

**RANI DURGAVATI VISHWAVIDYALAYA, JABALPUR**

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

**(Academic Session 2016 – 2017 & Onwards)**

**[PROGRAMME UNDER CHOICE BASED CREDIT SYSTEM - ORDINANCE 222]**

This brochure of the programme for the M.Sc. degree in Botany consists of three parts, viz., (A) Information from the relevant Ordinance(s) / Statutes, (B) Scheme of examination and (C) 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 4<sup>th</sup> 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.

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## 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”

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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) SCHEME OF EXAMINATION:****Semester I**

<b>(A) Continuous evaluation, Theory, Practical</b>		<b>Credits</b>	<b>Maximum Marks</b>		
			<b>Continuous Evaluation</b>	<b>End Semester Exam</b>	<b>Total</b>
<b>Course Code</b>	<b>Course Title</b>				
<b>I Core courses</b>					
BOC101	Biology & Diversity of Viruses, Bacteria and Algae	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
BOC102	Biological Diversity of Bryophytes, Pteridophytes & Gymnosperms	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
BOC103	Basic Ecology	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
BOC104	Practical based on BOC101 & BOC102	<b>4</b>	<b>40</b>	<b>60</b>	<b>100</b>
BOC105	Practical based on BOC103 & BOE101/ BOE102	<b>4</b>	<b>40</b>	<b>60</b>	<b>100</b>
<b>II Electives courses (Any one to choose)</b>		<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
BOE101	Biomolecules				
BOE102	Bioenergetics and Intermediary Metabolism				
<b>III Skill Development course</b>					
BOS101	Skill Development module 1	<b>2</b>	<b>Grade Point will be provided by Skill Development Centre</b>		
Total valid credits		<b>22</b>			
<b>(B) Comprehensive viva voce (virtual credits)</b>		<b>4</b>			<b>50</b>

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## Semester II

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
<b>I Core courses</b>					
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
<b>II Electives courses (Any one to choose)</b>		3	40	60	100
BOE201	Biology of the Immune System				
BOE202	Resource utilization and conservation				
BOE203	Microbial Metabolism				
<b>III Skill Development course</b>					
BOS201	Skill Development module 2	2	Grade Point will be provided by Skill Development Centre		
Total valid credits		22			
<b>(B) Comprehensive viva voce (virtual credits)</b>		4	50		

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## Semester III

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
<b>I Core courses</b>					
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
<b>II Electives courses (Any one to choose)</b>		3	40	60	100
BOE301	Advanced Molecular Biology				
BOE302	Agricultural Microbiology				
BOE303	Bioprocess Engineering and Technology				
BOE304	Biotechnology				
<b>III Skill Development course</b>					
BOS301	Skill Development module 3	2	Grade Point will be provided by Skill Development Centre		
Total valid credits		22			
<b>(B) Comprehensive viva voce (virtual credits)</b>		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

DISSERTATION	Credits	Maximum Marks
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<b>A. Valuation</b>		
(i) Language & Presentation	<b>18</b>	<b>300</b>
(ii) Review of Literature		
(iii) Methodology		
(iv) Analysis & interpretation of Result		
<b>B. Viva-Voce EXTERNAL</b>		<b>100</b>
<b>C. Viva-Voce INTERNAL</b>		
<b>Total</b>		<b>400</b>

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**FIRST – SEMESTER**

**COURSE CODE BOC101: BIOLOGY & DIVERSITY OF VIRUSES, BACTERIA  
AND ALGAE  
(Total Credits = 03)**

**UNIT – I**

Archaeobacteria 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.



**COURSE CODE BOC102: BIOLOGICAL DIVERSITY OF BRYOPHYTES,  
PTERIDOPHYTES & GYMNOSPERMS (Total Credits = 03)**

**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. Stellar in system in Pteridophytes.

**UNIT III**

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

**UNIT IV**

Classification of Gymnosperms, Distribution of living Gymnosperms 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.

**COURSE CODE BOC103: BASIC ECOLOGY (Total Credits = 03)**

**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 continuum, 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 2<sup>nd</sup> Edition.
- C.H. Southwick 1976 Ecology and Quality of Our Environment 2<sup>nd</sup> Edition .
- M. P. Singh, S. Chinnamani R.N. Trivedi (1993) Forestry & Environment.
- E. J. Koromand. (1996) Concept of Ecology.

**COURSE CODE BOC104:** Practical based on Course Code BOC101 & Course Code BOC102 (Total 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<sub>11</sub>
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*

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*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*.

**COURSE CODE BOC105:** Practical based on Course Code BOC103 & Course Code BOE101/ BOE102 (Total 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 frequency, density and abundance of different species in the grassland.
3. To determine minimum number of quadrats for sampling of grassland.
4. To compare community structure of different forest.
5. To determine the pH & Dissolve Oxygen of water sample.
6. To determine homogeneity and heterogeneity of grassland vegetation.
7. To determine the trophic state of alkalinity/ salinity of water body.
8. To determine the pH of soil samples.
9. To calculate Simpson's indices of diversity of grassland vegetation.
10. To calculate Shannon-Wiener indices of diversity of grassland vegetation.
11. To determine water holding capacity of the soil.

**FIRST – SEMESTER**

**COURSE CODE BOE101 : BIOMOLECULES (Total Credits =03)**

**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 biomolecules 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<sup>+</sup> K<sup>+</sup> 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., Bruening 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 Livingstone, Edinburgh.

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- 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 of amylase enzymes.
17. To study the effect of substrate concentration on enzyme activity.
18. To study the effect of temperature on enzyme activity.

