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SEMESTER SYSTEM OF P. G. BOTANY

P. G. SEMESTER EXAMINATION REGULATIONS

CHAPTER – I

REGULATION OF GENERAL ACADEMIC MATTERS

1.1 The Departments shall follow Semester System of teaching and Examination based on continuous evaluation internally as well as externally subject to moderation of question papers. The system of evaluations of the students shall be based on Course Credit System.

1.1.1 Academic Year

The Academic Year of the department shall ordinarily be from JUNE to MAY. It may however, be modified by the Staff Council from time to time.

1.1.2 Semester

The academic year shall have two semesters, each of which shall be of 6 months duration.

1.2 Minimum working days in a Semester

A Semester shall have a minimum of 90 working/instructional days excluding examination days/Sundays/Holidays etc. The minimum number of classes in a semester shall not fall short of the number of classes as mentioned below.

1. One Credit hour courses = 10 classes minimum
2. Two Credit hour courses = 20 classes minimum
3. Three Credit hour courses = 30 classes minimum
4. Four Credit hour courses = 40 classes minimum
5. Five Credit hour courses = 50 classes minimum

1.3 Credit hours

One credit shall signify the quantum of teaching imparted corresponding to one hour of theory class and two hours of laboratory/project work and two hours of seminar per week during a semester in respect of a particular course. Each teaching hour of theory class will be of 60 minutes and practical classes/project work will be of 120 minutes duration and seminar will be of 120 minutes duration. For field study outside headquarters, one working day will be considered as two teaching hours. However, the field study should not exceed 30 days (including Sundays) in one semester.

The P. G. Syllabus may be so designed that the total of credit hours for all four semesters shall be 80 spread equally over all semesters as far as practicable, tutorials and proctorials shall be treated as non-credit components.

1.4 Course

A course is a Unit of instruction under any discipline carrying a specific number of credit hours describing its weightage. Those courses, which a student must take as compulsory requirement, are called Core Courses. Those courses, which a student opts out of a list of specialized courses offered by the department, are called Elective Courses.

Choice Based Credit System (CBCS) is introduced at the P. G. Semester-I level uniformly in all the subjects to be taught in paper-103. The students of P. G. Arts stream can not opt for the CBCS course of Science stream. The details of the CBCS courses offered by different P. G. Departments are given in Annexure-II.

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ANNEXURE-II

CBCS: P. G. Paper-103

<u>Department</u>	<u>Name of the CBCS Course</u>
Botany	Plant in Human Welfare
Chemistry	Polymer Science
Commerce	Fundamental of Business Organization and Entrepreneurship Development
Economics	Indian Economy
Education	Pedagogical Trends and Issue
English	Global English
Geography	Introduction to Geography
History	Tourism & Heritage Management
Mathematics	Elements of Computer Programming
Odia	“Adhunika Odia Nataka o Odia Bhashara Dhwanitatwa” (Modern Odia Drama and Odia Phonetics)
Physics	Foundation in Physics
Philosophy	Practical Ethics
Political Science	Indian Government & Politics
Psychology	Fundamentals of Psychology
Sanskrit	Ancient Indian Culture
Zoology	Animal World, Human Health & Economic Zoology

1.4.1 *Grade*

The grade awarded to a student in any particular course shall be based on his/her performance in all the tests conducted during a semester and shall be awarded at the end of the semester. The grade in each course is expressed in numerical value in 10.00 scale. The marks of a student shall be converted to 10.00 scale and the points scored thereby shall be called the “Grade Point” in the course. Respective “Grade Point Average” (GPA) and “Overall Grade Point Average” (OGPA) shall be awarded at the end of each semester and all semester respectively. A 3.0 Grade Point is required for passing in individual paper and 4.0 GPA to pass any semester examination. The G. P. shall be rounded to one decimal point and GPA to two decimal points.

1.4.2 *Grade Point Average (G.P.A.)*

Grade Point Average (G.P.A.) of a semester shall be calculated as:

$$\text{GPA} = \frac{\text{Summation of } \{(\text{Credits in each course}) \times (\text{Grade point in that course})\}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all courses in a given semester, G.P.A. shall be rounded up to 2 decimal points.

