Domain)/any-one or as deemed fit (for Domain) Skill Enhancement Courses to be chosen from the above list.

Basket-5

Generic Elective (GE)

(Subjects from other Disciplines)

Basket-1 Core Courses (CC)

BSBO1101 PHYCOLOGY AND MICROBIOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PHYCOLOGY AND MICROBIOLOGY	**BSBO1101**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The course has been developed to provide the students basic knowledge about viruses, viroids, Prions, bacteria and algae. The students will explore the living world which is not visible to naked eye.
- The students will learn about how molecular entities like viruses have been used or can be exploited in future in the production of vaccines and medicines, disease diagnosis and in research.

Learning outcome

Upon successful completion of this course, students will be able to:

- Acquire, articulate, retain and apply specialized language and knowledge relevant to microbiology.
- Acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Introduction to microbial world: Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Module-II (7Hrs)

Viruses: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structurewith special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

Module-III (7Hrs)

Bacteria: Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

Module-IV (8Hrs)

Algae: General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, H.D. Kumar, M.O.P.Iyengar).Role of algae in the environment, agriculture, biotechnology and industry.

Module-V(8Hrs)

Cyanophyta and Xanthophyta: Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and *Vaucheria*

Module-VI (7Hrs)

Chlorophyta and Charophyta: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycles of *Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara.*

Module-VII (7Hrs)

Phaeophyta and Rhodophyta: Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus, Fucus* and *Polysiphonia.*

Phycology and Microbiology Lab

Experiments:

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology

1. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), *Volvox, Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus* and *Polysiphonia,* through electron micrographs, temporary preparations and permanent slides.

Text Book:

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.

Reference Book:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
2. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
3. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
4. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi

BSBO1102 BIOMOLECULES AND CELL BIOLOGY

SubjectName	Code	Type of course	T-P-Pr (Credit)	Prerequisite
BIOMOLECULES & CELL BIOLOGY	**BSBO1102**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- Exploration of different types of biomolecules.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Carry out a range of laboratory exercises, demonstrating the development of practical scientific skills
- Know about the structure and functions of macromolecules and the major organelles that occur in eukaryotic cells.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (10Hrs)

Biomolecules I: Types and significance of chemical bonds; Structure and properties of water; pH and buffers.**Carbohydrates:** Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.
Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties;
Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.

Module-II (6Hrs)

Biomolecules II: Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Module-III (8Hrs)

Bioenergenetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, Phosphoglycerides. Coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.
Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prostheticgroup; Classification of enzymes; Features of active site, substrate specificity, mechanism of action

(activation energy, lock and key hypothesis, induced - fit theroy), Michaelis– Mentenequation, enzyme inhibition and factors affecting enzyme activity.

Module-IV (7Hrs)

The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endo symbiotic theory).
Cell wall and plasma membrane: Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Module-V (8Hrs)

Cell organelles:
Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.
Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.
Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.

Module-VI (7Hrs)

Endomembrane system: Endoplasmic Reticulum–Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus

Module-VII (6Hrs)

Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle-checkpoints, role of protein kinases.

Biomolecules and Cell Biology Lab

Experiments:
1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cyto-chemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Text Books:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition. W.H. Freeman and Company.

Reference Book:

1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer 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

BSBO1201 MYCOLOGY AND PHYTOPATHOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
MYCOLOGY & PHYTOPATHOLOGY	**BSBO1201**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Demonstrate an understanding of the principles of plant pathology and the application of these principles in the control of plant disease.
- Human as well plant life is highly dependent upon the microbes present in the environment. These microbes interact with the other forms of life and affect them either positively or negatively. The aim of the course is to give understanding of Fungi, their structure and function, effect on living world, economic importance etc.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about the introduction to the science of plant pathology. Topics include causal agents of plant diseases, symptoms and diagnoses, modes of infection and spread, effects of the environment on disease development, and methods of disease control.
- Know plant's defense mechanisms, and conventional and novel control strategies practiced in plant disease management with some emphasis on molecular tools that are presently in use to understand these mechanisms and phenomena.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		***100***	

Course Outline

Module-I (10 Hrs)

Introduction to true fungi: General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.
Chytridiomycota and Zygomycota: Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium, Rhizopus.*

Module-II (10 Hrs)

Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces, Aspergillus*, *Penicillium*, *Alternaria, Neurospora* and *Peziza.*
Basidiomycota : General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation.

Module-III (6 hrs)

Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.
Oomycota: General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo.*

Module-IV (6Hrs)

Symbiotic associations: Lichen–Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Module-V (8 Hrs)

Applied Mycology: Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites(Pharmaceutical preparations); Agriculture (Bio-fertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides).

Module-VI (6Hrs)

Phytopathology: Terms and concepts; General symptoms of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

Module-VII (6Hrs)

Bacterial diseases: Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco, Mosaic viruses. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Mycology and Phytopathology Lab

Experiments:

1. Introduction to the world of fungi (Unicellular, coenocytic / septate mycelium, ascocarps & basidiocarps).

2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.

3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. *Peziza*: sectioning through ascocarp.
5. *Alternaria:* Specimens/photographs and temporary mounts.

6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/mounts of spores on wheat and permanent slides of both the hosts.

7. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy ringsand bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of 20 *Stemonitis* sporangia.

9. *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.

10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)

11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Text Book:

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.

2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.

Reference Book:

3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

BSBO1202 ARCHEGONIATE

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ARCHEGONIATE	**BSBO1202**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- To know the principles of Archegoniate taxonomy.
- To know economic importance of archegoniate.
- Studying the archegoniate phylogeny.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn brief summary of the knowledge or skill the course of archegoniate taxonomy.
- Knowledge of extant and extinct species of archegoniate.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Bryophytes: General characteristics; Adaptations to land habit; Classification; Range of thallus organization.
Type Studies- Bryophytes: Classification (up to family), morphology, anatomy and reproduction of *Riccia, Marchantia, Pellia, Porella.*

Module-II (8Hrs)

Type Studies- Bryophytes: Classification (up to family), morphology, anatomy and reproduction of, *Anthoceros, Sphagnum and Funaria*.

Module-III (7Hrs)

Reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

Module-IV (8Hrs)

Pteridophytes: General characteristics; Classification; Early land plants (*Cooksonia*and*Rhynia*).

Type Studies- Pteridophytes: Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*,(Developmental details not to be included).

Module-V (8Hrs)

Type Studies- Pteridophytes: Classification (up to family), morphology, anatomy and reproduction *Equisetum* and *Pteris* (Developmental details not to be included).

Module-VI (6Hrs)

Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution; Ecological and economic importance.

Module-VII (7Hrs)

Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and economic importance.

Archegoniate Lab

Experiments:

1. ***Riccia***–Morphology of thallus.

2. ***Marchantia***- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).

3. ***Anthoceros***- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters,columella) (temporary slide), vertical section of thallus (permanent slide).

4. ***Pellia, Porella***- Permanent slides.

5. ***Sphagnum***- Morphology of plant, whole mount of leaf (permanent slide only).

6. ***Funaria***- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.

7. ***Psilotum***- Study of specimen, transverse section of synangium (permanent slide).

8. ***Selaginella***- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).

9. ***Equisetum***- Morphology, transverse section of internode, longitudinal section of strobilus, transversesection of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

10. ***Pteris***- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slides)

Text Book:

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.

2. Bhatnagar, S.P. &Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

Reference Book:

3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.

4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.

5. Vanderpoorten, A. &Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

BSBO2301 ANATOMY OF ANGIOSPERMS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ANATOMY OF ANGIOSPERMS	**BSBO2301**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Evaluate the importance of various plant tissues in plant development
- Evaluate the stages of plant growth and development
- To understand the conduction path of water and mineral nutrients.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about different types of cells, tissue and tissue system along with the internal anatomical structures of root, shoot, and leaves, of representative monocot and dicot angiosperm plants.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy**.**

Structure and Development of Plant Body: Internal organization of plant body: The three tissue systems, types of cells and tissues.

Module-II (8Hrs)

Development of plant body: Polarity, Cyto differentiation and organogenesis during embryogenic development.

Tissues: Classification of tissues; Simple and complex tissues (no phylogeny), Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers

Module-III (8Hrs)

Apical meristems: Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto histological zonation); Types of vascular bundles; Structure of dicot and monocot stem.

Module-IV (7Hrs)

Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy.Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Rootcap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.

Module-V (7Hrs)

Vascular Cambium and Wood: Structure, function and seasonal activity of cambium; Secondary growth in root and stem.

Module-VI (7Hrs)

Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology; Development and composition of periderm, rhytidome and lenticels.

Module-VII (7Hrs)

Adaptive and Protective Systems: Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and non-glandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

Anatomy of Angiosperms Lab

Experiments:

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates;xylemfibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Text Book:

1. Dickison, W.C. (2000). Integrative Plant Anatomy.Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy.Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.

Reference Book:

1. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development, .John Wiley and Sons, Inc.

BSBO2302 ECONOMIC BOTANY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ECONOMIC BOTANY	**BSBO2302**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Investigate utilization and domestification of crop plant throughout history.
- Study origin, distribution, botanical description, brief idea of cultivation and economic uses of pulses.
- Analyze morphological description, brief idea of cultivation and economic uses of medicinal plants.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the importance of plant identification.
- Participate in plant identification using observation skills.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Origin of Cultivated Plants Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Module-II (8Hrs)

Cereals: Wheat and Rice (origin, morphology, processing & uses); Brief account of millets.
Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Module-III (7Hrs)

Sources of sugars and starches: Morphology and processing of sugarcane, products and by-products ofsugarcane industry.Potato – morphology, propagation & uses.

