RANI DURGAVATI VISHWAVIDYALAYA, JABALPUR

SYLLABUS PRESCRIBED FOR THE DEGREE OF THE MASTER OF SCIENCE IN BOTANY IN UNIVERSITY TEACHING DEPARTMENT

(Academic Session 2020-2021 & Onwards)

[PROGRAMME UNDER CHOICE BASED CREDIT SYSTEM - ORDINANCE 222]

This brochure of the programme for the M.Sc. degree in Botany consists of six parts, viz., (A) Information from the relevant Ordinance(s) / Statutes, (B) Programme Objective (C) Programme Outcomes (D) Programme Specific Outcomes (PSOS) (E) Scheme of examination and (F) Courses of study.

A. INFORMATION FROM THE RELEVANT ORDINANCE (S)/STATUTES

1. DURATION OF THE COURSE

M.Sc. Botany will be a full time two-year programme to be covered in four semesters, each of six months duration. The first year of the programme will complete the I and II semesters, and the second year will complete the third and fourth semesters. The maximum duration of the programme shall be twice of the minimum duration of the programme, i.e. four years.

2. ADMISSION TO THE COURSE

The number of seats shall be in accordance with the directives by the University. A candidate, who after having secured the B.Sc. degree with at least 50 % marks from a recognized university with a subject of Life Science, shall be eligible for admission to the course. The admission to the course will be on the basis of the merit and according to guidelines from the University and Government of Madhya Pradesh. After the term-end examination at the end of each semester, the student will be provisionally admitted to the next semester.

3. TUITION AND OTHER FEES

The admitted candidate shall pay the course fee in addition to the tuition fee and such other fees as prescribed by the University.

4. PROGRAM OF THE STUDY

The semester will consist of 16-18 weeks of academic work. One credit is equivalent to one hour (60 minutes) of teaching (lecture or tutorial) or two hours (120 minutes) of practical work/field work per week throughout a semester. The credits associated with the courses will be valid credits, while credits associated with comprehensive viva voce will be virtual credits. In the end term examination there will be **three components, namely Core Courses, Elective Courses and Skill Development Course,** except for the 4th semester where every student will carry out and submit a **dissertation**

The syllabus for the theory and practical examination will be prescribed by the Board of Studies in Botany, R.D. University, Jabalpur.

5. CONTINUOUS EVALUATION

During the semester, a teacher offering the course will do the continuous evaluation of the student at three points of time by conducting three tests of 20 marks each. Of these, two must be written tests and the third may be written test/quiz/seminar/assignment. Marks obtained in two best tests out of three will be awarded to the student.

Approved by
Board of Studies in Botany on 15/09/2020, **Faculty of Life Science on** 14/10/2020
Standing committee on **Executive Council on**

6. ATTENDANCE

The student whose attendance is less than 75 % will not be allowed to appear in the end semester examination and he/she will be declared fail in that semester.

7. END SEMESTER EXAMINATION

There shall be end semester examination at the end of first, second & third semester. The semester examination will be held every year normally in December and June or on the dates declared in the academic calendar of the University. A student proceeding to appear in end semester examination will submit through the Head of the Department his / her application on the prescribed form along with required examination fee, etc. to the Registrar of the University. Every student will appear in four respective theory papers and two combined practical examinations in first, second, & third semesters except for the fourth semester. In the fourth semester, every student will be allotted dissertation work in lieu of four theory papers. Allotment of the dissertation will be done by a committee comprising of the Dean of Faculty of Life Science, Head of Department of Biological Science, one Professor and one Associate Professor of the Department by rotation according to seniority. The dissertation may be undertaken in UTD or in any of the National Laboratories/ Institute/ Universities/ Government approved Companies/ Industries. In such cases, there will be two supervisors, one from the parent department and another from the place where the student completes his/her dissertation work.

The dissertation will be evaluated by the external examiner who has expertise in the concerned subject. For the purpose of holding viva-voce, the supervisor will be the internal examiner along with the external examiner who has evaluated the dissertation. The scheme of marks for evaluating the various components of the dissertation will be followed as given in the syllabus.

8. CONDITION FOR A PASS

For each course, each student has to appear in at least two tests and end semester examination, otherwise the student will be awarded "Ab" grade. The total marks obtained in end-semester examination, and best of two tests under continuous evaluation will decide the grade in that course. In addition, student also has to get valid credits for Skill development modules' courses and Virtual credits and grades for Comprehensive viva-voce. The grading will be made on 10-point scale as follows:

Letter Grade	Grade Points	Description	Range of Marks (%)
O	**10**	**Outstanding**	**90-100**
A+	**9**	**Excellent**	**80-89**
A	**8**	**Very Good**	**70-79**
B+	**7**	**Good**	**60-69**
B	**6**	**Above Average**	**50-59**
C	**5**	**Average**	**40-49**
P	**4**	**Pass**	**35-39**
F	**0**	**Fail**	**0-34**

Ab	**0**	**Absent**	**Absent**

For passing the examination in each semester, a candidate must have secured a minimum of 35% marks ("P" Grade: 4 Grade Points) in the course. If the marks obtained by the student in a course are less than the minimum cut-off percentage of marks, then "F" Grade will be awarded. If a student obtains "F" or "Ab" Grade in any course, he/she will be treated to have failed in the course. He/she has to reappear in the examination of the course as and when conducted or arranged by the UTD. Marks obtained earlier in continuous assessment may be carried forward and added to the marks obtained in repeat end semester examination to decide the grade in the repeat course.

The theoretical, practical and skill development courses can be repeated whenever offered or arranged by the UTD but within maximum duration of the programme. He/she can avail multiple repeat attempts to pass the course. The student will be promoted to the next semester if he/she secures at least 12 valid credits in a semester. In case the student secures less than 12 valid credits in any semester, then the student will be asked to repeat entire semester and that semester will be treated as zero semester.

The decision of the teacher regarding the evaluation and the grade shall be final. However, a student submits in writing for review of his Marks/Grade to the Head/Director who will place the case before the board of comprehensive viva voce. The decision of the board will be final. Result of review will be declared by the concerned Head/Director. Review is effective only when grade improves. Review will be allowed only if –

- The prescribed fee is paid.
- The candidate applies within 7 days of the declaration of the grade in that course.

There will be no provision for revaluation. However the candidates can apply for Re-totaling in one course per semester.

9. In matters not covered under this Ordinance, general rules of the University shall be applicable.

10. In case of any dispute/ambiguity, the ruling of the Vice-Chancellor shall be final and binding.

B. PROGRAMME OBJECTIVES

2.1. The objective of the Master's Program in Botany is to equip the students to gain conceptual and analytical skills about morphological, anatomical, physiological, biochemical and cellular aspects of lower and higher plants.

2.2. The program emphasizes to apply knowledge acquired about different taxa of plants for their manipulations, biomolecules and conservation.

2.3. The imparting of laboratory training for bioassay protocols of biological materials, their manipulative treatments, emerging tissue culture and genetic recombinant techniques, and bioinformatics databases and tools.

C. PROGRAMME OUTCOMES

The Masters in Botany Program will cater to the expanding demand for skilled manpower, which is equipped with an understanding of modern research protocols and ethics involving plants and their cellular and molecular materials in conservation of plant biodiversity, environmental

conservation and management, plant health and yield management, and their survival in nature to maintain natural biodiversity and ecological balance.

A M.Sc. Botany student should be able to independent study and researches related to

3.1. Taxonomic identification of plants including their chemotaxonomy, molecular taxonomy and creation of herbaria.

3.2. Application of modern emerging methodological and analytical tools and techniques in qualitative and quantitative assessment of biological materials and processes.

3.3. Extraction of biological molecules and sub-molecules and their biochemical, genetic and molecular characteristics and dynamics.

3.4. Designing of bioassay experiments including ex-situ culture of threatened and important plants for their conservation and variety improvement.

3.5. Undertaking of independent researches involving genomics, metabolomics, and protemics of plant taxa.

3.6. Competition at national and international to pursue career in advanced studies in research and industrial establishments.

3.7. Independent documentation and communication of scientific results in the public domain as well as peer-reviewed scientific magazines and journals.

3.8. Filing of intellectual property rights to national and international registries.

D. PROGRAMME SPECIFIC OUTCOMES (PSOS)

A successful graduate student will be able to identify plants belonging to different taxa and prepare standard herbaria. The student will be able to design and execute experiments related to biochemistry, physiology, genetics and molecular biology of plants. He/ She will be able to pursue independent researches in basic and applied researches in governmental, industrial and private academic and research establishments.

E. SCHEME OF EXAMINATION

SEMESTER I

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	**Course Title**				
I Core courses					
BOC101	Biology & Diversity of Viruses, Bacteria and Algae	**3**	**40**	**60**	**100**
BOC102	Biological Diversity of Bryophytes, Pteridophytes & Gymnosperms	**3**	**40**	**60**	**100**
BOC103	Basic Ecology	**3**	**40**	**60**	**100**
BOC104	Practical based on BOC101 & BOC102	**4**	**40**	**60**	**100**
BOC105	Practical based on BOC103 & BOE101/ BOE102	**4**	**40**	**60**	**100**
II Electives courses (Any one to choose)		**3**	**40**	**60**	**100**
BOE101	Biomolecules				
BOE102	Bioenergetics and Intermediary Metabolism				
III Skill Development course					
BOS101	Skill Development module 1	**2**	**Grade Point will be provided by Skill Development Centre**		
Total valid credits		**22**			

(B) Comprehensive viva voce (virtual credits)	**4**		**50**

SEMESTER II

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	**Course Title**				
I Core courses					
BOC201	Taxonomy of Angiosperms	**3**	**40**	**60**	**100**
BOC202	Biology & Diversity of Fungi	**3**	**40**	**60**	**100**
BOC203	Biostatistics & Computer Application	**3**	**40**	**60**	**100**
BOC204	Practical based on BOC201 & BOC202	**4**	**40**	**60**	**100**
BOC205	Practical based on BOC203 & BOE201/ BOE202/ BOE203	**4**	**40**	**60**	**100**
II Electives courses (Any one to choose)		**3**	**40**	**60**	**100**
BOE201	Biology of the Immune System				
BOE202	Resource utilization and conservation				
BOE203	Microbial Metabolism				
III Skill Development course					
BOS201	Skill Development module 2	**2**	**Grade Point will be provided by Skill Development Centre**		
Total valid credits		**22**			

(B) Comprehensive viva voce (virtual credits)	**4**		**50**

SEMESTER III

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	**Course Title**				
I Core courses					
BOC301	Plant Physiology	**3**	**40**	**60**	**100**
BOC302	Genetics & Molecular Biology	**3**	**40**	**60**	**100**
BOC303	Plant Reproduction and Development	**3**	**40**	**60**	**100**
BOC304	Practical based on BOC301 & BOC302	**4**	**40**	**60**	**100**
BOC305	Practical based on BOC303 & BOE301/ BOE302/ BOE303/ BOE304	**4**	**40**	**60**	**100**
II Electives courses (Any one to choose)		**3**	**40**	**60**	**100**
BOE301	Advanced Molecular Biology				
BOE302	Agricultural Microbiology				
BOE303	Bioprocess Engineering and Technology				
BOE304	Biotechnology				
III Skill Development course					
BOS301	Skill Development module 3	**2**	**Grade Point will be provided by Skill Development Centre**		
Total valid credits		**22**			

(B) Comprehensive viva voce (virtual credits)	**4**		**50**

*Both (A – Core courses; One Elective course and Skill Development modules) & (B) are compulsory components of a semester. The grades awarded in the comprehensive Viva-voce shall be shown separately in the Grade Sheet.