1.4.3 *O.G.P.A. (Overall Grade Point Average)*

It is the average of accumulated grade points of a student, worked out by dividing the cumulative total of grade points by the cumulative total of credit hours of all the courses covered and completed by a student during all the Semesters. For the first semester of the programme the GPA and OGPA shall be the same.

$$\text{OGPA} = \frac{\text{Summation of } \{(\text{Credits in each semester}) \times (\text{Total Credits in that semester})\}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all semesters in a given programme. OGPA shall be rounded up to 2 decimal points. For merit lists, in case of equality, the OGPA shall be calculated beyond two decimal places if necessary.

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1.4.4 Conversion of grades to marks and classification of results under course credit system

The OGPA can be converted to percentage of marks in the following manner:

Percentage of Marks = (OGPA) × 10

A student after successful completion of all the semesters, Degree shall be awarded in the following manner:

O.G.P.A. \geq 6.0 : FIRST CLASS

O.G.P.A. \geq 5.0 - < 6.0 : SECOND CLASS

O.G.P.A. 4.0 - < 5.0 : THIRD CLASS

O.G.P.A. < 4.0 : FAIL

1.5 Academic Calendar

The Examination Section and the academic section shall finalise the schedule of semester registration and other academic activities at the start of academic session. The Academic Calendar shall be prepared by the Academic Committee of the University in consultation with examination section.

The broad format for academic calendar for P. G. with regard to admission, registration and commencement of classes shall be as follows:

Admission and Registration and

Commencement of Classes for 1st Semester	JULY
1 st Semester Examination	DECEMBER
Commencement of Classes 2 nd Semester	JANUARY-MAY
2 nd Semester Examination	JUNE
Commencement of 3 rd Semester Classes	JULY-NOVEMBER
3 rd Semester Examination	DECEMBER
Commencement of 4 th Semester Classes	JANUARY-APRIL
4 th Semester Examination	APRIL & MAY
Final Results to be published in the month of	JUNE

1.5.1 Requirement of award of degree

The minimum credit hour requirement for the Master Degree shall be 80 (eighty) credits and the residence required for Master Degree shall be continuous four semesters from the first date of registration and the maximum time allowed to complete the Master Degree shall be 8 (eight) semesters.

1.6 Requirement for attendance

A candidate shall be required to attend 75% lectures, tutorials and practical classes separately during the semester (For late admitted students' attendance to be calculated from the date of admission). Condonation may be granted by the staff council only to the extent of 15% in exceptional cases. (Illness, accident, mishap in the family, deputation by University/Department). When a candidate has been deputed by the University to represent the University/state for any activity, the lectures delivered during his/her absence for the purpose shall not be counted towards the calculation of attendance provided the student submits a certificate to that effect from the appropriate authority.

1.7 Registration in a semester

A student has to register his/her name at the beginning of every semester in the prescribed form, for the course he/she wants to take in that semester. Examination Section (General) shall notify the registration dates and the list of registered students for the semester shall be given to the Head of the Department within two weeks of the commencement of the Semester.

CHAPTER – II REGULATIONS ON EXAMINATION MATTERS

2.1 *Mid Term Examination*

In each Semester there shall be one Mid Term Assessment examination of 60 minutes duration. The Mid Term examination shall be conducted by COE like that of End Term examination. The answer scripts shall be evaluated by the external and internal examiners and the marks along with answer scripts shall be retained in COE.

2.2 *Semester Examination*

After the end of each semester there shall be an examination of each theory paper of 2 hours duration and of each practical paper of 4 hours duration, which shall be called Term End / “Semester Examination”. The maximum marks for each theory paper shall be 50 out of which 40 marks for term end and 10 marks for Mid Term. The maximum marks for each practical/ semester/ project/ dissertation/ review examination shall be 50 for Arts and Commerce and 100 marks for Science. The classes shall remain suspended ten days (including Sundays and holidays, if any) before the date of commencement of semester test for preparation by the students.

2.3 *Results of Examinations*

The results shall be declared ordinarily within four weeks of completion of the examinations. A student who seeks re-addition of his/her marks in a course shall be allowed to do so by submitting an application to Registrar along with a required fee in the fee counter of the University. All such cases/complaints if any shall be disposed of by the Examination Section in a prefixed day and necessary corrections if any shall be reflected in the mark/grade sheet. The candidates shall have to appear in all the Units of a semester examination to be eligible to be declared ‘pass’ provided he/she secures minimum pass marks/grade.

2.4 *Promotion to the next semester*

A student shall be admitted to the next semester only when he/she appears in all the papers of the concerned semester examination. However, a student failing to appear semester examination in some or of all papers due to some reasons as mentioned in 2.5 may be admitted to the next semester. Such a student shall produce sufficient proof in favour of his/her reason for not being able to appear in some or all papers of the Semester Examination on the next academic session in the corresponding semesters.