Module-IV (7Hrs)

Spices: Listing of important spices, their family and part used. Economic importance with special reference tofennel, saffron, clove and black pepper
Beverages: Tea, Coffee (morphology, processing & uses)

Module-V (7Hrs)

Sources of oils and fats: General description, classification, extraction, their uses and health implicationsgroundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Module-VI (8Hrs)

Natural Rubber: Para-rubber: tapping, processing and uses. **Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to C*inchona, Digitalis,Papaver*and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards).

Module-VII (7Hrs)

Timber plants: General account with special reference to teak and pine.
Fibers: Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).

Economic Botany Lab

Experiments:

1. **Cereals**: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. **Legumes**: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. **Sources of sugars and starches**: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habitsketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m.starch grains, micro-chemical tests).
4. **Spices:** Black pepper, Fennel and Clove (habit and sections).
5. **Beverages**: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. **Sources of oils and fats**: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
7. **Essential oil-yielding plants**: Habit sketch of*Rosa*,*Vetiveria*, *Santalum*and*Eucalyptus*(specimens/photographs).
8. **Rubber**: specimen, photograph/model of tapping, samples of rubber products.
9. **Drug-yielding plants**: Specimens of*Digitalis*, *Papaver*and*Cannabis.*
10. **Tobacco**: specimen and products of Tobacco.
11. **Woods:** *Tectona, Pinus*: Specimen, Section of young stem.
12. **Fiber-yielding plants**: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiberand test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Text Book:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.

Reference Book:

1. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture.Jones & Bartlett_ Publishers.

BSBO2303 BASICS OF GENETICS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
BASICS OF GENETICS	**BSBO2303**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The basic principles of inheritance at the molecular, cellular and organism levels.
- Describe the mechanisms governing Mendelian inheritance, gene interactions, and gene expression.
- Apply principles of genetics to real-world problems in biology.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Apply quantitative problem-solving skills to genetics problems and issues
- Demonstrate their ability to reason both inductively and deductively with experimental information and data.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Mendelian genetics and its extension: Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis

Module-II (8Hrs)

Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits

Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast;Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium.*

Module-III (7Hrs)

Linkage, crossing over and chromosome mapping: Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Module-IV (7Hrs)

Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Euploidy and Aneuploidy

Module-V (8Hrs)

Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Baseanalogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClBmethod.Role of Transposons in mutation.DNA repair mechanisms.

Module-VI (8Hrs)

Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

Module-VII (7Hrs)

Population and Evolutionary Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

Basics of Genetics Lab

Experiments:

1. Meiosis through temporary squash preparation.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
3. Chromosome mapping using point test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1,9:3:4).
6. Blood Typing: ABO groups & Rh factor.
7. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
8. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
9. Study of human genetic traits: Sickle cell anemia, XerodermaPigmentosum, Albinism, red-green Colour blindness, Widow's peak, rolling of tongue, Hitchhiker's thumb and attached ear lobe.

Text Book:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition

Reference Book:

1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

BSBO2401 MOLECULAR BIOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
MOLECULAR BIOLOGY	**BSBO2401**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline.
- This course will emphasize the molecular mechanisms of DNA replication, repair, protein synthesis etc.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Molecular Biology gives you in-depth knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.
- You will gain an understanding of chemical and molecular processes that occur in and between cells

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Nucleic acids: Carriers of genetic information: Historical perspective; DNA as the carrier of geneticinformation (Griffith's, Hershey &Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.

Module-II (7Hrs)

The Structures of DNA and RNA / Genetic Material :DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves;

Module-III (8Hrs)

Organization of DNA- Prokaryotes, Viruses, Eukaryotes. Organelle DNA -- mitochondria and chloroplast DNA. The Nucleosome_ Chromatin structure- Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin. RNA Structure_

Module-IV (9Hrs)

The replication of DNA : Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semiconservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis anddiscovery of Mrnatemplate), Genetic code (deciphering & salient features**)**

Module-V (7Hrs)

Transcription: Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation;Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E.coli.* Eukaryotes: transcription factors; Gene silencing.

Module-VI (7Hrs)

Processing and modification of RNA : Split genes-concept of introns and exons, removal of introns,spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing(5' cap, 3' polyA tail); Ribozymes; RNA editing and mRNA transport.

Module-VII (7Hrs)

Translation : Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyltRNAsynthetases;

Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides;Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

Molecular Biology Lab

Experiments:

1. Preparation of LB medium and raising *E.Coli.*
2. Isolation of genomic DNA from *E.Coli.*
3. DNA isolation from cauliflower head.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel&Conrat's experiments)
8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Text Book:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics.John Wiley and Sons Inc., U.S.A. 5th edition.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.

4. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.

Reference Books:

1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

BSBO2402 PLANT ECOLOGY AND PHYTOGEOGRAPHY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PLANT ECOLOGY AND PHYTOGEOGRAPHY	**BSBO2402**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- This course will provide to understand the major factors influencing the geographic distribution of species.
- Be able to understand the ecological context in which a particular species may have evolved, or a specific ecological process takes place.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Have increased capacity to think critically; ability to design and execute an experiment; confidence and ability in communicating ideas.
- Serve as a lasting and practical basis for a career, for example, in research whether industry or academia - as well as teaching, media, law, commerce, government or management.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Basic concepts; Levels of organization.Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.

Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soilprofile; Role of climate in soil development.

Module-II (8Hrs)

Water : Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog,snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Light, temperature, wind and fire: Variations; adaptations of plants to their variation.

Module-III (6Hrs)

Biotic interactions: Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis,commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.

Module-IV (7Hrs)

Population ecology: Characteristics and Dynamics .Ecological Speciation

Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Module-V (7Hrs)

Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

Module-VI (7Hrs)

Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity;Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Module-VII (9 Hrs)

Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of majorterrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.

Plant Ecology and Phytogeography Lab

Experiments:

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of Ph of various soil and water samples (Ph meter, universal indicator/Lovibond comparator and Ph paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley& Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.

7. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
   (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with
   Raunkiaer's frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
11. Field visit to 15amiliarize students with ecology of different sites.

Text Book:

1. Odum, E.P. (2005). Fundamentals of ecology.Cengage Learning India Pvt. Ltd., New Delhi. 5thedition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment.Rastogi Publications, Meerut, India.8th edition.

Reference Book:

1. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.

2. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

BSBO2403 PLANT SYSTEMATICS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PLANT SYSTEMATICS	**BSBO2403**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The major features and evolutionary origins of vascular plants
- Identification of plants using dichotomous keys.
- The major features and evolutionary origins of vascular plants
- Collect, preserve and identify herbarium specimens in a phylogenetic context.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Develop understanding of major patterns in the evolution of seed plants. An *appreciation* of seed plant diversity. A basic *understanding* of the principles of phylogenetic systematics.
- Define order, family, genus and species. Students will understand the process of plant.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination

	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Significance of Plant systematics Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data.

Module-II (8Hrs)

Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access.

Module-III (6Hrs)

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Module-IV (7Hrs)

Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Module-V (9Hrs)

Systems of classification: Major contributions of Theophrastus, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Module-VI (7Hrs)

Biometrics, numerical taxonomy and cladistics
Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Module-VII (8Hrs)

Phylogeny of Angiosperms Terms and concepts (primitive and advanced, homology and analogy, parallelismandconvergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram)

Plant Systematics Lab

Experiments:

1. Study of vegetative and floral characters of the following families (Description, ovary, floral diagram/s, floral formula/e and systematic position according to Bentham& Hooker's system of classification):

i. Ranunculaceae - *Ranunculus, Delphinium*

ii. Brassicaceae - *Brassica, Alyssum / Iberis*

iii. Myrtaceae - *Eucalyptus, Callistemon*

iv. Umbelliferae - *Coriandrum /Anethum / Foeniculum*Asteraceae - *Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax*Solanaceae - *Solanumnigrum/Withania*Lamiaceae - *Salvia/Ocimum*

v. Euphorbiaceae - *Euphorbia hirta/E.milii, Jatropha*

vi. Liliaceae - *Asphodelus/Lilium/Allium*

vii. Poaceae - *Triticum/Hordeum/Avena*

2. Field visit (local) – Subject to grant of funds from the university.
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Text Book:

1. Singh, (2012). *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.
2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.*Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach.Sinauer Associates Inc., U.S.A. 2nd edition.

Reference Book:

4. Maheshwari, J.K. (1963). *Flora* of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of *Plant Systematics*.Harper and Row, New York.

BSBO3501 REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
REPRODUCTIVE BIOLOGY OF ANGIOSPERMS	**BSBO3501**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- To study the development of the different parts of the flower, and how these regions further develop to form the fruit with its seeds.
- To observe some of the variation in different parts of sample fruits, and relate these modifications to changes in function.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Differentiate among annual, biennial, and perennial plants.
- Differentiate between complete and incomplete flowers, and between monoecious and dioecious plants.
- Explain the process, locations, and significance of angiosperm gametogenesis and fertilization, including double fertilization.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Introduction History: (contributions of G.B. Amici, W. Hof Strasburger, S.G. Nawaschin, P. Maheshwari,B.M. Johri, W.A. Jenen, J. Heslop-Harrison) .
Reproductive development: Induction of flowering; flower as a modified determinate shoot. Flowerdevelopment: genetic and molecular aspects. Anther and pollen biology Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance.