SEMESTER IV

(A) DISSERTATION	Credits	Maximum Marks
A. Valuation (i) Language & Presentation (ii) Review of Literature (iii) Methodology (iv) Analysis & interpretation of Result	**18**	**300**
B. Viva-Voce EXTERNAL		**50**
C. Viva-Voce INTERNAL		**50**
Total		**400**

(B) Comprehensive viva voce (virtual credits)	**4**	**50**

F. COURSES OF STUDY

FIRST – SEMESTER

CORE COURSE CODE BOC101: BIOLOGY & DIVERSITY OF VIRUSES, BACTERIA AND ALGAE

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with the systematic position, occurrence, morphology, anatomy, and development of reproductive structures, affinity, pathogenicity and the classification of viruses, bacteria and algae.

Course Learning Outcomes:

CO1: Students will be able to understand the structure, identification, nutrition, reproduction and economic importance of bacteria.

CO2: Students will gain the knowledge of isolation and purification, chemical nature, replication and transmission of viruses.

CO3: Students will able to understand the thallus structure, reproduction and economic importance algae.

CO4: Students will learn the botanical approach to explain the evolution of organism and understand the genetic diversity.

CO5: Students will learn the role of algae in the symbiotic associations, soil fertility, crop productivity as well as food, feed, cosmetics & pharmaceuticals.

COURSE CONTENTS

UNIT – I

Archaebacteria and Eubacteria: General account, Ultrastructure, Nutrition and Reproduction, Biology and economic importance. Cyanobacteria salient features and biological importance. Phytoplasma: General characteristics and role in causing plant diseases.

UNIT – II

Viruses: Characteristics and ultra-structure of virions, Isolation and purification of viruses, Chemical nature, Replication, Transmission of viruses, Economic importance. Phycoviruses.

UNIT III

Phycology: Algae in diversified habitat (terrestrial, fresh water, marine), Thallus organization, Cell ultrastructure, Reproduction (vegetative, asexual, sexual), Criteria for classification of algae, Pigments, Reserve food, Flagella classification.

UNIT – IV

Salient features of the following divisions: Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

UNIT – V

Role of algae in symbiotic associations, Fisheries, Algal blooms, Productivity of algae in fresh water and marine environment, Role of algae in soil fertility and crop productivity. Algae as biofertilizer and bioenergy. Role of algae as food, feed, cosmetics, nutraceuticals & pharmaceuticals.

Books Recommended

- Mandahar C. L. (1978) Introduction to Plant Viruses.
- Clifton A. (1958) Introduction to The Bacteria.

- Dubey, R. C. & Maheshwari, D. K. 2005: A Text Book of Microbiology, S. Chand Publisher, New Delhi.
- Morris L. (1986) An Introduction to Algae.
- Round F. E. (1986) The Biology of Algae.
- Kumar H. D. and Singh H. N. (1972) Textbook on Algae.

CORE COURSE CODE BOC102: BIOLOGICAL DIVERSITY OF BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners in systematic position, occurrence, morphology, anatomy, and development of reproductive structures, affinity and the classification of bryophytes, pteridophytes and gymnosperms.

Course Learning Outcomes:

CO1: The student will be able to identify major groups and compare the characteristics of plants of bryophytes, pteridophytes and gymnosperms.

CO2: Students will be able to understand botanical approach to explain the evolution of organisms and understand their genetic diversity on the earth.

CO3: Students will be able to understand their adaptation, development, behavior, morphology, anatomy and reproduction, evolution with their transition to land habitat and their economical & ecological importance.

CO4: Demonstrate proficiency in the experimental techniques and methods to study of bryophytes, pteridophytes and gymnosperms

CO5: Students will be able to understand the concepts of Binomial Nomenclature and elementary knowledge of International Code of Botanical Nomenclature and their Systematic position.

COURSE CONTENTS

UNIT I

General characters & Classification of Bryophytes, Comparative morphological & anatomical studies of Gametophytes and Sporophytes of Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales & Funariales . Economic importance of Bryophytes.

UNIT II

General characters & Classification of Pteridophytes, Comparative Morphology, Anatomy and Reproduction in Psilophytales, Psilotales, Lycopodiales, and Sellaginellales. Stelar in system in Pteridophytes.

UNIT III

Morphology,Aanatomy and Reproduction in Equisetales, Ophioglossales, Osmundales & Salviniales.

UNIT IV

Classification of Gymnosperms, Distribution of living Gymnosprms in India, Economic importance of Gymnosperms, Structure & Reproduction in Cycadales and Coniferales with special reference to Cycas, Pinus & Thuja.

UNIT V

Structure & Reproduction in Ephedrales Gnetales & Welwitschiales with special reference to Ephedra , Gnetum & Welwitschia.

Books Recommended

- Parihar N. S. (1991) Bryophyta.
- Parihar N. S. (1996) Biology and Morphology of Pteridophytes.
- Puri P. (1980) Bryophytes.
- Sporne K. K. (1991) Morphology of Pteridophytes.
- Watson E. V. (1964) The Structure and Life of Bryophytes.
- Monographic study of the living Gymnosperms.

CORE COURSE CODE BOC103: BASIC ECOLOGY

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the students in the field of basic ecological principles with special reference to components, biogeochemical cycles, development and stability of the ecosystem, energy flow and matter recycling along with the concept, analysis of the community and its biodiversity.

Course Learning Outcomes:

CO1: The student will able to get the detailed knowledge about population characteristics and dynamics.

CO2: Students will be able to study the concept, organization and dynamics of the community along the concept of niche and biodiversity.

CO3: Students learn about the consequences of artificial or natural disturbances on community development and stability, including the concept of vegetation change and ecosystem restoration.

CO4: Students understand about fundamentals of energy flow in ecosystems, its models, efficiencies and trophic structure..

CO5: Students learn about various recycling pathways of matter in the ecosystems including exchanges and internal cycling processes, and global biogeochemical cycles of carbon, nitrogen, phosphorus and sulfur.

COURSE CONTENTS

UNIT – I

Ecology & ecosystem: Definitions, Organization and components, Population ecology density & distribution, Natality , Mortality, Survivorship curves, Age structure & pyramids, Fecundity schedules, Life tables, Population growth exponential and logistic curves, Intra specific competition and self-regulation, r- and k-strategists.

UNIT – II

Community organization: Concepts of community and continum, Analysis of community analytical and synthetic characters, Community coefficients and indices of diversity, interspecific association negative and positive associations, Concept of ecological niche, Concepts of biodiversity.

UNIT- III

Ecosystem development and stability: Temporal changes cyclic and non cyclic, Succession processes & types, Mechanism of succession facilitation, Tolerance and inhibition models, Concept of climax persistence resilience and resistance, Ecological perturbation natural and anthropogenic, Ecosystem restoration.

UNIT – IV

Fate of energy in ecosystems: Trophic organization and structure, Food chains & webs, energy flow pathways, Ecological efficiencies consumption, assimilation and production trophic, Primary production methods of measurement, Global patterns, Limiting factors.

UNIT – V

Fate of matter in ecosystems: Recycling pathways, Relationship between energy flow and recycling pathways, Nutrient exchange and cycling, Global biogeochemical cycles of C, N, P and S, Physical, chemical and Biological characteristics of soil.

Books Recommended

- J.L. Chapman 1999 Ecology Principles and Applications 2nd Edition.
- C.H. Southwick 1976 Ecology and Quality of Our Environment 2nd Edition .
- M. P. Singh, S. Chinnamani R.N. Trivedi (1993) Forestry & Environment.
- E. J. Kormondy. (1996) Concept of Ecology.

CORE COURSE CODE BOC104: PRACTICAL BASED ON

COURSE CODE BOC101 & COURSE CODE BOC102 (COURSE CREDITS = 04)

Suggested List of Practicals (Course CODE BOC101**)**

Biology & Diversity of Viruses, Bacteria and Algae.

1. To prepare liquid and solid media for the growth of microorganisms (Cyanobacteria, Bacteria & Virus).

   Nutrient broth

   NAM

   BG_{11}
2. To isolate & purify microorganism by pure culture techniques.
3. Morphological study of certain Genera of Algae (Green, Brown, Red & Blue-green)
4. Isolation of Bacteriophages/Cyanophages from water Bodies.
5. To determine Titre Value of Bacteriophages by Double Agar Technique.
6. Isolation and identification of bacteria from soil and water sample.
7. Isolation and identification of microorganisms on some selective media from soil and water sample.

   MacConkey

   EMB

   XLD

8. Microscopic identification of different algal and Cyanobacterial cultures.
9. To identify Gram-positive & Gram-negative bacteria by Gram staining technique.