**COURSE CODE BOE102: BIOENERGETICS AND INTERMEDIARY  
METABOLISM (Total Credits = 03)**

**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, gluconeogenesis, 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:  $\alpha$ ,  $\beta$ , 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 Principles 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 monosaccharides, polysaccharides, disaccharides.
3. To determine protein of unknown sample by Lowry method.

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**COURSE CODE BOS101: SKILL DEVELOPMENT MODULES 1 (Total 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

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**SECOND - SEMESTER**

**COURSE CODE BOC201: TAXONOMY OF ANGIOSPERMS (Total Credits = 03)**

**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, Ranunculaceae & Magnoliaceae, Papaveraceae & Capparidaceae, Oxalidaceae & Meliaceae, Combretaceae & Lythraceae 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*), Sarpagandha (*Rauwolfia serpentina*), Adhusa (*Adhatoda vasica*) Amla (*Embllica 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.

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**COURSE CODE BOC202: BIOLOGY AND DIVERSITY OF FUNGI**  
**(Total Credits = 03)**

**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 Homothallism and Heterothallism, 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, Mycopensticides, 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.

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**COURSE CODE BOC203: BIOSTATISTICS AND COMPUTER APPLICATIONS**  
**(Total Credits = 03)**

**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**

- B. L. Agarawal, Text Book of Biostatistics.
- A. K. Sharma Text Book of Biostatistics I.
- Paolo Coletti, Basic Computer Course Book.

**COURSE CODE BOC204:** Practical based on Course Code BOC201 & Course Code BOC202 (Total Credits = 04)

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

**Taxonomy of Angiosperms**

1. To study the plants of following Families.
  - Ranunculaceae – *Delphinium ajacis*
  - Asclepiadiaceae – *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.

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8. To cultivate Mushrooms as a source of myco-protein.
9. To examine Antibacterial properties of certain fungal species.

**COURSE CODE BOC205:** Practical based on Course Code BOC203 & BOE201/ BOE202/  
BOE203 (**Total 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.

**List of Elective Papers**

**SECOND – SEMESTER**  
**COURSE CODE BOE201: BIOLOGY OF THE IMMUNE SYSTEM**  
**(Total Credits =03)**

**A: Theory**

**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 immunodeficiencies, 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.

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**COURSE CODE BOE202: RESOURCE UTILIZATION AND CONSERVATION**  
**(Total Credits = 03)**

**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.

**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.

**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 the presence of carbonate in different soil mixtures.
3. To determine the presence of phosphate in soil and water sample.
4. To determine the presence of nitrate in mixture sample.
5. To determine the presence of nitrite in mixture sample.
6. To determine frequency, density and abundance of herbaceous species from local garden.
7. To determine the biomass of plant vegetation.
8. To determine leaf area, dry weight and moisture content of few species of plant from grassland.

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**COURSE CODE BOE203: MICROBIAL METABOLISM (Total credits: 3)**

**Theory**

**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**

Chemosynthesis: 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 CO<sub>2</sub>- 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.

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**COURSE CODE BOS201: SKILL DEVELOPMENT MODULES 2 (Total 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

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**THIRD SEMESTER**

**COURSE CODE BOC301: PLANT PHYSIOLOGY (Total Credits = 03)**

**Unit I**

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

**Unit II**

Photosynthesis in plants, Pigments, Photosystem I and II, Mechanism of quantum capture and energy transfer between photosystems, Reduction of CO<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and CAM metabolism, photorespiration and its significance.

**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 Plant Physiology.
- Taiz .L.and Zeiger, E. (1998) Plant Physiology (2<sup>nd</sup> Edition).

**COURSE CODE BOC302: GENETICS & MOLECULAR BIOLOGY**  
**(Total Credits = 03)**

**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 polymerases, 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.

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**COURSE CODE BOC303: PLANT REPRODUCTION & DEVELOPMENT**  
**(Total Credits = 03)**

**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.

**COURSE CODE BOC304:** Practical based on Course Code BOC301 & Course Code BOC302 (Total 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*.

**COURSE CODE BOC305:** Practical based on Course Code BOC303 & Course Code BOE301/ BOE302/ BOE303/ BOE304 (Total Credits = 04)

**Suggested List of Practicals (Course Code BOC303)**

**Plant Reproduction & Development**

1. Slide :- Amphitropous ovule (T.S.)  
Superficial placentation  
*Lilium* anther  
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.

**List of Elective Papers**

**Third semester**

**COURSE CODE BOE301: ADVANCED MOLECULAR BIOLOGY  
(Total Credits = 03)**

**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.

**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 fermentors. 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

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**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.

**COURSE CODE BOE302: AGRICULTURAL MICROBIOLOGY (Course credit: 3)**

**Theory**

**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 leaf 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. Study of weeds- Parthenium, water hyacinth.

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**COURSE CODE BOE303: BIOPROCESS ENGINEERING AND TECHNOLOGY  
(Total Credits =03)**

**A: Theory**

**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 in 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.

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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.

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**COURSE CODE BOE304: BIOTECHNOLOGY (Total Credits = 03)**

**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

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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.

**COURSE CODE BOS301: SKILL DEVELOPMENT MODULES 3 (Total Credits = 02)**

**ENTREPRENEURSHIP DEVELOPMENT PROGRAMME 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. GOVERNMENT SCHEMES AND ASSISTENCE**  
About financial loan / Place/ Training / Subsidy.....etc
- 10. INDUSTRY VISITS.**

**FOURTH- SEMESTER (TOTAL CREDITS = 18)**

**DISSERTATION**

**A. Valuation**

1. Language & Presentation
2. Review of Literature
3. Methodology
4. Analysis & Interpretation of Results

**B. Viva –Voce**

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