Module-II (10Hrs)

Microgametogenesis; Pollen wallstructure, MGU (male germ unit) structure, NPC system; Palynology andscope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.Ovule Structure; Types; Special structures–endothelium, obturator, aril, caruncle .

Module-III (6Hrs)

Female gametophyte: Megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonumtype); Organization and ultrastructure of mature embryo sac.

Module-IV (7Hrs)

Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

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Module-V (7Hrs)

Self-incompatibility Basic Concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, in vitro fertilization.

Module-VI (7Hrs)

Embryo, Endosperm and Seed Structure and types; General pattern of development of dicot and monocot
embryo and endosperm; Suspensor: structure and functions.

Module-VII (7Hrs)

Embryo-endosperm relationship; Nutrition of embryo;Unusual features; Embryo development in Paeonia.Seed structure, importance and dispersal mechanisms Polyembryony and apomixis Introduction; Classification; Causes and applications.

Reproductive Biology of Angiosperms Lab

Experiments:

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazoliumtest. Germination: Calculation of percentage germination in different media using hanging drop method.
3. Ovule: orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
5. Intra-ovarian pollination; Test tube pollination through photographs.
6. Endosperm: Dissections of developing seeds forendosperm with free-nuclear haustoria.
7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos atvarious developmental stages; Study of suspensor through electron micrographs

Text Book:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryologyof Angiosperms, Vikas Publishing House. Delhi. 5thedition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology.Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.

Reference Book:

1. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
2. Johri, B.M. l (1984). Embryology of Angosperms, Springer-Verlag, Netherlands.

BSBO3502 PLANT PHYSIOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PLANT PHYSIOLOGY	**BSBO3502**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Describe how physiological processes scale up from the functioning of complex structures such as stems, roots and leaves to whole plants and plant communities
- Our objective is to provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the knowledge on metabolism, physiology and structure of plants together with a better understanding of regulation of growth and development and influence of environment.
- Integrate and analyze the data and concepts from current scientific literature

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Plant-water relations: Water Potential and its components,water absorption by roots, aquaporins, pathway of water movement,symplast, apoplast, transmembrane pathways, root pressure, guttation.

Module-II (8Hrs)

Ascent of sap: Cohesion-tension Theory; Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement; Mineral nutrition Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

Module-III (7Hrs)

Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems.

Module-IV (7Hrs)

Translocation in The Phloem: Experimental evidence in support of phloem as the site of sugar translocation, Pressure–Flow Model; Phloem loading and unloading, Source–sink relationship.

Module-V (8Hrs)

Plant Growth Regulator: Discovery, chemical nature (basicstructure**),** bioassay and physiological role of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassino steroids and Jasmonic acid.

Module-VI (7Hrs)

Nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

Module-VII (8Hrs)

Physiology of Flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.
Phytochrome, Crytochromes and Phototropins: Discovery, chemical nature, role in photo morphogenesis, low energy responses (LER) and high irradiance responses (HIR),mode of action.

Plant Physiology lab

Experiments

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study different concentration on Avenacoleoptile elongation (IAA Bioassay).
8. To study the induction of amylase activity in germinating barley grains.
9. To demonstrate suction due to transpiration.
10. Fruit ripening/Rooting from cuttings (Demonstration).
11. Bolting experiment/Avenacoleptile bioassay (demonstration)

Text Book:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant PhysiologyIntroduction John Wiley and Sons. U.S.A. 4th edition.
   TEXT BOOK
2. Taiz, L., Zeiger, E., Mller, I.M. and Murphy, A (2015). Plant Physiology and Development.Sinauer Associates Inc. USA. 6thedition.

Reference Book:

1. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

BSBO3601 PLANT METABOLISM

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite

PLANT METABOLISM	BSBO3601	Theory + Practice	4-2-0 (6)	Nil

Objective

- Explain the purposes of and relationship between photosynthesis and respiration in plants.
- Explain the significance of plant mass gain and loss to larger-scale ecosystem processes, such as the global carbon cycle.
- Describe the sources and sinks involved in the acquisition and utilization of carbon in plant systems.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Understand on the kingdoms of biomolecules, metabolites and pathways that are the prerequisites and consequences of physiological phenomenon for further manipulations.
- Develop integrative approach for visions in biological problems.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (6Hrs)

Concept of metabolism Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes).

Module-II (9Hrs)

Carbon assimilation Historical background photosynthetic pigments, role of photosynthetic pigments(chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII,Q cycle,CO_2reduction,photorespiration,C4pathways; **Crassulacean acid metabolism**; Factors affecting CO_2 reduction.

Module-III (9Hrs)

Carbohydrate metabolism Synthesis and catabolism of sucrose and starch. Carbon Oxidation Glycolysis :fate of pyruvate, regulation of glycolysis, oxidativepentosephosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH,NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

Module-IV (6Hrs)

ATP-Synthesis Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism(oxidative and photophosphorylation), ATP synthase, Boyers conformational model, role of uncouplers.

Module-V (7Hrs)

Lipid metabolism Synthesis and breakdown of triglycerides, β-oxidation, glyoxylatecycle, gluconeogenesisand its role in mobilisation of lipids during seed germination, α oxidation.

Module-VI (7Hrs)

Nitrogen metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.

Module-VII (8Hrs)

Mechanisms of signal transduction: Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade

Plant Metabolism Lab

Experiments:

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Text Book:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology.John Wiley and Sons. U.S.A. 4thedition.
2. Taiz, L., Zeiger, E., MØler, I.M. and Murphy, A (2015). Plant Physiology and Development.Sinauer Associates Inc. USA. 6thedition.

Reference Book:

3. Harborne, J.B. (1973). Phytochemical Methods.John Wiley & Sons. New York

BSBO3602 PLANT BIOTECHNOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PLANT BIOTECHNOLOGY	**BSBO3602**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The objective of the course is to give students new knowledge by handling of classical and modern plant biotechnology processes
- Understanding of biotechnological processes has also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Develop fundamental knowledge in Plant Molecular Biotechnology and its application in laboratory and industry settings.
- Get hands on training with some of the most basic, techniques in micropropagation.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Plant Tissue Culture Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); **Protoplast** isolation, culture and fusion;

Module-II (6Hrs)

Tissue culture applications (micropropagation, and regenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation, Germplasm Conservation).

Module-III (7Hrs)

Recombinant DNA technology Restriction Endonucleases (History, Types I-IV, biological role andapplication) Restriction Mapping (Linear and Circular); Cloning
Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC)Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).

Module-IV (8Hrs)

Gene Cloning Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; **PCR**

Module-V (8Hrs)

Methods of gene transfer Agrobacterium-mediated, Direct gene transfer By Electroporation, Microinjection,Microprojectile bombardment; Selection of transgenics– selectable marker and reportergenes(**Luciferase,GUS, GFP**).

Module-VI (7Hrs)

Applications of Biotechnology Pest resistant (Bt-cotton); herbicide resistant plants(RoundUp Readysoybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice);Improved horticultural varieties (Moondust carnations);

Module-VII (7Hrs)

Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase,Protease, Lipase); GenticallyEngineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

Plant Biotechnology Lab

Experiments

1. (a) Preparation of MS medium.

(b)Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.

2. Study of anther, embryo and endosperm culture micro propagation, micropropagation, somaticembryogenesis&artificia seeds through photographs.
3. Isolation of protoplasts.

4. Construction of restriction map of circular and linear DNA from the data provided.

5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.

6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.

7. Isolation of plasmid DNA.
8. Restriction digestion and gel electrophoresis of plasmid DNA.

Text Book:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam.The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). MolecularBiotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms.Vikas Publication House Pvt. Ltd., NewDelhi. 5thedition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5thedition.

Reference Book:

1. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications.John Wiley & Sons Inc. U.S.A

N.B-Students can choose Generic Elective Subjects from other Departments other than Botany Department as specified by UGC.

Basket-2

Ability Enhancement Compulsory Course (AECC)

BSFL1101 ENGLISH

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ENGLISH	**BSFL1101**	**Theory**	**2-0-0 (2)**	**Nil**

Objective

- To expose the students to a variety of self-instructional, learner-friendly modes of language learning.
- To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
- To maintain good linguistic -through accuracy in grammar, pronunciation and vocabulary.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Ability to communicate fluently in different business situation
- Effective oral and written communication
- Appropriate word usage with correct pronunciation
- Clarity of word stress and intonation.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*30*	Written examination
	Assignment	*05*	Report and Presentation
	Attendance	*05*	Attendance percentage
	Total	***40***	
External Examination		***60***	Written examination
Total		*100*	

Course Outline

Module-I: Communication Skill

Communication: Definition, concept
Channels of Communication: Sender, receiver, channel, message, encoding, decoding, context, feedback
Verbal & Non-Verbal Communication: Spoken & written-advantages & disadvantages, Bias free English,
Formal & informal style.

Module-II: Communicative Grammar

Time, Tense & Aspect
Verbs of state & events
Modality
Active & Passive voice
Antonyms, Synonyms, Homonyms, one word substitutions & correction of errors

Module-III: Sounds of English

Length of vowels:
Long vowels as in the words feel, food, shoot, card etc.
Short vowels as in the words pen, sun, cut, shut, etc.
Consonants
Stress pattern
Intonation: Rising & Falling.