Suggested List of Practicals (Course CODE BOC102**)**

Biology and Diversity of Bryophytes, Pteridophytes & Gymnosperms

Bryophytes

1. To study the morphological and anatomical characters of given material.

Marchantia

Riccia

Pellia

Anthoceros

Sphagnum

Funaria

Polytrichum

Pteridophytes

2. To study the morphological and anatomical characters of given material.

Lycopodium

Ophioglossum

Marsilia

Selaginella

Psilotum

Osmunda

Equisetum

Gleichenia

Salvinia

Isoetes

Gymnosperms

3. To study the morphological and anatomical characters of given material.

Pinus

Cycas

Thuja

4. To prepare the slides of given material.

T. S stem of *Thuja*

V.S of cone of *Thuja*

T.S stem of *Cycas*

T.S stem of *Araucaria.*

T.S leaf (needle) of *Pinus.*

CORE COURSE CODE BOC105: PRACTICAL BASED ON COURSE CODE BOC103 & COURSE CODE BOE101/ BOE102 (COURSE CREDITS = 04)

Suggested List of Practicals (Course Code BOC103)

Basic Ecology

1. To determine the minimum area of quadrat for phytosociological analysis of grassland.
2. To determine the minimum number of quadrats for phytosociological analysis of grassland.
3. To determine frequency, density and abundance of different species in the grassland.
4. To determine homogeneity and heterogeneity of grassland vegetation.
5. To determine the pH of soil samples.
6. To calculate Simpson's indices of diversity of grassland vegetation.
7. To calculate Shannon-Wiener indices of diversity of grassland vegetation.

ELECTIVE COURSE CODE BOE101: BIOMOLECULES (COURSE CREDITS = 03)

Course Objective: It makes students understand the structure and principles dealing with the working of biomolecules and their mutual interactions to support the life system.

Course Learning Outcomes

CO 1: Enabling students to understand the importance of water in maintaining the various biochemical reactions such as buffering, phosphorylation, oxidation-reduction etc.

CO 2: The students learn the principle of working of enzyme and the process of enzymology, that is, how the enzymes work and where the active sites play a key role.

CO 3: The students also learn the basic and functional structures of all the biomolecules in detail.

CO 4: The inter-relationships and communication between the biomolecules is a major part of signal transduction. The students become well versed with this mode of biological process.

CO 5: The students learn various techniques such as chromatography, spectroscopy and electrophoresis to understand the purity of biomolecules and their analytical properties for further application.

COURSE CONTENTS

UNIT I

Structure of water and its solvent properties, Acid- bases, pH and buffer, Bi and polyprotic buffer. Free energy and spontaneity of reactions, ATP and other phosphorylated compound with their free energy of hydrolysis, Phosphoryl group transfer, Biological oxidation reductions reaction, Coupled reaction and oxidative phosphorylation, Inhibitors and uncouplers.

UNIT II

Enzyme classification, Specificity, Active site, Enzyme kinetics, Michealis Menton equation, Determination of kinetic parameters, Bi-substrate reaction and their kinetics, Enzyme inhibition and kinetics, Allosteric enzyme. Kinetics and Allosteric regulation of phosphofructo kinase

UNIT III

Structure and chemistry of macromolecules, Proteins, Carbohydrates and Lipids, Protein folding, Structure and chemistry of bimolecules such as antibiotics, Pigments, Vitamins as coenzymes, Lipid analysis by GLC and Mass Spectrometry, Oligosaccharide and Polysaccharide analysis.

UNIT IV

Biosignaling molecular mechanism of signal transduction, Gated ion channels, Nicotinic acetyl choline receptor, Receptor enzyme, The insulin receptor, G- proteins and cyclic AMP membrane transport, Biomembrane, Nutrient transport across membranes, Active and passive diffusion, Symport, Antiport and uniport, Na^+ K^+ pumps and their metabolic significance.

UNIT V

Chromatographic technique, Paper and TLC , Gel filtration, Ion exchange, Affinity, HPLC, SDS, PAGE, Isoelectric focusing, Western blotting, Protein sequencing, Mass spectrometry, MALDI , TOF, MS.

Books Recommended

J. L., Jain, Sanjay, and Jain Nitin, (1979) Fundamentals of Biochemistry (6th revised Edition). S. Chand & Co. Ltd. New Delhi.

Buchanan . B.B. Gruissem, W. and Jones .R.L. (2000) Biochemistry and Molecular Biology of Plants , American Society of Plant Physiologists, Maryland ,USA.

Albert L. lehninger, Davis L. Nelson, Michael M. Cox. (2004) Lehninger Principles of Biochemistry.

Lea P.J. and Leegood ,R.C. (1999) Plant Biochemistry and Molecular Biology (2 nd Edition) John Wiley and Sons. Chichester, England

Berg Jeremy, Tymoczko John, Stryer Lubert (2001) Biochemistry 4th Ed, W. H. Freeman, New York.

Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) Outlines of Biochemistry 5th Ed , John Wiley and Sons, New Delhi.

Dawes Edwin A. (1972) Quantitative Problems in Biochemistry, Churchill Livingston, Edinburgh.

Hall D. D. and Rao K. K. (1996) Photosynthesis 5th Ed., Cambridge University Press. 5. Mandelstam Joel and McQuillen Kenneth (1976) Biochemistry of Bacterial Growth, Blackwell Scientific Publication London.

Metzler David E. (2001) Biochemistry: The chemical Reactions of Living Cells, Volume 1&2, Academic Press California.

Moat Albert G. and Foster John W. (1988) Microbial Physiology 2nd Ed. John Wiley and Sons New York.

Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. New York.

Palmer Trevor (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry, Horwood Pub. Co. Chinchester, England.

Segel Irvin H. (1997) Biochemical Calculations 2nd Ed., John Wiley and Sons, New York.

Voet Donald and Voet Judith G. (1995) Biochemistry, 2nd Ed.. John Wiley and sons New York.

White Abraham, Handler Philip, Smith Emil, Hill Rober, Lehman J. (1983) Principles of Biochemistry, Edition 6, Tata Mc-Graw Hill Companies, Inc.

White David (2000) Physiology and Biochemistry of Prokaryotes. 2nd Ed. Oxford

University Press, New York.

Zubay Geoffrey (1998) Biochemistry, 4th Ed., W. C. Brown, New York.

Suggested list of practicals (Course Code BOE101**)**

1. To study working of weighing balance.
2. To study the working of pH meter.
3. To determine the pKa value of acetic acid by pH titration method.
4. Preparation of acetate buffer at pH=5.
5. Prepare Phosphate buffer at pH=8.
6. To prepare tris buffer at pH=9.
7. Estimation of protein by Lowry method.
8. Chromatographic separation by paper and thin layer Chromatography.
9. To determine pKa value of glycine.
10. Determine the absorption maxima of Potassium dichromate.
11. To prove the validity of Beer-Lambert's law.
12. Qualitative assessment of carbohydrate.
13. Qualitative assessment of lipids.
14. Qualitative assessment of proteins.
15. To prepare standard curve of glucose by anthrone method.
16. To determine the Km and Vmax od amylase enzymes.
17. To study the effect of substrate concentration on enzyme activity.
18. To study the effect of temperature on enzyme activity.

ELECTIVE COURSE CODE BOE102: BIOENERGETICS AND INTERMEDIARY METABOLISM

(COURSE CREDITS = 03)

Course objectives – Learners obtain the knowledge about the bioenergetics and intermediary metabolism within the living system for production of energy in form of ATP and different biomolecules, participate in different metabolic pathway.

Course learning outcomes –

CO1: Learners will understand the concepts of bioenergetics, mitochondrial respiratory chain, cytochromes characterization and Oxidative phosphorylation.

CO2: Students will get knowledge of cell transport systems, influx and efflux mechanisms, symport, antiport, uniport,

CO3: Students will learn about the carbohydrate metabolism; glycolysis, TCA cycle, energy generation, energy rich bonds, biosynthesis of sugars, HMP shunt and alternate pathways.

CO4: Students will learn about lipid metabolisms; fatty acid synthesis and oxidation, triglycerol, steroids and terpenes.

CO5: Students will understand about the amino acid and nucleic acid biosynthesis, degradation, regulation, urea cycle, inhibitors and inborn error metabolism.

COURSE CONTENTS

UNIT I

Bioenergetics: energy transformation, biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes; free energy changes and redox potentials, phosphate potential, ion and proton electrochemical potentials, membrane potentials, chemo-osmotic theory; ion transport across energy transducing membranes, influx and efflux mechanisms, transport and distribution of cations, anions and ionophores. Uniport, antiport and symport mechanisms, shuttle systems.

UNIT- II

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization; the Q cycle and the stoichiometry of proton extrusion and uptake. Oxidative phosphorylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes. ATP synthetase complex, microsomal electron transport.

UNIT- III

Carbohydrates: glycolysis, citric acid cycle- its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway, alternate pathways of carbohydrate metabolism, gluconeogensis, inter-conversions of sugars, biosynthesis of glycogen, starch and oligosaccharides.

UNIT- IV

Lipids: fatty acid biosynthesis: acetyl CoA carboxylase, fatty acid synthase; fatty acid oxidation: α, β, oxidation and lipoxidation; lipid biosynthesis: of triacylglycerols, phosphoglycerides and sphingolipids, biosynthetic pathways for terpenes and steroids.

UNIT- V

Amino acids and nucleic acids: biosynthesis and degradation of amino acids and their regulation, specific aspects of amino acid metabolism, urea cycle and its regulation, in-born errors of amino acid metabolism; Nucleic acids: degradation of purines and pyrimidines, regulation of purine and pyrimidine biosynthesis, structure and regulation of ribonucleotide biosynthesis, biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides, inhibitors of nucleic acid biosynthesis.

Books recommended

M.M. Cox and D.L. Nelson (2008) Lehninger Principals of Biochemistry W.H. Freeman & Company

Otto Hoffmann-Ostenhof (2008) Intermediary metabolism; *Van Nostrand Reinhold (USA).*

P.H. Clarke (1978) Intermediary metabolism; *John Wiley & Sons Ltd Hoboken, New Jersey (United States).*

Alexander Lowen (1994) Bioenergetics; *Penguin/Arkana Books USA.*

David G. Nicholls and Stuart Ferguson (2013) Bioenergetics; *Academic Press Elsevier United States*.

Suggested list of practicals (Course Code BOE102)

1. To prepare acetate buffer of pH4.7.
2. To perform carbohydrate tests of manosaccharides, polysaccharides, disaccharides.
3. To determine protein of unknown sample by Lowry method.