2.5 *Absence from Examination*

If a student is unable to appear a semester examination in some or all papers the Registrar shall consider his/her case for admission into the next higher semester only the following cases:

- (a) When he/she is hospitalized.
- (b) When he/she is not able to appear in the examination due to serious illness or death of parents, brothers, sisters, spouse or children.
- (c) When he/she met an accident of serious nature.
- (d) When the department/University or any official directive deposes him/her

2.6 *Procedure for Repeat/Improvement*

A student who wants to sit for the semester examination of first and/or second semester in the subsequent academic session (for repeat or improvement) he/she shall have to apply to the Registrar in plain paper before fifteen days of the commencement of the said examination. If allowed by the Registrar, he/she shall deposit the required fees for each paper with centre charge and produce the proof to the teacher in-charge examination with permission letter from the Registrar.

In a semester to appear improvement examination the candidates must have passed the semester examination. A candidate can appear repeat examination of papers in which he/she has failed or not appeared for reasons mentioned in 2.5.

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The Master Degree student seeking to appear/improvement examination in any course(s) shall get 3 chances for 1st and 2nd semester within 8 semesters.

Candidates appearing in repeat/improvement examination shall not be considered in the merit list and it shall be reflected in the Provisional Certificate cum Mark sheet (PCM) but not in the final degree certificate.

2.7 *Award of Degree Certificate, Grade/Mark sheet*

A Degree certificate under the official seal of the university and signed by the Vice-Chancellor shall be presented at the Convocation or in absentia to each of the successful students of particular degree. The Controller of Examinations shall issue the mark/grade sheet of each semester to the candidates in the sheet of each semester to the candidates in the prescribed format by depositing the required fees for marks/Grade Sheet to be deposited in the University counter.

2.8 **Guideline for filling up of Forms for PG Classes (IMP/ Repeat)**

A student shall repeat all the theory and practical papers in which he/she failed in the semester examination within a period of eight semesters from the date of first registration. Such students shall have to apply to the Head of the Department/Registrar in plain paper during the filling up of form for the ensuing semester examination. If allowed, he/she shall deposit the fees as prescribed by the University

If a candidate secures less than 3.0 Grade point in a paper(s) and less than 4.0 Grade point average in a Semester examination he/she has to appear all the papers in that Semester.

If a candidate secures less than 3.0 Grade Point in a paper(s) and a minimum 4.0 Grade point average in a semester examination, he/she has to appear only the paper(s) in which he/she secured less than 3.0 Grade point.

A candidate is eligible to sit for improvement in a paper(s) only when he/she has passed the semester examination concerned. Further, he/she can improve in a maximum of EIGHT paper(s) in the entire course. The Master Degree students seeking to take improvement examination in any course(s) shall get chances within 8 semesters from the year of admission to the course. The candidates taking this advantage (improvement) will be examined on the basis of current syllabus and the higher marks shall be retained during computation of result.

2.9 If a candidate fails to appear in any paper of the said examination and marked ABSENT his/her results will be declared only when he/she clears that paper/those papers.

2.10 *Disciplines in the Examination*

(A) Late Comers: A student arriving in the examination hall/room fifteen minutes after the commencement of the examination shall not be ordinarily allowed to sit for the examination. No examinee shall be allowed to go out of the examination hall within one hour of commencement of examination. The invigilators shall keep a record of temporary absence of students from the examination hall/room during the examination.

(B) Adoption of unfair means in the Examination:

Possession of unauthorized materials and using it, copying from scripts of other students or from any other source, showing his/her answer script to others during the examination, creating disturbance or acting in a manner so as to cause inconvenience to other students in the examination hall or near about shall be treated as adoption of unfair means or malpractice.

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P. G. COURSE OF THE DEPARTMENT OF BOTANY AT A GLANCE

(Under Course Credit System)

Each theory carries 50 marks out of which the question in the term-end examination will be set out of 40 marks and sessional examination will be of 10 marks. The sessional examination will be of written examination carrying 10 marks of 60 minutes duration. Out of 40, Unit I & II carry 13 marks each and Unit III carries 14 marks.