Text Book:

1. Effective technical communication by M.A.Rizvi

Reference Books:

1. Communicative English & Business Communication by R.K.Panda, J.Khuntia, M.Pati, Alok Publication.
2. Communicative Grammar of English Geoffery Leech

FCBS0101 ENVIRONMENTAL SCIENCE

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ENVIRONMENTAL SCIENCE	**FCBS0101**	**Theory**	**2-0-0 (2)**	**Nil**

Objective

- To understand the concept of multi-disciplinary nature of Environmental Science where different aspects are dealt with a holistic approach.
- Students will develop a sense of community responsibility by becoming aware of environmental issues in the larger social context.
- One must be environmentally educated.

Learning outcome

Upon successful completion of this course, students will be able to:

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
- Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
-

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*30*	Written examination
	Assignment	*05*	Report and Presentation
	Attendance	*05*	Attendance percentage
	Total	***40***	

External Examination		***60***	Written examination
Total		*100*	

Course Outline

Module-I (6Hrs)

Environment and its multidisciplinary nature of environmental science; Need for public awareness

Module-II (8Hrs)

Renewable and non -renewable resources–forest, water, mineral, land, food and energy resources; Structure and function of ecosystems of forest, grass land, desert and aquatic types.

Module -III (8Hrs)

Biodiversity and its conservation: Biodiversity at global, national and local levels; Threats to biodiversity - Habitat loss; wild life poaching and man - wildlife conflicts

Module -IV (6 Hrs)

IUCN: Rear, Endangered and endemic species; conservation measures.
Causes, effects and control measures of pollution, air, water and noise pollution; Nuclear hazards

Module -V (8Hrs)

Solid-waste management–Causes, effects and control measures; Management of disasters due to natural causes of floods, earthquakes, cyclones and landslides.

Module-VI (8Hrs)

Social issues and the environment; Sustainable environment, Water conservation measures; Rain water harvesting; Resettlement and rehabilitation of people; Climate change and global warming; Acid rain; Ozone layer depletion; water land reclamation; Consumerism and waste products

Module-VII (7 Hrs)

Features of Environment Protection Act, Air pollution and Control of Pollution Acts; Water Pollution and its Control Act. Effects of Pollution explosion on environment and public health; Need for value education to Protect environment and resources.

Text Book:

1. Anubhav Kaushik & C.P. Kaushik: Environmental Studies-New age International Publishers.

Reference Book:

1. Benny Joseph: Environmental Studies-Tata Mac Graw Hill

2. E. Bharucha: Text book of Environmental Studies for under graduate courses– Universities Press. (Book prepared by UGC Committee).

Basket-3+4
Domain / Non Domain Courses

DOMAIN-Herbal Science and Medico Botany

DEHB0401 MEDICINAL BOTANY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
MEDICINAL BOTANY	**DEHB0401**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The student will be able to know about the importance of medicinal plants.
- They will have an idea about ethnomedicine.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the knowledge of conservation of endangered and endemic medicinal plants.
- Acquire the knowledge of medicinal plants to certain diseases.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module I (8 hrs)

Importance of Medicinal Plants: Role in human health care: health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

Module-II (6 Hrs)

Classification of Medicinal Plants: Based on their effects; Ecological status with special reference to Odisha & India.

Module-III (7 hrs)

Conservation of Endangered and Endemic Medicinal Plants: Definition, endemic andendangered medicinal plants, Importance of Red data book (IUCN)

Module-IV (8 Hrs)

Conservation: *In situ*&*Ex situ* conservation: Biosphere reserves, sacred groves, National Parks;

Botanic Gardens, Ethnomedicinal plant Gardens; Patenting and IPR

Module-V (7 hrs)

Ethnomedicines: Definition, history and its scope; Inter disciplinary approaches in ethnobotany ; ethnic communities of India, Collection of ethnic information , Methods to studyethnobotany

Module-VI (8 Hrs)

Applications of Ethnobotany: National interacts, Palaeo-ethnobotany, ethnoecology
Application of Natural Products to Certain Diseases: Jaundice, cardiac, infertility, diabetics, common cold, contraceptives, dysuria, Blood pressure, skin diseases and organ related diseases.

Module-VII (8 Hrs)

Tribal medicine: Methods of disease diagnosis and treatment; Plants in folk religion(*Aeglemarmelos, Ficusbenghalensis, Curcuma domestica, Cyanodondactylon*and*Sesamumindicum*).

Medicinal Botany Lab

Experiments:

1. Identification and Medicinal value of locally available medicinal plants.
2. Morphological and anatomical identification of the useful plants and plant parts.
3. Vegetative propagation methods.

Text Book:

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd Edn. Agrobios, India.
3. Tyagi, Dinesh Kumar (2005) Pharma Forestry. Field Guide to Medicinal Plants. Atlantic Publishers and Distributors, New Delhi.
4. Faroogi, A.A., and B.S. Sreeramu (2004). Cultivation of Medicinal and Aromatic Crops. University Press (India) Pvt. Ltd., Hyderabad.
5. Handa S.S. and Kaul. K.L. Supplement to cultivation and utilization of medicinal plants.

Reference Book:

1. CSIR - Wealth of India, Raw Materials
2. CSIR- Cultivation and Utilization of Medicinal Plants
3. C.K. Atal and B.M. Kapoor, Cultivation of Medicinal Plants.
4. T. Swain Chemical Plant Taxonomy.

DEHB0402 TRADITIONAL BOTANY AND PHYTOCHEMISTRY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
TRADITIONAL BOTANY AND PHYTOCHEMISTRY	**DEHB0402**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The student will be able to know about Indian Systems of Medicines.
- They will have an idea about different phytochemical constituents of some important medicinal plants.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the nutritive value of plants in daily life.
- Acquire the knowledge of panchamahabhutas, saptadhatu and tridosha concepts.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8 Hrs)

Indian Systems Medicines: Ayurveda, Siddha, Unani (ASU), Homeopathy
Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts; Rasayana, plants used in ayurvedic treatments,

Module-II (7Hrs)

Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine
Unani: History, concept, polyherbal formulations.

Module-III (8Hrs)

Organoleptic study of the following medicinal plants: Fruit (Amla,); Bulb(Garlic); Rhizome (Ginger), seed (castor), Bark (Cinchona), Leaves (Neem) and Flower (Clove)
Plants in day today life: *Ocimum sanctum, Centella asiatica, Solanum trilobatum, Cassia auriculata, Aloe vera.*

Module-IV (8Hrs)

Nutritive and medicinal value of some fruits: Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate, Apple, Jamun
Nutritive and Medicinal value of vegetables: Greens (*Moringa, Solanum nigrum*) Cabbage.

Module-IV (8 Hrs)

Classification of Crude drugs: Taxonomical, Morphological, Pharmacological and chemical classifications; Chemistry of drugs and its evaluation.

Module-VI (7Hrs)

Phytochemical Screening: Analysis of secondary Metabolites, Role of biomarkers in crude ASU drug analysis, isolation and identification of Phyto Constitutent of by using Chromotography;

Module-VII (6 Hrs)

Chemical properties and therapeutic uses of some medicinally important class of Plant Phenolics, Alkaloids, Glycosides, Terpenoides, Steroids and Resinous substances.

Traditional Botany and Phytochemistry Lab

Experiments:

1. Histo – anatomical analysis of crude powder drug of locally available medicinal plants.
2. Study of organoleptic parameters of the plants prescribed in the syllabus.
3. Field study of Herbal preparation of
   a) *Aristolochiaindica*
   b) *Azadirachtaindica*
   c) *Boerhaveadiffusa*
   d) *Vitexnegundo*
   e) *Phyllanthusfraternus*

Text Book:

1. An Introduction to Medicinal Botany and Pharmacognosy – N.C. Kumar, EmkayPublications, Delhi.
2. Herbs that Heal, AcharyaVipulRao – Diamond Pocket Books, New Delhi.
3. Pridham and Swain - Biosynthetic Pathways in Higher Plants.
4. T. Swain, Comparative Phytochemistry.

References Book:

1. Max Wicht, Herbal Drugs and Phytopharmaceuticals, Third Edition - Hardcover Manske.
2. Sim. Medicinal Plant Glycosides.
3. Sim. Medicinal Plant Alkaloids.
4. Max Wichtl, Herbal Drugs and Phytopharmaceuticals, Third Edition
5. Wagner. Wolf- New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutic Activity
6. Reinhold and Liwschitz - Progress in Phytochemistry.
7. Rosenthaler, The Chemical Investigation of Plants.
8. Horborne,Phytochemical methods

DEHB0403 ADVANCE PHARMACOGNOSY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ADVANCE PHARMACOGNOSY	**DEHB0403**	**Theory**	**4-0-0 (4)**	**Nil**

Objective

- The student will be able to know importance in herbal drug industry.
- To aware about WHO Guidelines for cultivation and collection of Herbal Drugs.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about drug adultration and detection.
- Acquire the knowledge of phytochemical investigations.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8Hrs)

Pharmacognosy: Introduction to Pharmacognosy and its importance in herbal drug industry; Classification and vegetable drug with special reference to chemotaxonomy

Module-II (7Hrs)

Collection of Herbal Drugs: WHO Guidelines for cultivation and collection of Herbal Drugs; Factors affecting cultivation of crop including Plant Growth Regulators

Module-III (6 Hrs)

Influence of Mutation, Polyploidy, Hybridization in chemo demes; Insecticides and pesticides of herbal origin and their suitable utilization.