CORE COURSE CODE BOS101: SKILL DEVELOPMENT MODULES 1

(COURSE CREDITS = 02)

PERSONALITY DEVELOPMENT- MODULE- 1 (Semester-1) Hrs.-30

S. No.	Subject	Classroom Activity	Hrs.
01	Orientation , Personality Development	Worksheet	1
02	Role and Impact of Personality	Group Activity	1
03	Pre Self-Assessment (Psychometric Analysis)	PDP Assessment Sheet	2
04	Listening and Caring	Group Activity	1
05	The Art of Communication	Worksheet	1
06	Different level of Effective Communication	Worksheet	1
07	Professional Communication P-A-C	Worksheet	1
08	Rules of Professional Communication	Group Activity	1
09	Body Language - 1	Worksheet	1
10	Language Lab	Worksheet	1
11	Thought Process - 1	Worksheet	1
12	Interpersonal Skills	Worksheet	1
13	Observation & Imagination Power	Group activity	1
14	Creativity	Group Activity	1
15	Extempore - 1	Group activity	1
16	Extempore - 2	Group Activity	1
17	Presentation Skills	Worksheet	2
18	How to Draw the Attention of Audience	Worksheet	1
19	Steps of Effective Presentation	Worksheet	1
20	Prioritizing Matrix	Worksheet	1
21	Leadership Quality	Group activity	1
22	SWOT Analysis	Worksheet	1
23	Interview Skills	Lecture	2
24	Group Discussion	Group Activity	2
25	Resume Preparation	Group Activity	1

SECOND - SEMESTER

COURSE CODE BOC201: TAXONOMY OF ANGIOSPERMS

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with the knowledge about terminologies, theories, conventional and modern methods and practices of taxonomy of flowering plants, focusing on the local plant species. It also aims to create awareness about the plants used by tribals of MP.

Course Learning Outcomes:

CO1: Understanding principles of biodiversity and its conservation. Gaining insight into the rules of nomenclature, adaptive features of ICBN and different classification systems.

CO2: Learning and applying different techniques of identification, documentation of plants and role of computer in database identification. They will know how to prepare herbarium and use of keys to identify floras.

CO3: Knowledge of modern taxonomy and its application in taxonomic evidences from anatomy, embryology palynology, cytology, secondary metabolites. Understanding numerical taxonomy OUT's coding.

CO4: Empowers student to recognize, collect and compare the plants of the given fourteen angiosperm families. Learners will be able to describe the plant specimen with taxonomical terms, floral formula and diagrams.

CO5: Acknowledge the economic uses of plants in modern society. An increased awareness and appreciation of plants & plant products encountered used by tribes of MP. Knowledge of important families of useful plants, the parts used and active biomolecules present in medicinal plants.

COURSE CONTENTS

UNIT-I

Principles of Biodiversity & its conservation, Concept of systematic, Identification & nomenclature with special reference to International code of Botanical nomenclature. Taxonomic Category species, Genus & family, Angiosperm classification systems (Bentham & Hooker & Hutchinson).

UNIT- II

Herbarium, Herbarium Techniques, Role of botanical gardens, Documentation (Floras, Monographs, Journals, Manuals, Abstracts, Indices & Dictionaries), Keys for identification of plants single access and multi-access, Role of computers and Database in identification.

UNIT- III

Modern Taxonomy, Supportive evidence from Anatomy, Embryology, Palynology, Cytology, Phytochemistry including secondary metabolites, Numerical Taxonomy OUT'S coding, Cladistics.

UNIT- IV

Comparative study of Angiosperm families, Rannunculaceae & Magnoliaceae, Papaveraceae & Capparidaceae, Oxalidaceae & Meliaceae, Combretaceae & Lytheraceae Rubiaceae & Asteraceae, Convolvulaceae & Lamiaceae, Gramineae & Orchidaceae.

UNIT V

Importance and nature of plants & their products, Industrial plants, Shisham (*Dalbergia sisoo*), Sagon (*Tectona grandis*), Rubber plant (*Ficus elastica*) Cotton plants (*Gossypium hirsutum*), Semal (*Bombex ceiba*), Flax (*Glycine max*), Kattha (*Acacia catechu*), Neel (*Indigofera tinctoria*), Sindoor (*Melilotus alba*).

Drug Plants, Ashwagandha (*Withania somnifera*),Sarpgandha (*Rauwolfia serpentina*),Adhusa (*Adhatoda vasica*)Amla (*Emblica officinalis*), Neem (*Azadirachta indica*), Punarnava (*Boerhaavia diffusa*) safed musli.

Food Plants, Wheat (*Triticum aestivum*),Rice (*Orriza sativa*) Maize (*Zea mays*), Arhar (*Cajanus cajan*) Chana (*Cicer aurientinum*), Onion (*Allium cepa*) Clove (*Piper longum*) Turmeric (*Curcuma domestica*), Mustard (*Brassica compestris*), Groundnut (*Arachis hypogea*).

Ethnobotany, Plants used by tribals of M.P., Sitaphal, Champa, Bel, Ber, Sal, Achar, Palash, Kachnar, Siris, Arjun, Harra, Bahera, Mehndi, Mahua, Tendu,Latjira, Gular, Anar, Datura.

Books recommended

- Davis P. R. and Heywood V. M. (1973) Principles of Angiosperm Taxonomy.
- Eames A. I. (1961) Morphology of Angiosperms.
- Naik V. N. (1984) Taxonomy of Angiosperms.

CORE COURSE CODE BOC202: BIOLOGY AND DIVERSITY OF FUNGI

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with the knowledge of fungal biodiversity, phylogeny and classification; fungal plant ecology, physiological aspects and nutritional modes of fungi; fungal genetics at classical and molecular level, economic and biotechnological dimension of fungi.

Course Learning Outcomes:

CO1: Understanding general features and status of fungi along with classification, phlogeny fungal physiology, growth and interactions.

CO2: Gaining Insight into the world of fungal diversity by learning Structure, Reproduction, Life cycle and significance of the following representative: I) Gymnomycota II) Mastigomycota III) Amastigomycota

CO3: Identification of fungi from leaf sample and knowledge of Structure, Reproduction, Life cycle and significance of the following representative: I Ascomycotina II Basidiomycotina III Deutromycotina

CO4: Empowers student to understand fungal genetics at classical and molecular level; the fungal holomorph; asexual and sexual reproduction. Understanding variation in fungi; heterokaryosis, parasxuality, homothallisum and Heterothallisum, Mutation, and improvement of strains.

CO5: Acknowledge the economic uses of fungi in modern society. Understanding and applying knowledge of production of alcoholic beverages, Antibiotics, Organic acids, Ergot alkaloids, mushrooms, Myco protein, Mycofoods and role of fungi in agriculture and forestry. Knowledge of mycotoxins and conservation of fungi germplasm.

COURSE CONTENTS

UNIT –I

Status of fungi in the living world, General features of fungi and fungus like organisms, Recent trends in the classification of fungi, Physiology and growth of fungi, Nutritional and environmental factors affecting growth, Saprotrophs, parasites of mutualistic symbionts, Physiology of reproduction in fungi, Phylogeny of fungi.

UNIT – II

Fungal diversity, Major taxonomic groups, Structure, Reproduction, Life cycle and significance of the following representative:

I) Gymnomycota – Cellular slime moulds (*Dictyostelium*), Plasmodial slime moulds (myxomycetes).

II) Mastigomycota- *Coelomomyces, Langenidium, Achlya, Phytophthora, Peronospra, Plasmodiophora*.

III) Amastigomycota – *Zygomycotina – Mucor, Synephalastrum, Blakeslea, Cunninghamella, Entomorphthora*.

UNIT – III

Fungal diversity contd, Structure, Reproduction, Life cycle and significance of the following representative:

I Ascomycotina: *Taphrina, Emericella, Chaetomium, Morchella, Neurospora, Claviceps*.

II Basidiomycotina: *Puccinia, Melampsora, Ustilago, Polyporus, Lycoperdon, Ganoderma*.

III Deutromycotina: *Fusarium, Cercospora, Curvularia, Beauveria, Microsporum, Phoma, Colletotrichum*.

UNIT – IV

Fungal genetics, Life cycle and sexual process in fungi, Structure and organization of fungal genomes (Mitochondrial genes, Plasmids of transposable elements, Virus and viral genes). Genetic variations in fungi nonsexual variations Haploidy, Heterokaryosis, Parasexuality, Sexual variations mating or Breeding systems Homothallisum and Heterothallisum, Mutation, Physiological specialization, Strain improvement.

UNIT – V

Fungi and Biotechnology, Production of alcoholic beverages, Antibiotics, Organic acids, Ergot alkaloids, The cultivation of fungi for food mushrooms and Myco protein, Mycofoods, Role of fungi in agriculture and forestry, Mycorrhizae and their application, Mycopesticides, Mycotoxins, Conservation of fungi germplasm.

Books recommended

- Gaumann G. S. (1952) The Fungi.
- Mehrotra R. S. and Aneja R. S. (1998) An Introduction to Mycology.
- Dayal (1995) Aquatic Fungi of India.
- Wolf F. A. and Wolf F. T. (1947) The Fungi Vol. I and II,
- Thind K. S. (1977) The Myxomycetes of India.
- Ainsworth G. F. and A. S. Sussman. The Fungi Vo. I, II, III, IVA and IVB.

CORE COURSE CODE BOC203: BIOSTATISTICS AND COMPUTER APPLICATIONS

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with tools and techniques in collection, collation, summarization and interpretation of data along with various experimental designs and bioinformatics.

Course Learning Outcomes:

CO1: Proficiency of students in various techniques of collection, collation, summarization and presentation of data. They could learn basic concepts of probability and probability distribution functions along with applications.

CO2: Understanding and applications of descriptive and inferential statistics enabling students to use tests of significance in biological data.

CO3: Can apply Analysis of Variance tools and different experimental designs to biological experiments, enabling them to minimize experimental and sampling errors.

CO4: Understands concepts of correlation and regression tools and techniques, attempts extrapolation and simulation of biological processes.

CO5: Empowers students to utilize software packages in digital analysis and processing of biological data. Integrate informatics with biology through data submission protocols, sequence alignment and searches, annotations and possible applications in human health and welfare.

COURSE CONTENTS

UNIT – I

Importance and scope of statistics in experimentation, Measure of central tendency Arithmetic, Geometric and Harmonic means, Measure of dispersion variance, Standard deviation, Coefficient of variation, Confidence limits of population mean.

UNIT – II

Elements of probability**,** Statistical and Mathematical definitions, Probability distribution function: Normal, Binomial and Poisson distribution.

UNIT – III

Tests of significance, Hypothesis and errors, 't' test, Population mean equals a specified value, Test of the equality of two means (Independent samples & Equal variances), Test of the equality of two means (Paired samples), 'F'- test, One way analysis of variance (Sample sizes, Equal and Unequal).

UNIT – IV

Chi-square statistics**,** Test of goodness of fit and test of independence of factors, Simple correlation coefficient, Significance tests, linear regression equation and diagram regression coefficient, Standard error, Significance tests.