FIRST SEMESTER

<u>Course No.</u>	<u>Name of the Course</u>	<u>Marks</u>	<u>Credit</u>
BOT 101	Plant Morphology, Plant Pathology, Microbiology & Immunology	40+10	5 CH
BOT 102	Genetics and Plant Breeding, Cell Biology and Evolution, Molecular Biology	40+10	5 CH
BOT 103	Environmental Biology, Biodiversity and Biotechnology, Plants in Human Welfare (CBCS)	40+10	5 CH
BOT 104	Practical (Relevant to above theory papers)	(100)	5 CH
Total		(250)	20 CH

SECOND SEMESTER

<u>Course No.</u>	<u>Name of the Course</u>	<u>Marks</u>	<u>Credit</u>
BOT 201	Instru. Techniques, Env. Biology and Physiology	40+10	5 CH
BOT 202	Biochemistry	40+10	5 CH
BOT 203	Biophysics and Biophysical Chemistry	40+10	5 CH
BOT 204	Practical (Relevant to above theory papers)	(100)	5 CH
Total		(250)	20 CH

THIRD SEMESTER

<u>Course No.</u>	<u>Name of the Course</u>	<u>Marks</u>	<u>Credit</u>
BOT 301	Taxonomy and Biodiversity, Economic Botany & Developmental Botany	40+10	5 CH
BOT 302	Biostatistics, Embryology & Dev. Physiology	40+10	5 CH
BOT 303	Special Paper - I	40+10	5 CH
BOT 304	Practical (Relevant to B 301 & B 302)	(100)	5 CH
Total		(250)	20 CH

FOURTH SEMESTER

(PROJECT WORK TO START FROM THIRD SEMESTER)

<u>Course No.</u>	<u>Name of the Course</u>	<u>Marks</u>	<u>Credit</u>
BOT 401	Biochemistry and Genetic Engineering	40+10	5 CH
BOT 402	Special paper – II	40+10	5 CH
BOT 403	Special paper – III	40+10	5 CH
BOT 404	Practical (Relevant to B 303, B 402 & B 403)	(80)	4 CH
	Project	(20)	1 CH
Total		(250)	20 CH
GRAND TOTAL		(1000)	80 CH

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FIRST SEMESTER

BOT – 101

PLANT MORPHOLOGY, PLANT PATHOLOGY, MICROBIOLOGY AND IMMUNOLOGY

Term end - 40

Internal – 10

Unit-1

Algae: Range of thallus structure and reproduction in Algae. Economic importance of Algae.

Fungi: Heterothallism. Degeneration of sex in Fungi.

Plant Pathology : Mode of infection of pathogen. Molecular basis of infection and disease resistance. (13)

Unit-2

Bryophyte: Anthocerotales as a synthetic archegoniate group, Mosses as the most advanced group of Bryophytes.

Pteridophyte: Stelar evolution in ferns.

Gymnosperm: Fossil gymnosperm. Fossilization process, Geological time scale.

Cycadofilicales as an intermediate group between pteridophytes and gymnosperms. (13)

Unit-3

Microbiology: Genomic organization in Bacteria (Chromosomal and extra-chromosomal), Bacterial genetics (transformation, transduction and conjugation).

Virus: Lysogeny and lytic cycle of viruses.

Immunology: Types of Immunity, Antigen and Antibody (structure, function and diversity). Cell of immune system (T Cell & B Cells).

Immunological techniques: Agglutination, precipitation, immunodiffusion. immuno-electrophoresis. Radio immunoassay (RIA) & (ELISA), Immunodeficiency and AIDs. (14)

BOT – 102

GENETICS AND PLANT BREEDING, CELL BIOLOGY AND EVOLUTION, MOLECULAR BIOLOGY

Term end - 40

Internal – 10

Unit-1

Genetics: Gene mapping, Chromosomal aberration and Ploidy. Molecular basis of gene mutation.

Plant Breeding : Principles and methods of breeding field crops. Hybrid vigour.

Gene transfer and transgenic plant. (13)

Unit-2

Cell Biology: Ultra structure of chromosome, variation in chromosome types (polytene, lampbrush and B chromosome). Molecular structure of DNA, RNA, RNA silencing, antisense RNA.

Evolution: Main lines of evolution of land plants. Origin of species. (13)

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Unit-3

Molecular Biology: Gene Duplication – DNA replication, Repair of DNA damage. Gene expression: Transcription-Organization of transcriptional units in prokaryotes and eukaryotes (RNA polymerases, promoter sites, silencers, activators, transcription factors). Mechanism of transcription, reverse transcription.

Translation-Requirements and mechanism. Post - transcriptional modification, protein targeting, inhibitors of protein synthesis.