Module-IV (7 Hrs)

Analytical Pharmacognosy: Drug adulteration and detection; Biological testing of herbal drug;

Module-V (8 Hrs)

Phytochemical investigations with reference to secondary metabolites of locally available medicinal plants

Module-VI (7 Hrs)

Application of microscopy in evaluation: T.S./L.S./Surface views of Plant drugs; Use of microtome and preparation of histological slides

Module-VII (8 Hrs)

Determination of various diagnostic features of identification of different organs as per different herbal pharmacopoeias

Text Book:

1. Ramstad, Modem Pharmacognosy.
2. S.B.Gokhale, Dr.C.K. Kokate, A.P. Purohit, Pharmacognosy, Publisher: NiraliPrakasham, Pune.
4. AcharyaVipulRao , Herbs that Heal, Diamond Pocket Books, New Delhi.
5. S.B.Gokhale, Dr.C.K. Kokate, A.P. Purohit ,Pharmacognosy, Publisher: NiraliPrakasham, Pune.
6. N.C. Kumar, An Introduction to Medicinal Botany and Pharmacognosy, Emkay Publications, Delhi.
7. Wagner and Horhammer- Pharmacognosy and Phytochemistry
8. Dr.C.K. Kokate et al, Practical Pharmacognosy

References Book:

1.Varro E. Tyler, Lynn R. Brady and James E. Robberrt, Pharmacognosy .
2. G. E. Trease and W. C. Evans, Pharmacognosy.
5. Margaret L. Vikery and Brian Vikery,Secondary plant metabolism.

DEHB0404 STANDARDIZATION AND QUALITY CONTROL OF ASU DRUGS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
STANDARDIZATION AND QUALITY CONTROL OF ASU DRUGS	**DEHB0404**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- To aware about the general methods of processing of herbs.
- They will have an idea about standardization of herbal raw materials.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about preparation of Crude and Commercial Drugs.
- Acquire the knowledge of Primary processing of herbal products and other guidelines for Quality Assurance of Herbal drugs

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (6 Hrs)

Standardization of ASU Drugs: Introduction to Drug, Standardization, Formulation, Biological screening, toxicity screening, packing

Module-II (8 Hrs)

General Methods of Processing of Herbs: Definition, sources, identification and authentication of herbs
Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions; Methods of drying (Natural and artificial drying methods with their merits and demerits)

Module-III (8 Hrs)

Standardization of Herbal Raw materials: Standardization of herbal raw materials including physical, chemical and biological methods **(**Pharmacological screening of herbal extracts and microbiological evaluation of herbal extracts); toxicity studies of herbal extracts

Module-IV (7 Hrs)

Preparation of Crude and Commercial Drugs: Making infusion, decoction, lotion, washers, Insect repellents, herbal syrups, ointments, herbal oils , detergents.

Module-V (8 Hrs)

Methods of Preparation of Extracts: Principles of extraction (Different methods of extraction including maceration, percolation, hot continuous extraction, with their merits and demerits and selection of suitable extraction method)

Module-VI (7 Hrs)

GMP for the Production of ASU Drugs: Primary processing of herbal products and other guidelines for Quality Assurance of Herbal drugs

Module-VII (7 Hrs)

Stability aspect and PE Gylation based stability of Biopharmaceutical drugs, Stability study of Phytomedicines

Standardization and Quality Control of ASU Drugs Lab

Experiments:

1. To study the extraction process from different plant parts
2. To study the antibacterial activity of herbal extracts
3. To study the antifungal activity of herbal extracts
4. To study the toxicity studies of herbal extracts
5. To prepare of Insect repellents, herbal syrups

Text Book:

1. Sarfaraz K. Niazi, Hand book of Preformulation
2. Manske, The Alkaloid- Chemistry and Physiology.
3. P. D. Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulations .
4. Peach and Tracey, Modern Methods of Plant Analysis.
5. Backett and Stenlake . Practical Pharmaceutical Chemistry

Reference Book:

1. Aulton, Pharmaceutics-The Science of Dosage form design.
2. Wagner, Wolf- New Natural Products and Plant Drugs with Pharmacological,Biological or Therapeutic Activity
3. Jens Carstensen, Drug stability (Principles and Practices)
4. Sarfaraz K. Niazi, Hand book of Preformulation.

5. J. Wells, Pharmaceutical Preformulation.
6. Peach and Tracey, Modern Methods of Plant Analysis.

DEET0300 PROJECT WORK

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PROJECT WORK	**DEET0300**	**Project**	**0-0-6**	**Nil**

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Experiments	*100*	Lab work, report, viva
Total		*100*	

DOMAIN-Food Preservation and Industrial Microbiology

DEFM0401 FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY	**DEFM0401**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The student will be able to know concepts and practices of microbiology in industry.
- They will have an idea about different diseases, mode of transmission of microorganisms and their prevention.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Acquire the knowledge of beneficial microorganisms in pharmaceuticals and fermentation technology.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8 Hrs)

Definition and scope of Industrial Microbiology: Concepts and practices of microbiology proceeded to Industrial Microbiology.

Module-II (8 Hrs)

Industrially important microorganisms: Introduction to industrially important microorganisms: Bacteria, fungi, actinomycetes, microalgae, viruses; Characteristics and sources of industrial microorganisms

Module-III (6 Hrs)

Role of Microorganisms in Various Industries: Role of microorganisms in various industries like leather, textile, paper, detergent food, biofuel industries

Module-IV (7 Hrs)

Pharmaceuticals: Production of therapeutic compound antibiotics (Ansamycins, Rifamycin; Peptide antibiotics Quinolinones),enzymes,biotransformation of steroids, vaccines, vitamins (vitamin B 12 and riboflavin fermentation)

Module-V (7Hrs)

Agriculture: Modern trends in microbial production of biofertilizers (nitrogen fixer *Azotabacter* and Phosphate solubilizing microorganisms),biopesticides,bioinsecticides (thuricide), bioplastics (PHB and PHA), biopolymer (dextran, alginate, xanthan and pullulan)

Module-VI (6 Hrs)

Biofuels: Microorganisms in the process of biogas production (biomethanation); Production of bioethanol from sugar, molasses, starch and cellulosic materials; Microbial production of hydrogen gas, biodiesel from hydrocarbons

Module-VII (8 Hrs)

Fermentation Technology: Types of Fermentation (Aerobic, anaerobic, batch,fed-batch, continuous, submerged surface, solid state); Design of a stirred tank reactor fermentor
Media Preparation and Industrial Sterilization: Fermentation media, preparation and sterilization, development of inoculum, assay of fermentation product, types of fermentation; Growth and fermentation Kinetics

Fundamentals of Industrial Microbiology Lab

Experiments:

1. Preparation of different of culture media and sterilization for cultivation of bacteria & fungi.
2. Isolation and identification of Industrial Microorganisms.
3. Techniques of maintenance of stock cultures.
4. Staining techniques of industrially important microorganisms: Simple, differential and special staining.
5. Culturing of bacteria from different natural sources.
6. Culturing of Yeast from different natural sources.
7. Culturing of Fungi from different natural sources.
8. Culturing of Algae from different natural sources.

Text Book:

1. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
2. Cassida, L.E. (1968). Industrial Microbilogy, Wiley Eastern Ltd. And New Age International Ltd., New Delhi.
3. Crueger, W. and Crueger, A. (2000). Biotechnology – A Text Book of IndustrialMicrobiology, Panima Publishing Corporation, New Delhi
4. Reed, G. (Ed.) (1987). Prescott and Dunn's Industrial Microbiology, 4th Edition, CBS Publishers & Distributors, New Delhi.
5. SubbaRao, N.S. (1999). Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6.SubbaRao, N.S. (1993). Biofertilizers in Agriculture and Forestry, 3rd Edition Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7.Rangaswami, G. and Bhagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Edition, Prentice Hall of India, New Delhi.
8.Alexander, M. (1985). Introduction to Soil Microbiology, 3rd Edition.Wiley Eastern Ltd., New Delhi.

Reference Book:

1. Waites MJ et al. (2001) Industrial Microbiology.Blackwell Science.
2. Casida LE (1999) Industrial Microbiology. Jr.New Age International Publ.
3. Michael R. Ladisch (2001) Bioseparations Engineering: Principles, Practice, and Economics ,wiley.
4. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology - Fundamentals and Applications, Addison Wesley Longman, Inc., USA
5.Paul, E.A. and Clark, F.E. (1989). Soil Microbiology and Biochemistry,Academic Press, USA.

DEFM0402 BASIC MICROBIAL TECHNIQUES

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
BASIC MICROBIAL TECHNIQUES	**DEFM0402**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The student will be able to know the Basic Microbial Techniques.
- They will have an idea about different instruments used in microbiology laboratory.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the methods of culture of microorganism and their maintenance.
- Acquire the knowledge of different microbial techniques for future research.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8 Hrs)

Instrumentation in Microbilogy: Laminar air flow, Autoclave, Oven, pH meter: Principle and working of pH meter, Colony counter, Incubator-shaker, Cyclomixer

Module-I I (8 Hrs)

Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications

Module-III (8 Hrs)

Microscopy: Light microscopy, Camera Lucida, dark field microscopy, Phase contrast microscopy, Fluorescent microscopy, electron microscopy, Scanning and transmission microscopy

Module-IV (8 Hrs)

Electrophoretic Techniques: Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing.