UNIT – V

History and development of computers, Hierarchy of computers, Computer hardware components and functional structures, Computers software: system and application software.

Books recommended

1. B. L. Agarawal, Text Book of Biostatistics.
2. Paolo Coletti, Basic Computer Course Book. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) Mc Graw Hill, NewYork.
3. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
4. Programming in C by E. Ballaguruswamy
5. How Computers work - 2000. By Ron White. Tech. Media
6. How the Internet Work 2000 by Preston Gralla Tech. Media.
7. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.

8. Biostatistics - 7th Edition by Daniel
9. Fundamental of Biostatistics by Khan
10. Biostatistical Methods by Lachin
11. Statistics for Biologist by CampbellR.C. (1974) Cambridge University Press, UK.
12. INTERNET – CDC publication, India.

CORE COURSE CODE BOC204: PRACTICAL BASED ON
COURSE CODE BOC201 & COURSE CODE BOC202 (COURSE CREDITS = 04)

Suggested List of Practicals (Course CODE BOC201**)**

Taxonomy of Angiosperms

1. To study the plants of following Families.
   - Rananculaceae – *Delphinium ajacis*
   - Asclepidiaceae – *Calotropis procera* (Aak)
   - Papaveraceae – *Argemone maxican*
   - Orchidaceae – *Zeuxine stratecemitica*
   - Rubiaceae – *Ixora coccinea* (Rukmani)
   - Lamiaceae – *Ocimum sanctum* (tulsi)
   - Poaceae (Gramineae) – *Triticum aestivum*
   - Asteraceae (Compositeae) – *Helianthus annus*
   - Combretaceae – *Quinsqualis indica*
   - Magnoliaceae – *Michelia champaca Linn*.
   - Convolvulaceae – *Convolvulus microphyllus*
   - Capparidaceae – *Cleome gynandra* (Hut-hul)
   - Meliaceae – *Azadirachta indica* (Neem)
2. To study the Ethnomedicinal importance of the following plants–
   - Arjun (*Terminalia arjuna*)
   - Harra (*Terminalia chebula*)
   - Clove (*Syzygium aromatium*)
   - Mehndi (*Lawsonia inermis*)
   - Neem (*Azadirachta indica*)
   - Amla (*Emblica officinalis*)
   - Onion (*Allium cepa*)
   - Ashwagandha (*Withania somnifera*)
   - Sarpagandha (*Rauvolfia serpentina*)
   - Bahera (*Terminalia bellerica*)
3. To prepare the Herbarium of the plants.

Suggested List of Practicals (Course Code BOC202)

Biology and Diversity of Fungi

1. To study the structure of given fungi by using Camera Lucida.
2. To perform micrometry for measurement of fungal spores and sporangia.
3. To study slide culture technique for observing morphology of fungi.
4. Isolation and identification of fungi from infected leaves of different plant parts.
5. Isolation and identification of fungi from air.
6. Classification and characterization of micro-organism

   Alternaria sp.

   Mucor sp.

   Fusarium sp.

   Rhizopus sp.

   Curvularia sp.
7. Morphological study of edible Mushroom.
8. To cultivate Mushrooms as a source of myco-protein.
9. To examine Antibacterial properties of certain fungal species.

CORE COURSE CODE BOC205: PRACTICAL BASED ON

COURSE CODE BOC203 & BOE201/ BOE202/ BOE203 (COURSE CREDITS = 04)

Suggested List of Practicals (Course Code BOC203)

Biostatistics and Computer Applications

1. To find out the average length of the mango leaf by arithmetic, harmonic and geometric mean.
2. To find out the standard deviation and coefficient of variation of the length of leaf.
3. To find out the confidence limit of the length of the leaf.
4. To find out the probability of getting head in 10, 20, 30, 40 & 50 tosses of a fair coin.
5. To test the hypothesis that average pulse rate of biostatistics class students is 72 beats per minute.
6. To calculate the correlation coefficient between length and weight of 10 different pieces of *Parthenium* stem.
7. To find out the prediction or regression equation of the *Parthenium* stem.
8. To study Hardware's & Software's of computer.

ELECTIVE COURSE CODE BOE201: BIOLOGY OF THE IMMUNE SYSTEM

(COURSE CREDITS = 03)

Course objectives:

The course is designed with an objective to enhance students understanding of the biomolecules and the structural organization involved in host individual's immune responses and also the immune mechanisms.

Course Learning Outcomes:

CO1: It will help understanding the structure, types and functions of antigens and immunoglobulins.

CO2: Understand the role of cells and organs in immune system.

CO3: Clinical and sub-clinical practices of collection, transportation and handling of pathological samples in laboratories.

CO4: Practical knowledge of serology.

CO5: Skill as an epidemiologist and adaptation to prophylaxis.

COURSE CONTENTS

UNIT-I

Introduction: phylogeny of immune system, innate and acquired immunity, clonal nature of immune response; organization and structure of lymphoid organs, nature and biology of antigens and super antigens.

UNIT-II

Antibody structure and function; antigen-antibody interactions, major histocompatibility complex, BCR & TCR, generation of diversity, complement system.

UNIT-III

Cells of the immune system; hematopoiesis and differentiation, lymphocyte trafficking. Blymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophils, neutrophils and mast cells. Regulation of immune response: antigen processing and presentation, generation of humoral and cell mediated immune responses, activation of B-and T-lymphocytes, cytokines and their role in immune regulation; T-cell regulation, MHC restriction, immunological tolerance.

UNIT-IV

Cell- mediated cytotoxicity; mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; hypersensitivity autoimmunity, transplantation.

UNIT- V

Immunity to infectious agents (intracellular parasites, helminthes & viruses); tumor immunology; AIDS and other immunodeficiences, hybridoma technology and monoclonal antibodies.

Recommended Books:

1. Kuby immunology, 4th Edition, R.A. Goldsby, Thomas J.Kindt, Barbara, A.

Osbarne. (Freedom)

2. Immunology-A short Course, 4th Edition- Ell Benjamin, Richard Coico, Geoffrey

Sunshine (Wiley-Liss).

3. Fundamentals of immunology, William Paul.

4. Immunology, Roitt and others.

Suggested list of practicals (Course Code BOE201)

1. To perform test for antibiotics sensitivity by disc method.
2. To determine the minimum inhibitory concentration of given antibiotics.
3. Preparation of blood smear.
4. To isolate serum from blood plasma.
5. To perform agglutination reaction to identification of blood group.

ELECTIVE COURSE CODE BOE202: RESOURCE UTILIZATION AND CONSERVATION

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with knowledge pertaining to world biomes, resources, conservation, sustainable development, pollution and its management, and remote sensing in management of earth resources.

Course Learning Outcomes:

CO1: Deep understanding of distribution, structure and function of various aquatic and terrestrial biomes.

CO2: Learn definitions, types and utilities of biodiversity along with threats along their applications in management and sustainable development of resources from various biomes.

CO3: Empowers students to apply in-situ and in-vitro techniques in conservation of aquatic and terrestrial resources in real time.

CO4: Understands concepts of pollution of different environments and can monitor and treat pollution loads in artificial and natural ecosystems; and appreciate nuances of industrial, societal and urban pollutions.

CO5: Gains insight knowledge about remote sensing of earth resources along with platforms, sensors and scanners, visual and digital interpretation of remotely sensed data.

COURSE CONTENTS

UNIT – I

Major Biomes of the world, Tropical rain & Seasonal Forests, Temperate rain & Seasonal forests, Boreal forests, Grasslands, Deserts, Aquatic Ecosystems wetlands, Lakes & Ponds Streams & Rivers, Marine & Estuarine habitats.

UNIT – II

Resource utilization**,** Status & Utilization of Biodiversity, Sustainable development resources from forest, Grassland and aquatic habitats, Food forage, Fodder, Timber & Non-wood forest products, Threats to quality & quantity of Resources due to overexploitation. Biodiversity in India: Status, Threats, Utility & Conservation; Indian Biodiversity ACT 2002 and Biodiversity Rules 2004.

UNIT –III

Strategies for conservation of resources: Classifications of resources, Principles of conservation, *In-situ* conservation sanctuaries, National parks, Biosphere reserves for wildlife conservation, Habitat conservation practices of conservation for forests ranges, Soil and water.

UNIT – IV

Air, Water and Soil pollution**,** Kinds, Sources, Quality parameters, Effects on structure & function of ecosystems, Management of pollution, Bioremediation, Climate changes sources, Trends & role of

greenhouse gases, Effect of global warming on climate, Ecosystem processes & Biodiversity, Ozone layer & Ozone hole.

UNIT – V

Resource monitoring, Remote sensing concepts & Tools, Satellite remote sensing basics sensors, Visual & digital interpretation, EMR bands and their applications, Indian remote sensing program, Thematic mapping of resources, Application of remote sensing in Ecology &Forestry.

Books recommended

- Chopra R. N. (1933) Indigenous Drugs of India.
- Hayes W. B. (1953) Fruit Growing in India.
- Atkinson E. T. (1980) Economic Botany of Himalayan Regions.
- Chapman, J.L. and Reiss, M.J. (1999) Ecology: Principles and Applications.
- Singhal, P.K. and Shrivastava, P. (2004) Challenges in Sustainable Development.
- Odum, E.P. (1971) Fundamentals of Ecology.
- Begon, M., Harper, J.L. and Townsend, C.R. (1986) Ecology: Individuals, Populations and Communities.
- Wetzel, R.G. (1983) Limnology.

Suggested list of practicals: Course Code BOE202 (Resource Utilization and Conservation)

1. To find the pH of the various sample of soil by pH meter.
2. To determine ground flora in forest ecosystems.
3. To determine IVI of species in forest ecosystmes.
4. To determine the presence of carbonate in different soil mixtures.
5. To determine the presence of phosphate in soil and water sample.
6. To determine the presence of nitrate in mixture sample.
7. To determine the presence of nitrite in mixture sample.
8. To determine frequency, density and abundance of herbaceous species from local garden.
9. To determine the biomass of plant vegetation.
10. To determine leaf area, dry weight and moisture content of few species of plant from grassland.

ELECTIVE COURSE CODE BOE203: MICROBIAL METABOLISM

(COURSE CREDITS = 03)

Course Objectives:

The major objective of this paper is to develop clear understanding of various aspects of microbial physiology along with diverse metabolic pathways existing in bacteria in relation to its survival and propagation, and to enable students to better understand courses taught later.

Course Learning Outcomes:

CO1: Students become acquainted with methods of measuring microbial growth, calculating growth kinetic parameters with understanding of steady state and continuous growth.

CO2: They gain an in-depth knowledge of primary, secondary and group translocation transport systems existing in bacteria, simultaneously learning membrane transport proteins and kinetics

of solute transport.

CO3: They learn central metabolic pathways for carbon metabolism in bacteria enlisting differences with eukaryotic systems and their regulation in diverse physiological conditions. This allows students to apply the acquired knowledge in engineering metabolic pathways for developing industrially useful strains.

CO4: Will have gathered understanding of inorganic and organic nitrogen assimilation and its regulation. Also knows role of glutathione in cellular redox regulation and biochemistry of glutamate overproducing strains.

CO5: They learn basic concepts of enzyme biochemistry, its kinetics and regulation, details of lipid and nucleotide metabolism in *E. coli* and its regulation along with biochemical basis of lipid accumulation in yeasts, and intracellular signaling in bacteria in response to various nutritional and physiological stresses.

COURSE CONTENTS

UNIT-I

Microbial growth: mathematical expression of growth, growth measurement, efficient growth curve, synchronous growth and continuous culture, effect of environmental factors on microbial growth, nutrients diffusion, active transport, group translocation, solutes, temperature, oxygen relations.

UNIT-II

Chaemolithotrophy: Sulphur, iron, hydrogen, carbon monoxide, nitrogen oxidations. Methanogenesis, luminescence. Brief account of photosynthetic and accessory pigments chlorophyll, bacteriochlorophyll, carotenoids, oxygenic, anoxygenic photosynthesis. Electron transport- photoautotrophic generation of ATP, fixation of CO2- Calvin cycle, reverse TCA, carbohydrate anabolism.

UNIT-III

Respiratory metabolism: Embden Mayer Hoff pathway, Entner Doudroff pathway, glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, Pasteur effect, fermentation of carbohydrates- homo and heterolactic fermentations. Synthesis of polysaccharides- gluconeogenesis and other pathways.

UNIT-IV

Assimilation of nitrogen: Dinitrogen - nitrate nitrogen-ammonia- denitrification, synthesis of major amino-acids, polyamines; peptidoglycan-biopolymers as cell components.

UNIT-V

Microbial development, sporulation and morphogenesis, hyphae vs. yeast forms and their significance. Multicellular organization of selected microbes. Dormancy. Endospore-structure, properties and germination.

List of Recommended Books

1. Doelle H.W. 1969. Bacterial Metabolism. Academic Press.
2. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag. Moat AG. 1979. Microbial Physiology. John Wiley & Sons.
3. Sokatch JR. 1969. Bacterial Physiology and Metabolism. Academic Press.
4. Moat A G., Foster J W., Spector M P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009.

Suggested list of Practicals (Course CODE BOE203: Microbial Metabolism)

1. Determination of Bacterial growth by turbidity measurements (spectrophotometric method).
2. Study of effect of temperature on growth of bacteria.
3. Study of effect of pH on growth of Bacteria.

4. Isolation of rhizobia from root nodules.
5. Slide culture technique for studying morphology and molds.

CORE COURSE CODE BOS201: SKILL DEVELOPMENT MODULES 2

(COURSE CREDITS = 02)

SOFT SKILLS DEVELOPMENT MODULE-2 (Semester- 2) Hrs. 30

S. No.	Subject	Classroom Activity	Hrs.
01	Orientation , Personality Development	Worksheet/ lecture	02
02	Role and Impact of Personality	Group Activity/ lecture	01
03	Pre Self-Assessment (Psychometric Analysis)	PDP Assessment Sheet	02
04	Importance of characteristics and Traits	lecture/Group Activity	02
05	Empowerment of Internal and external traits	Lecture	02
06	Definition of Personality	Lecture	02
07	Power of Self	Lecture	03
08	Path to Improve Personality	lecture/Group Activity	03
09	Body Language - 1	Worksheet	02
10	Grooming Yourself	Lecture	02
11	IQ / EQ / MQ / SQ	Lecture	02
12	Disposition of Body in various aspects	Group Activity	03
13	Getting desired output	Group Activity	02
14	Post Assessment of Personality	Group Activity	02

THIRD SEMESTER

CORE COURSE CODE BOC301: PLANT PHYSIOLOGY

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners with basic principles of plant functions such as mechanism of the transport of the water, inorganic and organic substances, metabolism (photosynthesis and respiration), secondary products, plant hormones, cell and stress physiology, principles of growth & development.

Course Learning Outcomes:

CO1: The student will able to get the huge knowledge about pathways of water through xylem and phloem. Know about the requirement of mineral nutrition for plant growth.

CO2: Students will understand the process of Photosynthesis, Respiration and Nitrogen metabolism.

CO3: Learners will gain the idea about Stress physiology – Responses of plants to biotic and abiotic stresses, biological clock and the photoperiodism.

CO4: Student will know about the Plant Growth hormones (Auxins, Gibberellins. Cytokinins, Ethylene), they understand the biosynthesis of phenolic acids, alkaloids.

CO5: Demonstrate proficiency in the experimental techniques and methods to study the plant physiology.

COURSE CONTENTS

Unit I

Mechanism of transport of water inorganic and organic substances, Source and sink relationship, Mineral nutrition & absoption.

Unit II

Photosynthesis in plants, Pigments, Photosystem I and II, Mechanism of quantum capture and energy transfer between photosystems, Reduction of CO_2 , C_3, C_4 and CAM metabolism , photorespiration and its signification.

Unit III

Overview of plant respiration, Glycolysis, TCA cycle, Electron transport and ATP synthesis, Pentose phosphate pathway, Glyoxalate cycle.

Unit IV

Plant hormone, Mode of action of Auxins, Gibberellins, Cytokinin, Ethylene, Abscissic acid, Special features of secondary plant metabolites, Biosynthesis and functions of phenolic acids, Alkaloids.

Unit V

Stress physiology, Water deficit and drought resistance, Temperature stress, Salinity stress metal toxicity, Biological clock and its regulation, Photoperiodism and floral induction.

Books recommended

- Buchanan. B.B. Gruissem, W and Jones. R.L. (2000) Biochemistry and Molecular Biology of plants.
- Galston, A.W. (1989) Life Processes in Plants. Physiology,
- Hopking W.G. (1995) Introduction to Plant physiology
- Nobel P.s. (1999) Physiochemical and Environmental Plan Physiology.
- Taiz .L.and Zeiger, E. (1998) Plant Physiology (2nd Edition).

CORE COURSE CODE BOC302: GENETICS & MOLECULAR BIOLOGY

(COURSE CREDITS = 03)

Course Objectives:

The course aims to empower the learners insights into various molecular biological processes of DNA replication, transcription and translation. Molecular biology of recombination, synthesis and processing of various RNA molecules are discussed. Further the course provides deeper understanding of regulation of gene expression in various organisms.

Course Learning Outcomes:

CO1: Understanding of DNA as the genetic material and its types. Knowledge of chromatin organization, euchromatin, heterochromatin, C value paradox and restriction mapping.

CO2: Knowledge of Mutation, its kind and mechanism of DNA repair system.

CO3: Conceptualize different aspects of genetics of microorganism with deep understanding of molecular mechanism of recombination, role of Rec ABC&D, linkage and crossing over.

CO4: Empowers student to acquire knowledge about different enzymes of DNA replication, transcription and translation. Deep understanding of DNA and RNA sequencing methods, process of transcription and post transcriptional processing.

CO5: Gains insight into the process of translation and gene expression in prokaryotes and eukaryotes by understanding different types of RNA, translational factors, concept of operon ; lac and tryptophan and different models of gene expression in eukaryotes.

COURSE CONTENTS

Unit I

Nucleic acid as genetic material (experimental proof) DNA structure A, B & Z forms. Chromosome structure & chromatin organization, Euchromatin & Heterochromatin different models, Nuclear DNA content, C-value paradox, Cot curves, Restriction mapping, Concept & techniques, *In-situ* hybridization.

Unit II

Spontaneous & induced mutations, Physical & chemical mutagens types of mutations, Molecular mechanism of mutation, forward, back, Missense, Nonsense, Frameshift and suppresser mutations, Mutations induced by transposons, Site directed mutagenesis, Mechanism of DNA damage & repair , Photo-repair, Excision or dark repair.

Unit III

Genetics of microorganisms, Transformation, Conjugation & transduction in bacteria, Conjugation mapping, Molecular mechanism of recombination, Role of Rec ABC&D, general & site specific recombination, Independent assortment, Linkage and crossing over.

Unit IV

DNA & RNA sequencing, Different methods, DNA replication, DNA polymerases, Topoisomerases, Ligases, Gene transcription, RNA polmersases, Promoters, Transcription factors, Mechanism of transcription, Chain initiation, Elongation, & termination, Post transcriptional processing of RNA, Capping, Adenylation & splicing, Introns & Exons.

Unit V

Translation of messenger RNA into proteins, Structure & role of t- RNA & ribosomes, Different factors (I, EFTs , RFs), Protein chain initiation, Elongation & termination, Inhibitors of protein synthesis, *In vitro*

protein synthesis, Gene expression in prokaryotes, Operon concept, Inducer, Repressor, Co-repressor, c-AMP / CRP, co-induction & co-repression . Regulation of lac operon & Tryptophan operons, Attenuation Gene expression in eukaryotes, Britton and Davidsons, Gene battery model, HCP / NHCP Hormones.

Books recommended

- Bray, Lewis Ralf, Roberts and Watson (1983) Molecular Biology of the Cell.
- Schwer M. A. (1989) Methods in Plant Molecular Biology.
- Wolf S. L. (1993) Molecular and Cellular Biology.
- Shaw C. H. (Ed.) (1988) Plant Molecular Biology – A Practical Approach.
- Clug & Cummings: Essential of Genetics.

CORE COURSE CODE BOC303: PLANT REPRODUCTION & DEVELOPMENT

(COURSE CREDITS = 03)

Course Objectives:

The course aims to provide deeper understanding of various anatomical structures and their functions, several embryological processes including pollen pistil interaction, applied aspects of embryology and seed development.

Course Learning Outcomes:

CO1: Understanding of organization of shoot apical meristem (SAM), differentiation of xylem and phloem; characteristic of wood.

CO2: Learning about the various arrangements of leaf, its growth and differentiation. Learners will also understand various types of epidermal appendages present.

CO3: Knowledge of organization of root apical meristem (RAM), root development and root microbe association.