Module-V (8 Hrs)

Spectroscopy: Spectroscopic techniques, theory and applications of Uv, Visible, IR, Fourier Transformed Infrared Spectroscopy (FTIR), NMR (Nuclear Magnetic Resonance) Fluorescence

Module-VI (8 Hrs)

Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.

Module-VII (8 Hrs)

Chromatography: TLC, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography

Basic Microbial Techniques Lab

Experiments:

1. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
2. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
3. Separation of serum protein by horizontal submerged gel electrophoresis.
4. Protein estimation by gel electrophoresis
5. Demonstration of PCR, DNA sequencer and Fermenter.
6. Quantitative estimation of hydrocarbons/pesticides/organic Solvents /methane by Gas chromatography.
7. Separation of haemoglobin or blue dextran by gel filtration.
8. Paper electrophoresis.

Text Book:

1. B.B. Straughan and S. Walker. Spectroscopy. Volume 1. Chapman and Hall Ltd.
2. Chatwal G and Anand, S. (1989): Instrumental Methods of Chemical Analysis Himalaya Publishing House, Mumbai.
6. Hanes: Gel Electrophoresis of Proteins- A Practical Approach
7. TiborKremmery: Gel Chromatography, Wiley Publications.
8. B.P. Straughan and S. Walker. Spectroscopy
6. R. J. Hamilton and P. A. Sewell. Introduction to High Performance Liquid Chromatography
7. Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.

Reference Book:

1. H.H. Willard, L.L. Merritt Jr. and others (1986): Instrumental Methods of Analysis. 6th Edition..CBS Publishers and Distributors.
2. James Miller. John Wiley and Sons(1988). Chromatography: Concepts and Contrasts Inc., New York.
3. Williams, B.L. and Wilson, K. (1975) A Biologists Guide to Principles and Techniques of Practical Biochemistry.

DEFM0404 FOOD MICROBIOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
FOOD MICROBIOLOGY	**DEFM0404**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The student will be able to know sources of food contamination.
- They will have an idea about different industrial microbial fermented products.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Acquire the knowledge of microbial fermentations.
- Learn about microbial productions of antibiotics, beverages, *and amino acids etc.*

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*

	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8 Hrs)

Food and Microbes: Food as a substrate for microbial growth, sources of food contamination, extrinsic and intrinsic factors influencing microbial growth in food; Biochemical changes in food by microorganisms.

Module-II (7Hrs)

Microbial Fermentations: Industrial production of alcohols (ethyl alcohol), beverages (beer), enzymes (amylases),

Module-III (6 Hrs)

Industrial production of antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid), Vitamins (B12)

Module-IV (8 Hrs)

Biofuels (biogas: methane), Production and application of Baker's yeast

Module-V (7 Hrs)

Microbes Used in Food and Dairy Products: Cheese, bread, Vinegar, and dairy products (acidophilus milk, yoghurt)

Module-VI (7 Hrs)

Applications of microbial enzymes in dairy industry [Protease, Lipases], spoilage and defects of fermented dairy products

Module-VII (7 Hrs)

Role of microorganisms in beverages: Tea and coffee fermentations

Food Microbiology Lab

Experiments:

1. Isolation and staining of *Lactobacillus* from curd.
2. Production of fermented milk by *Lactobacillus acidophilus.*
3. Production and estimation of lactic acid by *Lactobacillus* Sp. or *Streptococcus* Sp.
4. Isolation of food poisoning bacteria from contaminated foods.
5. Isolation of food poisoning bacteria from contaminated fruits.
6. Isolation of food poisoning bacteria from contaminated dairy products.
7. Isolation of food poisoning fungi from contaminated fruits.
8. Isolation of food poisoning fungi from contaminated foods (Bread, cooked rice).
9. Extraction and detection of afla toxin from infected foods.
10. Preservation of potato/onion by UV radiation.

Text Book:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
2. Reddy, S.R. and SingaraCharya, M.A. (2007). A Text Book of Microbiology - Applied Microbiology.Himalaya Publishing House, Mumbai.
3. Singh, R.P. (2007). Applied Microbiology.Kalyani Publishers, New Delhi.
4. Adams, M.R. and Moss, M.O. (1996). Food Microbiology, New Age International (P) Ltd, New Delhi.
5.Banwart, G.J. (1987). Basic Food Microbiology, CBS Publishers and Distributors, New Delhi.

Reference Book:

1. Reed G (2004) Industrial Microbiology, by CBS Publishers (AVI Publishing Co.)
2. Davis JE and Demain A.L (1999) Manual of industrial Microbiology and Biotechnology 2nd edition,ASM publications.
3. Doyle et al. MP (2001) Food Microbiology: Fundamentals and frontiers. 2nd Ed. by ASM publications
4. David A. Mitchell (2006) Solid-State Fermentation Bioreactors Fundamentals of Design and Operation.
5. Ray, B. (1996). Fundamentals of Food Microbiology, CRC Press, USA
9. Jay, J.M. (1996). Modern Food Microbiology, Chapman and Hall, New York.
10. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology, McGraw-Hill, New York.

DEHB0404 QUALITY ASSURANCE IN FOOD PRESERVATION METHODS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
QUALITY ASSURANCE IN FOOD PRESERVATION METHODS	**DEHB0404**	**Theory**	**4-0-0 (4)**	**Nil**

Objective

- The student will be able to know microorganisms associated in fermented foods, their quality and standards.
- The student will be able to know about food borne infections and intoxications

Learning outcome

Upon successful completion of this course, the student will be able to:

- Build entrepreneurship.
- Acquire the knowledge of beneficial microorganisms in preservation of vegetables and fruits, milk and milk products, meat and meat products and canned foods.
- Learn to increase the shelf-life of food and its supply during times of scarcity.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments and Attendance	*20*	Lab work and Attendance percentage
External Examination		*60*	Written examination
Total		*100*	

Course Outline

Module-I (8Hrs)

Food Preservation Methods: Principles involved: Radiations: UV, Gamma and microwave Temperature, Asepsis, high and low temperatures, Chemical and naturally occurring antimicrobials , irradiation, drying and food additives

Module-II (8 Hrs)

Preservation of vegetables and fruits, milk and milk products, meat and meat products and canned foods.

Module-III (7 Hrs)

Fermented foods: Fermented foods, their quality and standards; Detection of spoilage and their characterization; Biosensors in food industry

Module-IV (8 Hrs)

Foods Borne Intoxications: Food borne infections and intoxications; bacteria with examples of infective and toxic types: *Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria*

Module-V (6 Hrs)

Mycotoxins: Mycotoxins in food with reference to *Aspergillus* species.

Module-VI (7 Hrs)

Recycling: Preservatives, waste recycling, industrial effluent treatment (Diary, beverage and food industry)

Module-VII (7 Hrs)

Quality Assurance: Microbiological quality standards of food; Government regulatory practices and policies. FDA, EPA, HACCP, ISI.

Text Book:

1. D. Pearlman. Advances in Applied Microbiology, Academic Press.
2. Food Microbiology: Fundamentals and Frontiers. 2nd Edition ,Michaell P. Doyle, Larry R. Beuchat and Thomas I. Montville (Eds.), ASM Publications.
3. Abigail A.Salyers and Dixie D. Whitt (2001) Bacterial Pathogenesis A Molecular Approach.2nd Edition.ASM Publications.
4. Prajapati, Fundamentals of Dairy Microbiology

Reference Book:

1. Adams. Food Microbiology.2nd edition,
2. Banwart George J. Basic Food Microbiology
3.Microbiology of Fermented Foods. Volume II and I. Brian J. Wood .Elsiever, Applied Science Publication.
4. Joshi. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2
5. Robinson. Dairy Microbiology, Volume II and I.
6. Essentials of Food Microbiology. Edited by John Garbult,Arnold International Students Edition.
7. Microbiology of Foods by John C. Ayres. J. OrwinMundt. William E. Sandinee. W. H. Freeman and Co.

Reference Lab Manual:

1. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology, ASM Press, Washington, D.C., USA.
2. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition.Himalaya Publishing House, Mumbai.
3. Reddy, S.M. and Reddy S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
4.Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition.Himalaya Publishing House, Mumbai.
5. Talwar, G.P. and Gupta, S.K. (1992). A Hand Book of Practical and Clinical Immunology.CBS Publications, New Delhi.
6. Baren, E.J. (1994). Bailey and Scott's Diagnostic Microbiology, 9th Edition, Mosby Publishers.
7. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
8. Samuel, K.M. (Ed.) (1989). Notes on Clinical Lab Techniques, M.K.G. Iyyer& Son Publishers, Chennai.
9. Wadher, B.J. and Reddy, G.L.B. (1995). Manual of Diagnostic Microbiology, Himalaya Publishing House, Mumbai.
10.Dey, N.C., Dey, T.K., Dey, M. and Sinha, D. (1998). Practical Microbiology, Protozoology, and Parasitology. New Central Book Agency (P) Ltd. Calcutta.

DEET0300 PROJECT WORK

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
PROJECT WORK	**DEET0300**	**Project**	**0-0-6**	**Nil**

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Experiments	*100*	Lab work, report, viva
Total		*100*	

DSE COURSES (For Non Domain)

Discipline Specific Elective – 1

BSBO3503 ANALYTICAL TECHNIQUES IN PLANT SCIENCES

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ANALYTICAL TECHNIQUES IN PLANT SCIENCES	**BSBO3503**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- The course will cover the techniques and methods within plant biotechnology research and the use of molecular genetics and genetically modified organisms (GMO)
- The course will be relevant for students who wish to understand the potentials of these techniques in future plant production.