CO4: Empower students to understand embryology of flowering plants with detail knowledge about the structure of gametes, and the processes of sporogenesis, gametogenesis and embryogenesis.

CO5: Understanding different modes of reproduction, process of fertilization, pollen pistil interaction and significance of seed maturation, dormancy, and germination.

COURSE CONTENTS

UNIT – I

Organization of shoot apical meristem (SAM), Control of tissue differentiation especially Xylem & Phloem, Secretary ducts & Lactifers, Diagnostic features of woods.

UNIT – II

Leaf growth & differentiation, Determination of Phyllotaxy, Differentiation of Epidermis including Stomata, Trichomes, & Mesophyl tissue.

UNIT – III

Root development, Organization of root apical meristem (RAM), Vascular tissue differentiation, Lateral roots, Root hairs, Root microbes interactions.

UNIT – IV

Male gametophyte development , Structure of anther, Microsporogenesis , Pollen germination, Pollination. Female gametophyte development**,** Ovule development, Megasporogenesis organization of embryosac, Endosperm development, storage protein of Endosperm & Embryo.

UNIT – V

Reproduction, Vegetative & Sexual reproduction, Pollen Pistel interaction and Fertilization, Double fertilization , Seed germination & Seedling growth, Seed dormancy.

Books recommended

- B. D. Singh 2013 Plant Breeding : Principles & Method.
- Stanley R. G. and E. L. Linkens 1974. Pollen Biology, Biochemistry and Management.
- Nair P. K. K. 1964. Advances in Palynology.

CORE COURSE CODE BOC304: PRACTICAL BASED ON

COURSE CODE BOC301 & COURSE CODE BOC302

(COURSE CREDITS = 04)

Suggested List of Practicals (Course Code BOC301)

Plant Physiology

1. To measure Diffusion Pressure Deficit of Potato cells.
2. To prepare molar, Molal & Normal solution of NaCl and Sucrose.
3. To determine the incipient plasmolysis of cells under different concentration of sucrose solution.
4. Extraction and separation of the chlorophyll pigment from spinach leave by paper chromatography.
5. Separation of anthocyanin pigment by Paper Chromatography.
6. Quantification of pigments from spinach leaves by Spectrophotometer.
7. To determine the stomatal index in different plant species.
8. To study the effect of salt & osmotic stress on plants.

Suggested List of Practicals (Course Code BOC302)

Genetics & Molecular Biology

1. Staining technique for chromosomes preparation in plant (Onion plant) and animal cell.
2. To study the mitotic stages in the root of onion (*Allium cepa*) and to calculate the mitotic index.
3. To study the pollen sterility and fertility in buds of *Tradescantia*.
4. To study the effect of UV rays on *E.coli*.
5. To study the effect of dark and light treatment in DNA repair in *E. coli.*

CORE COURSE CODE BOC305: PRACTICAL BASED ON

COURSE CODE BOC303 & COURSE CODE BOE301/ BOE302/ BOE303/ BOE304

(COURSE CREDITS = 04)

Suggested List of Practicals (Course Code BOC303)

Plant Reproduction & Development

1. Slide :- Amphitropus ovule (T.S.)

   Superficial placentation

   Lilium anthor

Dicot embryo endodermis seed coat

Campylotropous ovule

Lillium Bud (Early anther)

2. To study the structure of given pollen grain (*Tradescantia*) using camera lucida.
3. To measure the size of given pollen grain.

ELECTIVE COURSE CODE BOE301: ADVANCED MOLECULAR BIOLOGY

(COURSE CREDITS = 03)

Course Objectives:

This course combines special set of tutorials centered on research activities in molecular biology with practical exercises and/or laboratory placements. The content is designed to provide students with a perspective of how cutting edge molecular biology principles and techniques are applied to major research questions. This course will illustrate that cross disciplinary approaches are essential in modern research.

Course Learning Outcomes

CO1: To understand key principles of how cells work, including gene regulation, protein synthesis and signal transduction.

CO2: To locate, analyse, evaluate and synthesise information from a wide variety of sources to understand the key principles of Molecular Biology.

CO3: To read, interpret and discuss major contributions to Molecular Biology research published in scientific research literature.

CO4: To develop effective, creative and innovative solutions, both independently and cooperatively, to current and future research problems in Molecular Biology.

COURSE CONTENTS

UNIT I

Recombinant DNA technology I: methods of creating recombinant DNA molecule, properties of restriction endonucleases and their mode of action, selection screening construction of DNA library.

UNIT II

Recombinant DNA Technology II: Use of cloned gene, sub-cloning; recombinant proteins production in bacteria, site-directed mutagenesis, RFLP, PCR, DNA-fingerprinting, antisense-RNA technology, chromosomal walking. Bioethics.

UNIT III

Hybridoma technology: monoclonal antibodies mycelium cell infusion selection of hybridomas, protoplast fusion and HAT-medium screening assay purification and application of monoclonal antibodies.

UNIT IV

Cell and tissue culture: micropropagation, somatic cell culture, somoclonal variations, somatic cell hybridization, protoplast isolation, protoplast fusion, protoplast culture, genetic transformation, various methods of gene transfer (all vector and methods), production of transgenic plant and animal; production of secondary metabolites, primary and transferred cell culture, differentiated cells in culture application.

UNIT V

Fermentation technology: continuous and batch type culture techniques, principle types of Fermenters, general design of fementors. Fermentation processes, brewing manufacture of antibiotics, production of single cell protein. Application of genetic and molecular biology procedures in strain improvement.

Books recommended

1. Molecular cloning : A Laboratory Manual , J. Sambrook ; Fritsch and T. Maniatis Cold Spring Harbor Laboratory Press, New York, 2000.

2. Introduction to practical molecular biology P.D. Dabre, John Wiley & sons Ltd. N York 1988

3. Molecular Biology LabFax, T.A. Brown (Ed) Bios Scientific Publishers Ltd. Oxford, 1991

4. Molecular Biology of the Gene (4th edition), J.D. Watson N.H. Hopkins, J.W. Roberts J.A. Steitz and A.M. Weiner, The Benjamin/ Cummlngs Publ Co. Inc. California, 1987.

5. Molecular Cell Biology (2nd Edition) J. Darnell, H. Lodish and D. Baltimore, Scientist American Books, Inc., USA, 1994.

6. Molecular Biology of the Cell (2nd Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, Garland Publishing, Inc., New York, 1994.

7. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.

8. Molecular Biology and biotechnology; a comprehensive desk reference, R.A. Meyers (Ed.)

VCH Publishers, Inc, New York, 1995

9. Genomes, T.S. Brown

Suggested list of practicals (Course Code BOE301)

1. To isolate genomic DNA from fungi by LETS methods.
2. To determine the quantity and quality of the isolated fungal DNA.
3. To determine the agarose gel electrophoresis of the isolated fungal DNA.
4. To isolate plasmid DNA from bacteria by quick method.
5. To purify the DNA from agarose gel.
6. To study the Thermal cycler.
7. To study the gel documentation system.

ELECTIVE COURSE CODE BOE302: AGRICULTURAL MICROBIOLOGY

(COURSE CREDITS = 03)

Course Objectives:

To make students aware about agricultural techniques, crop diseases, soil health, composting, agriculture losses, pest management, green revolution and agricultural biotechnology.

Course Learning Outcomes:

CO1: Describe role of microorganism in recycling soil nutrients, biodegradation of complex plant polymers, sustaining and improving plant growth through improving nutrient availability, production of plant growth promoting substances and inhibiting pathogens.

CO2: Critically discuss the need for agricultural microbiology and explain their limitations.

CO3: Clarify application of microorganisms in varied fields of agricultural microbiology like bioremediation, biofertilizers and waste water treatment.

CO4: Analyse various aspects of N_2 fixation, Phosphate solubilization, PGPR etc. Pre and post harvesting agricultural losses, management, formulation, mass production and applications.

CO5: Green revolution, transgenic plant, gene protection technology, resistant verities, management of agricultural waste as food, feed and fuel.

COURSE CONTENTS

UNIT – I

History, scope and development of agricultural microbiology, rhizosphere and phyllosphere: concept, importance, factors affecting microbial diversity.

UNIT – II

Soil health: crop residues, humus, mineralization, immobilization, soil-sickness, composting, vermicomposting, green manure. Effect of crop residues on plant growth; biodegradation of pesticides and pollutants; biodegradation fate, bioavailability, acceleration, bioremediation. Biofertilizers: types, production, formulation and constraints.

UNIT – III

General idea about major agricultural pests: Plant diseases- late blight potato. downy mildew of pea, stem gall of coriander, powdery mildew / rust / smut, rust of linseed, Ergot of bajara, Anthracnose of soybean, Tikka disease of groundnut, wilt of arhar, bacterial blight of paddy, citrus canker, leaf curl of papaya, little left of brinjal. Insects: gram, soybean. Weeds: parthenium, xanthium, waterhyacinth, cyperus, phalaris

UNIT – IV

Post harvest losses of agricultural products: causes, problems and management recent trends in pest management: strategies, mass production, formulation and application technology, achievements, constraints

UNIT – V

Biotechnology in agriculture: the new green revolution, transgenic crops, gene protection technology, frost control technology, resistant varieties. Bioconversion futurology: exploitation of agricultural wastes for food / feed and fuel.

List of Recommended Books

1. Soil microbiology by Subba Rao
2. Soil and microbes by Waksman and Starkey.
3. Plant pathology by Mehrotra.
4. Alexander, M. Introduction to Soil Microbiology, 3rd Edition. Wiley Eastern Ltd., New Delhi
5. Microbiology by S.S. Purohit.

Suggested list of Practicals (Course CODE BOE302**: Agricultural Microbiology)**

1. Isolation and Enumeration of the microorganism from soil by serial dilution agar plate method.
2. Isolation of fungi from soil by warcup's method.
3. Isolation of azotobacter species from soil.
4. Isolation of microorganism from rhizosphere.
5. Isolation of microorganism from phyllosphere (phyloplane) by serial dilution, agar plate method or leaf impression method.
6. Plant diseases – leaf curl of papaya, rust of wheat, citrus canker, red rot of sugarcane.

Approved by
Board of Studies in Botany on 15/09/2020, **Faculty of Life Science on** 14/10/2020
Standing committee on **Executive Council on**

Study of weeds- Parthenium, water hyacinth.

ELECTIVE COURSE CODE BOE303: BIOPROCESS ENGINEERING AND TECHNOLOGY

(COURSE CREDITS = 03)

Course Objectives:

The course will enable students to apply biotechnological concepts in the exploitation of biological organisms for industrial and human benefits. The strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant biotechnological products and therapeutic proteins.

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1: Insights on industrially important organisms, recent developments in fermentation processes and various optimization strategies at fermenter level. Learns about the design, types of fermenters and various critical components of bioreactors.

CO2: Is able to describe control parameters, fluid rheology and process constraints in large scale bioreactors. Strategies of product recovery from a fermentation broth.

CO3: Understand the significance and activities of microorganisms in food. Recognize the characteristics of food-borne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification.

CO4: Analyze the importance of microbiological quality control programme's in food production.

CO5: Discuss the microbiology of different types of food commodities. Describe the rationale for the use of standard methods and procedures for the microbiological analysis of food

COURSE CONTENTS

UNIT-I

Biofermentation: designing and application, principles of biofermentation, monitoring and control of parameters (pH, oxygen, agitation, temperature, foam etc.), batch & continuous; production medium, raw materials, isolations; maintenance, preservation & improvement of industrial strains, computer control of fermentation processes.

UNIT-II

Downstream processing: Filtration of fermentation broths, ultra-centrifugation, recovery of biological products by distillation, superficial fluid extraction.

UNIT-III

Industrial production of solvents: Ethyl alcohol, citric and acetic acids; enzymes; amylases, proteases, cellulases; vitamins: vitamin B12, vitamin C, antibiotics (penicillin, streptomycin, tetracycline and griseofulvin). Microbes in petroleum industry (oil recovery); immobilized cells & enzymes.

UNIT-IV

Microbiology of food: sources and types of microorganisms in food, food borne pathogens, microbiological examination of food, spoilage of food, food preservation, fermented foods, microbial proteins.

UNIT-V

Dairy microbiology: sources and types of microorganisms in milk, microbial examination of milk, pasteurization and phosphatase test, sterilization of milk, grades of milk, dairy products, fermented milk, butter & cheese.

Recommended Books:

1. Biochemical Engineering, Aiba, S., Humphrey, A.E. and Millis, N.F. Univ of Tokyo Press, Tokyo.
2. Biochemical Reactors, Atkinson, B: Pion Ltd. London.
3. Biochemical Engineering Fundamentals, Baily, J.E. and Ollis, D.F. McGraw-Hill Book Co. New York.
4. Bioprocess Technology: Fundamental and Application, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson, A.T., Prentice Hall, Engelwood Cliffs.
6. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs.
7. Principles of Fermentation Technology, Stanbury, P.F. and Whitaker, A. Pergamon Press, Oxford.
8. Bioreaction Engineering principles, Nielson, J. and Billadsen, J. Plenum Press.
9. Chemical Engineering Problems is Biotechnology, Shuler, M.L. (Ed.) AICHE.
10. Biochemical Engineering, Lee, J.M. Prentice Hall Inc.
11. Bioprocess Engineering-kinetics, Mass Transport, Reactors and Gene Expression, Viet; W.F., John Wiley & Sons, Inc.

Suggested list of Practicals (Course **CODE** BOE303)

1. Isolation of micro-organism from canned food.
2. Isolation of bacteria and fungi from spoiled bread.
3. Quantitative test of milk by resazurin test.
4. Quantitative estimation of Amylase production.
5. Isolation of lipase producing bacteria from soil.
6. Isolation of phosphate solubilizing/producing bacteria from soil**.**
7. Estimation of antibiotic property of bacteria.

ELECTIVE COURSE CODE BOE304: BIOTECHNOLOGY

(COURSE CREDITS = 03)

Course Objectives:

The course will help students to understand various applications of microbes for the development of various products of agriculture, industrial and clinical application. The knowledge of recombinant technology, bioreactors and optimization strategies will be beneficial in development of production processes.

Course Learning Outcomes: Upon successful completion of the course, the student:

CO1: Will learn about industrially relevant microbial products and their production process, role of biotechnology in environment management.

CO2: Acquires knowledge about strains development, selection of hyper producers, microbial products, metabolic engineering and various industrial relevant microbial products and their production

process Learns about the designing of recombinant heterologous expression systems such as *E. coli*, yeast, mammalian and insect cells.

CO3: Learns about sterilization at reactor scale and different types of sterilization strategies.

CO4: Attains knowledge about designing large scale industrial processes and types of cultivation strategies Understands the concept of recombinant biomolecules, therapeutic proteins, vaccines, antibodies, bio-pesticides, bio-fertilizers, and probiotics .

CO5: Understands different types of regulatory approvals required for drug development and difference between biologics, biosimilars and biobetters.

COURSE CONTENTS

UNIT I

Biotechnology an Overview, Definition, Perspective and scope of biotechnological processes and products, Biotechnology and Ethics, Introduction, Medical and chemical Biotechnology, Agriculture and Food, Energy and environment and human, Bioethics, Facing problem and finding solutions, Regulating the use of biotechnology, Patenting biotechnology inventions.

UNIT II

Genetic Engineering and gene cloning, Introduction of genetic engineering procedure, restriction endonuclease, cloning vehicle, Vectors for animals and plants, Insertion of DNA molecule in to a vector, Direct transformation, Isolation and cloning, Transformation and growth of cells, Selection and screening of particular recombinants, Genomic library, sequencing of DNA, Gene identification and mapping, Analysis of expression of cloned genes, Polymerase chain reaction, Monoclonal Antibodies.

UNIT III

Plant cell and tissue cultures, Culture techniques, Protoplast fusion, Direct gene transfer, Microinjections, Nuclear transplantation, Plastid and mitochondrial genes, production of secondary metabolites by immobilized plant cell, Development of disease resistant, herbicide resistant, Salt & drought resistant plant varieties, Microbial Toxins, Introduction, Toxins gene isolation, Genetic engineering of *B. thuringiensis* strains, *Baculovirus* as biocontrol agents.

UNIT IV

Culturing microorganisms for the production of biomass, Production of microbial (Bacterial, Cyanobacterial and Fungal) products, Batch culture, Continuous culture, Fed-batch culture, Mass culture, Use of culture system for the production of microbial products, Production of cyanobacterial biomass for food, Feed and health care products, Improvement of microbial strains for industry, Agriculture, Immobilization of microbial cells and enzyme and its applications.

UNIT V

Strain improvement, bioreactor design, Reactor types, Application of immobilized cells and enzyme, improvement in bioreactor to control environment of process organism. use of microorganisms in pollution control, Waste treatment, Bioremediation, Biological removal of eutrophic nutrients, Heavy metals, Toxic chemicals (Herbicide, Insecticide and Fungicide and Other Toxicants) from waste water and industrial effluents, Utilization of waste water for the production of food and feed, Biodegradation, Bioleaching of metals, Application of microorganisms from environment

Books recommended

- Haekett P. B., Fuchs J. A. and Mesing J. W. (1988) An Introduction to Recombinant DNA techniques – basic experiments in gene manipulation.
- Glck B. R. and Thompson J. E. (1993) Methods in Plant Molecular Biology and Biotechnology.
- Bjorn Kristiansen, (2012) Basic Biotechnology third Edition.

Suggested list of practicals (Course Code BOE304)

1. Demonstration:-
   - PCR
   - Spectrophotometer
   - pH meter
   - Centrifuse
   - Photomicrographic Camera
2. To prepare the media for plant tissue culture.
3. Isolation of pathogenic fungi from infected plants/Disease plants (Leaf/ Stem/ root)
4. Identification of unknown microorganism from given plates.
5. Preparation of tissue culture media.

CORE COURSE CODE BOS301: SKILL DEVELOPMENT MODULES 3

(COURSE CREDITS = 02)

ENTREPRENEURSHIP DEVELOPMENT PROGRAME AGENDA (Semester-3)

TIME - 30 Hrs

1. ORIENTATION PROGRAM FOR ENTREPRENEURSHIP

2. WHAT IS ENTREPRENEURSHIP

Definition of Entrepreneurship

Be a Successful Entrepreneurship

3. TYPE OF ENTREPRENEURSHIP

Manufacturing

Trading

Service Provider

4. NEED TO BE SUCCESSFUL ENTREPRENEURSHIP

Knowledge - About work and Concern

Information - About sources/ market/ Customer's

Assets - About Technology, Place, Man power and money

5. CHOOSING A BUSINESS -

Micro Scale Unit **Small Scale Unit**

Large Scale Unit **Mega Scale Unit**

6. MARKETING and DISTRIBUTION

Definition and Type of Marketing

About Sales and Marketing

Distribution channels

7. PRODUCT DESIGNING / BRANDING / MERCHANDIZING

Research and Development

8. FINANCIAL FLUENCY, PLANNING AND LEGAL ASPECTS

Taxation

Rules and norms of the Govt. to run a business

9. GOVERMENT SCHEMES AND ASSISTENCE

About financial loan / Place/ Training / Subsidy.....etc

10. INDUSTRY VISITS.

FOURTH SEMESTER

(COURSE CREDITS 18)

(A) DISSERTATION	Credits	Maximum Marks
A. Valuation (i) Language & Presentation (ii) Review of Literature (iii) Methodology (iv) Analysis & interpretation of Result	**18**	**300**
B. Viva-Voce EXTERNAL		**50**
C. Viva-Voce INTERNAL		**50**
Total		**400**

(B) Comprehensive viva voce (virtual credits)	**4**	**50**

Course Objectives:

The primary object is to expose the students to research culture and technology. They learn how to choose a research problem, plan and perform experiments, collect data, and analyze the data qualitatively and quantitatively. The student gets trained in presenting the results in the form of an oral presentation as well as a thesis. The student presents his/ her research orally at the end of the semester, and this is coupled to a viva-voce. This not only equips the student for a career in research/ industry, but also fosters self-confidence and self-reliance in the student as he/she learns to work and think independently.

Course Learning Outcomes:

CO1: Student is able to conceive a research problem based on current published researches through comprehensive survey of literature on the topic of research.

CO2: Student is able to plan and design bioassay protocols, to isolate microbes and macrobes from different sources, to identify the isolated organisms using morphological, structural, biochemical and molecular methods.

CO3: Student becomes well-versed in enzymatic, growth and toxicological assay systems through handling, use of instruments, reagents and chemicals, and in execution of experiments independently.

CO4: They learn to summarize and present research data by tables and graphs, and statistically analyze and interpret data.

CO5: They are trained to write dissertation (research reports) and present their important findings for peer evaluation. They also learn to publish their research output in peer reviewed journals and magazines.