Learning outcome

Upon successful completion of this course, students will be able to:

- Understand and employ advanced technologies in plant biotechnology such as genetic modification and molecular genetics.
- Develop strategies and models to solve problems relating to plant biotechnology by using fundamental principles in plant biotechnology and genetics.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (8Hrs)

Imaging and Related Techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting;

Module-II (7Hrs)

Transmission and Scanning Electron Microscopy: Sample preparation for electron microscopy, cryo fixation, negative staining, shadow casting freeze fracture, freeze etching; Cell fractionation.

Module-III (7Hrs)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Module-IV (7Hrs)

Radioisotopes: Use in biological research, autoradiography, pulse chase experiment.
Spectrophotometry: Principle and its application in biological research.

Module-V (7Hrs)

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography, Affinity chromatography.

Module-VI (8Hrs)

Characterization of Proteins and Nucleic Acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of protenucleicacids; Electrophoresis: AGE, PAGE, SDS-PAGE

Module-VII (8Hrs)

Biostatistics: Statistics, data, population samples parameters; Representation of Data: Tabular, Graphical;
Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

Analytical Techniques in Plant Sciences Labs

Experiments:

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration througLowry's methods.
8. To separate proteins using PAGE.
9. To separation DNA (marker) using AGE.

10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining)

Text Book:

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rdedition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.

Reference Book:

3.Ausubel, F., Brent, R., Kingston, R. E.,Moore,D.D.,Seidman, J.G., Smith, J.A., Struhl, K. (1995). ShortProtocolsinMolecular Biology. John Wiley & Sons. 3rdedition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4thedition.

Discipline Specific Elective – 2

BSBO3504 BIOSTATISTICS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
BIOSTATISTICS	**BSBO3504**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- Biostatistics trains students for work in a wide variety of challenging positions in government, industry, and education.
- Biostatistics is to advance statistical science and its application to problems of human health and disease, with the ultimate goal of advancing statistics.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Understand and use mathematical and statistical theory underlying the application of biostatistic al methods; use and interpret results from specialized computer software statistical analysis of re search data
- Participate in a research team in the development and evaluation of new and existing statistical methodology.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Statistical Methods: Definition, basic principles. Variables - measurements, functions, limitations and uses of statistics.

Module-II (7Hrs)

Collection of Data: Primary and Secondary:Types and methods of data collection procedures - merits and demerits.

Module-III (7Hrs)

Classification: Tabulation and presentation of data, sampling methods.

Module-IV (7Hrs)

Measures of Central Tendency: Mean, median, mode, geometric mean - merits & demerits.

Module-V (8Hrs)

Measures of Dispersion: Range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations.

Module-VI (8Hrs)

Correlation Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression

Module-VII (8Hrs)

Statistical Inference Hypothesis: Simple hypothesis: student't' test - chi square test

Biostatistics Lab

Experiments:

1) Calculation of mean, standard deviation and standard error
2) Calculation of correlation coefficient values and finding out the probability
3) Calculation of 'F' value and finding out the probability value for the F value

Text Book:

1. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991.New York University Press.

Reference Book:

4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
5 The Principles of scientific research, Freedman, P. New York, Pergamon Press.

Discipline Specific Elective – 3

BSBO3603 BIOINFORMATICS

Subject Name	Subject Code	Type of course	T-P-Pr (Credit)	Prerequisite
BIOINFORMATICS	**BSB03603**	**Theory + Practice**	**4-2-0 (6)**	**Nil**

Objective

- To set up a collaborative development environment to avoid redundancy and to facilitate future bioinformatics developments across organizations
- To provide training in bioinformatics and support for bioinformatics projects hosted on the ARCAD platform
- To collaborate (share software, workshop, mailing lists, and good practices) with other national as well as international bioinformatics platforms

Learning outcome

Upon successful completion of this course, the student will be able to:

- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
- An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test	*20*	Written examination
	Experiments	*30*	Lab work, report, viva
External Examination	Semester Examination	*30*	Written examination
	Experiments	*20*	Lab work, report, viva
Total		*100*	

Course Outline

Module-I (7Hrs)

Introduction: Branches of Bioinformatics, Aim,Scope and Research areas of Bioinformatics

Module-II (7 Hrs)

Data bases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological DatabaseBiological Database Retrieval System.

Module-III (8Hrs)

Biological Sequence Databases: National Center for Biotechnology Informa) tion (NCBI): Tools andDatabases of NCBI, Database Retrieval Tool, Sequence Submission to

NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database.

Module-IV (7 Hrs)

EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, SequenceSubmission to EMBL, Sequence analysis tools.
DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ.

Module-V (8 Hrs)

Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

Module-VI (7Hrs)

Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA byCLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Module-VII (10 Hrs)

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency ofMoleculaPhylogenetic Prediction.
Applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activityrelationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement

Bioinformatics Lab

Experiments:

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Text Book:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.

Reference Book:

1. Campbell A. M., Heyer L. J. (2006) Discoovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

<u>Discipline Specific Elective – 4</u>

DEET0300 PROJECT

Subject Name	Subject Code	Type of course	T-P-Pr (Credit)	Prerequisite

PROJECT	**DEET0300**	**Practice**	**0-0-6 (6)**	**Nil**

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Skill Enhancement Courses (Any two of the following)

BSLS2001 TECHNIQUES IN BIOFERTILIZERS

Subject Name	**Code**	**Type of course**	**T-P-Pr (Credit)**	**Prerequisite**
TECHNIQUES IN BIO FERTILIZER	**BSLS2001**	**Practice**	**0-2-0(2)**	**Nil**

Objective

- The main objective is to maintain the soil health by application of bio fertilizer for better plant growth.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn to improve the entire ecosystem and will serve the society in the best way by caring their health through natural products.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work
Total		*100*	

Experiments:

1. Isolation of Rhizobium or Aztobacter from plant root nodules and rhizosphere.
2. Identification of soil cyanobacteria from different soil samples.
3. Preparation of culture media
4. Culture of cyanobacteria
    a. Growth media
    b. Media preparation and Starter culture
    c. Sterilization of medium in autoclave
    d. Prepare slants and Plates
    e. Inoculation & Growth of Cyanobacteria

5. Cyanobacterial inoculation to plants.

6. To study different types of Mycorrhizal association.

7. Isolation of VAM

8. Methods of Biocompost

9. Methods of vermicomposting

10. Field application of Vermicompost

Text Book:

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand and Co, New Delhi.

2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.

3. John JothiPrakash, E. 2004. Outlines of Plant Biotechnology.Emkay _Publication, New Delhi.

Reference Book:

1. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya Publishers.

2. SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.

BSLS2002 SKILL IN APICULTURE

SubjectName	Code	Type of course	T-P-Pr (Credit)	Prerequisite
SKILL IN APICULTURE	**BSLS2002**	**Practice**	**0-2-0(2)**	**Nil**

Objective

- The students will able to know about beekeeping, conservation and harvesting of honey.
- The students will understand the concept of pollination and willwork towards bee security for the future.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the role and value of honey bees along with honey harvesting.
- Acquire skills for engaging themselves in self-employment.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments:

1. Study of characteristics of Honey Bee (Queen, Worker and Drawn Bee).

2. Study of social organization of bee colony

3. Demonstration of bee keeping equipment.

4. Observation of pollination and work of Bee

5. Study of beehives

6. Impact of flowers of local areas on quality and medicinal properties of honey

7. Study of impact of season on honey quality

8. Cultivation of bees and honey harvesting techniques and enterprenuership.

Text Book:

1.Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi

Reference Book:

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Bisht D.S., Apiculture, ICAR Publication.

BSLS2003 HERBAL TECHNOLOGY

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
HERBAL TECHNOLOGY	**BSLS2003**	**Practice**	**0-2-0(2)**	**Nil**

Objective

- To aware the students to different types of instruments used for processing of herbal drugs

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the method of collection of medicinal plants.
- They will acquire the skill of extraction of phytochemicals and preservation of herbarium.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments:

1. Collection of wild herbs and their herbarium preparation.

2. Study of different morphological structure and floral parts of the following plants of locally available medicinal herb.

3. Starch test

4. Proteins and Lipid Test.

5. Study of different types of instruments used in the extraction of phtyochemicals.

a. Soxhlet Apparatus

b. Colorimeter

c. Thin Layer Chromatography

d. High Performance Layer Chromatography

e. UV –Spectrophotometer

6. Extraction of an alkaloid

Text Book:

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R,New Delhi.

2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.

Reference Book:

1. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.

2. Ayurvedic drugs and their plant source. V.V. Sivarajan and BalachandranIndra 1994.Oxford IBH publishing Co.

4. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998.Banarsidass, Delhi.

5. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

6. Pharmacognosy, Dr.C.K.Kokate et al. 1999. NiraliPrakashan

BSLS2004 TECHNIQUES IN MEDICAL DIAGNOSTICS

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
TECHNIQUES IN MEDICAL DIAGNOSTICS	**BSLS2004**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- The students will able to know about different tests for primary health care.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the basic clinical skills required to provide effective and efficient primary care.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments:

1. Preparation of blood Smear.
2. Study of D.L.C (Differential Leucocyte Count) using Leishman's stain.
3. Platelet count using haemocytometer.
4. Determination of ABO Blood group
5. Estimation of haemoglobin using Sahli'shaemoglobinometer
6. Preparation of haemin and haemochromogen crystals
7. Recording of blood pressure using a sphygmomanometer.
8. Study of various Medical imaging.

Text Book:

1. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers

Reference Book:

1. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
2. Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II
. Edition, Bhalani Publishing House
3.. Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for
Training Courses
4. Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
5. Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
6. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S.Chand and Co. Ltd.

BSLS2005 VERMICOMPOSTING

Subject Name	**Code**	**Type of course**	**T-P-Pr (Credit)**	**Prerequisite**
VERMICOMPOSTING	**BSLS2005**	Practice	**0-2-0(2)**	**Nil**

Objective

- The objective is to learn to compost organic wastes o to produce superior quality manure to improve soil quality.
- They will learn recycling of organic waste.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the methods of production of organic fertilizers, reduced use of chemical fertilizers and production of best quality of food.
- This will provide a source of income.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments

1.Collection and identification of different species of earthworms used for vermicomposting.

2.Studyof different compostable waste for the production of vermicompost.

3. The growth of cereals in the soil applied with cow dung compost, chemical fertilizer and vermicompost.

4. The growth of different vegetable plants in the soil applied with cow dung compost, chemical fertilizer and vermicompost.

5. The growth of differentpulse crops in the soil applied with cow dung compost, chemical fertilizer and vermicompost.

6. Study about high Level of beneficial soil micro-organisms promoting plant growth.

7.Role of vermiculture in bio-accumulation of toxic chemicals and detoxification of the medium in which it lives.

Text Book:

1.Keshav Singh, (2014)Textbook of Vermicompost: Vermiwash and Biopesticides, Biotech Books

Reference Book:

1. The complete Technology Book on Vermiculture and Vermicompost,(2004) NPCS Board of Consultants and Engineers

BSLS2006 TOOLS AND TECHNIQUES IN BIOSCIENCES

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
TOOLS AND TECHNIQUES IN BIOSCIENCES	**BSLS2006**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- To familiarise students with many of the common tools used by cell biologists, microbiologists.
- The students can learn biochemistry, genetics and molecular biology techniques for future research work.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn fundamental methods, procedures, and techniques for conducting experimental research.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments

1. General principle and application of colorimeter, spectrophotometer,
2. General principle and application of centrifuge and ultracentrifuge.
3. Microbial techniques: media preparation, sterilization, inoculation and growth monitoring.
4. Identification of Gram positive and Gram negative bacteria using Gram staining.
5. Preparation of permanent slides (double staining) of leaves, roots and stems of plant.
6. Separation techniques such as chromatography
7. Principle types and applications of gel electrophoresis.
8. DNA sequencing, polymerase chain reaction (PCR)
9. Histological techniques: principle of tissue fixation, microtomy, staining, mounting.
10. Molecular biology techniques: Southern hybridization, Western hybridization, Northern hybridization(demonstration of any one of these)

Text Book:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam.The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). MolecularBiotechnology: Principles and Applications of recombinant DNA. ASM Press, Washington.

Reference Book:

1. Stewart, C.N. Jr. (2008). Plant Biotechnology and Genetics: Principles, Techniques and Applications.John Wiley and Sons Inc. U.S.A.

BSLS2007 FOOD PROCESSING

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
FOOD PROCESSING	**BSLS2007**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- The objective is to learn to increase the shelf-lifeand helps in preventing spoilage of food until it can be used.
- It ensures the availability of food throughout the yearand ensures the availability of food even at distant or remote places.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn the methods of processing of different food production.
- Provide a source of income in baking, canning and diary industries.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments

1. Common methods of Food processing and preservations (Drying, Smoking, Freezing, Vacuum packs, Salting, Sugaring and Pickling)

2. Benefits and draw backs of Food processing and preservations

3. Food storage

4. Food fortification

5. Canning methods: Sauce, Jam, Jelley and Pickle preparation; Tomato purie processing

6. Baking methods: . Biscuit Making and Bread Production

7. Ginger Garlic Paste Processing
8. Potato Chips and Banana Wafer Making
9. Papad and Pasta Making
10. Coconut Oil Manufacturing/ Energy Drink Production

Text Book:

1. R.P.Srivastava and Sanjeev Kumar (2014),Fruit and Vegetable Preservation,CBS Publishing
2. B.Srilakshmi (2018),Food Science, New Age International Publishers
3. Sharda Gupta, Santosh Jain Passi, Rama Seth, RanjanaMahna&SeemaPuriKumudKhanna (2016),Textbook of Nutrition and Dietetics ,Elite Publishing House Pvt. Ltd

Reference Book:

1. V. Sivasankar(2002),Food Processing and Preservation,Prentice Hall India Learning Private Limited
2. G. Subbulaxmi and Sobha, A. Udipi((2006),Food Processing and Preservation,New Age International Publishers; First edition

BSLS2008 MUSHROOM CULTIVATION

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
MUSHROOM CULTIVATION	**BSLS2008**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- The objective is to learn to the cultural practices for mushroom cultivation.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Earn besides the knowledge on food value and nutritional content.

Evaluation Systems

Internal Examination	*Component*	*% of Marks*	*Method of Assessment*
	Experiments	*100*	Lab work, report, viva
Total		*100*	

Experiments:

1. Compost making for mushroom cultivation
2. Finishing the compost

3. Spawning and Spawn run
4. Casing and Case run
5. Materials used for casing
6. Casing treatment
7. Pin head formation
8. Cropping
9. Harvesting and packaging
10. Nutritional content

Text Book:

1. Hand Book of Mushroom Cultivation(2007),Processing and Packaging,Engineers India Research Institute (EIRI)
2. V. N. Pathak (2011),Mushroom Production and Processing Technology, IST Edition,Agrobios (India)
3. N.N. Patil(2010),Mushroom : Cultivation, Processing and Uses, Universal Prakashan; First Edition edition
4. Dr R.K. Pandey and Dr S.K. Ghosh(1999),A Handbook of Mushroom Cultivation, Emkay Publications

Reference Book:

1. Bahl N. (2000), Handbook on Mushrooms Paperback, Oxford and Ibh Publishing Co. Pvt Ltd
2. Eleanor Cameron(1988),The Wonderful Flight to the Mushroom Planet,Hachette Book Group USA; Reprint edition

BSLS2009 Plant Tissue Culture

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Plant tissue culture	**BSLS2009**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- The objective is to learn about Geographical Positioning System(GPS) reading and collection of RET Plant species..

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about the methods in vitro culture of RET plants for propagation and conservation.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	*100*	Lab work, report, viva

Total		*100*	

Experiments:

1. Survey
2. Geographical Positioning System(GPS) reading
3. Collection of RET Plant species
4. Identification
5. Herbarium
6. Preservation
7. ***In vivo*** culture of RET plants
8. ***In vitro*** culture of RET plants
9. Medicinal Value
10. Ethnic Uses

Text Book:

1. Nagar Santosh and AdhavMadhavi(2010), Practical Book of Biotechnology and Plant Tissue Culture, S Chand & Company
2. Purohit S.D(2012),Introduction to Plant Cell, Tissue and Organ Culture, Prentice Hall India Learning Private Limited
3. M. C. Gayatri (2015), Plant Tissue Culture: Protocols in Plant Biotechnology (Pb), Narosa Publishing House Pvt. Ltd. - New Delhi
4. Kalyan Kumar De(2008),Plant Tissue Culture,New Central Book Agency

Reference Book:

1. TimirBaranJhaand BiswajitGhosh(2016),Plant Tissue Culture: Basic and Applied,Platinum Publishers; 2nd Edition
2. Razdan M K, (2005), Introduction to Plant Tissue Culture, Oxford andIbh

BSLS2010NURSERY AND GARDENING

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
NURSERY AND GARDENING	**BSLS2010**	**Practice**	**0-2-0 (2)**	**Nil**

Objective

- The students will learn about the practices of gardening and raising of seedlings.

Learning outcome

Upon successful completion of this course, the student will be able to:

- Learn about different methods of plant propagation.

Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Experiments	100	Lab work, report, viva

Total		100	

Experiments:

1. Seasonal plants and time of raising the seedlings
2. Planting: Direct seedling and transplants
3. Vegetative propagation: Methods(selection of cuttings, treatment of cuttings, rooting medium and planting of cuttings)
4. Hardening of plants – green house - mist chamber, shed root, shade house and glass house.
5. Types of gardening: Landscape and home gardening
6. Gardening operations: soil laying, manuring and watering
7. Sowing/ raising of seeds and seedlings
8. Management of pests and diseases in nursery
9. Harvesting
10. Ethnic Uses

Text Book:

1. S.C. Dey (2000), Vegetable Growing (Agro's Gardening), Agro-Botanica Publishers
2. Amarjeet Singh Batth(2016),Home Gardeners' Guide Indian Garden Flowers, Fingerprint! Publishing
3. RomenKapoor (2004),Home Gardening, UBS Publisher's Distributors
4. Purohit and Vyas,2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Reference Book:

1. Lisa Baker Morgan and Ann McCormick(2015),Homegrown Herb Garden: A Guide to Growing and Culinary Uses, Quarry Books

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N. B.- Highlighted portions indicate modification by the external expert.