Regulation of gene expression-Inducible and repressible systems, positive and negative regulation. (14)

BOT – 103

ENVIRONMENTAL BIOLOGY, BIODIVERSITY AND BIOTECHNOLOGY, PLANTS IN HUMAN WELFARE (CBCS)

Term end - 40

Internal – 10

Unit-1

Origin of life, General idea of organic evolution. Evidences and theories of evolution with special reference to Darwinism and Lamarkism.

Environmental Pollution: Types of pollution, cause, effect and control of air pollution (Global warming, Acid rain, Green house effect), Water pollution, Noise pollution. (13)

Unit-2

Biodiversity: Basic concept, Endangered and rare species, Causes of extinction of species, Biodiversity conservation.

Biotechnology: Basic concept of Biotechnology Elementary idea on plant tissue culture. Genetic Engineering, transgenic plant. (13)

Unit-3

Plants in human welfare: Cultivation and use of rice and sugarcane. Economic importance of pulses (Gram, Green gram), oil yielding (Mustard, Ground nut), fiber yielding (Jute), timber yielding (Shorea, Tectona).

Medicinal plants: Ocimum, Azadirachta, Rauwolfia, Catharanthus. Parts used and their therapeutic use. (14)

BOT – 104

PRACTICALS (Relevant to paper BOT-101, BOT-102, BOT-103)

Term End – 100 Marks

1. Permanent microscope preparation and identification of Algae, Fungi, Bryophytes, Pteridophytes, and Gymnosperms.
2. Inoculation and culture of Bacteria and slide preparation.
3. Permanent cytological slide preparation.
4. Plant Hybridization techniques.

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SECOND SEMESTER

BOT – 201

INSTRUMENTAL TECHNIQUES, ENV. BIOLOGY AND PHYSIOLOGY

Term end - 40

Internal – 10

Unit-1

Principles of electron microscopy: Chromatography-Principles & techniques of paper chromatography. ion-exchange and thin layer chromatography.

Spectrophotometry-Laws of light absorption colorimeters and spectrophotometers.

Electrophoresis-Principles and methods of gel electrophoresis, General idea on tracer technique, Autoradiography. (13)

Unit-2

Environmental Biology: Ecological energetics, Environmental pollution (air, water and soil) and its control (including phytoremediation) Environmental laws and protection. Bioindicators. Conservation of plant species, Endangered species, causes of extinction, Red Data books. Intellectual Property Rights (patent) Phytogeography of India with special reference to Orissa. (13)

Unit-3

Physiology: Water relations- Concept of water potential, osmotic unit of water potential, measurement of osmotic, turgor and water potential. Theories of permeability, bulk flow, laws governing flow.

Stress physiology-General idea about stress and strain, stress injury and stress resistance.

Temperature stress: Response of plant to chilling, freezing and high temperature, Mechanism of cold resistance and acclimation, Adaptation to high temperature stress, Heat shock proteins (HSP).

Water stress: Drought stress, nature of stress injury & resistance expression of stress resistant genes. LEA proteins. (14)

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BOT – 202 BIOCHEMISTRY

Term end - 40

Internal – 10

Unit-1

Structure of Biomolecules: Polysaccharides, starch and glycogen, reserve fuel. Cellulose as structural polysaccharides. Lipids: triglycerides, structure of phospholipids and sphingolipids, steroids and terpenoids.

Proteins: Structural and molecular organization. Different level of protein structure such as primary, secondary, tertiary and quaternary structures. (13)

Unit-2

Metabolism and Energetics: Gluconeogenesis and glycogenolysis. HMP shunt, its energetics and metabolic significance, Gluconeogenesis and its physiological significance. Fats as energy rich molecules, oxidation of fatty acids. Terminal oxidation and electron transport in mitochondria, Electron transport in chloroplast and reduction of NADP. Proton translocation and basic principles of oxidation and photophosphorylation. (13)

Unit- 3

Enzymes: Nomenclature and modern classification of enzymes, concept of active site and its analysis. Mechanism of enzyme catalysis, Michaelis-Menten, Lineweaver-Burke and Eddy-Hoftsee plots. Enzyme inhibition. Allosteric enzymes. Factors affecting enzyme catalysis. (14)

BOT – 203 BIOPHYSICS AND BIOPHYSICAL CHEMISTRY

Term end - 40

Internal – 10

Unit-1

Intermolecular forces: Charge-charge and charge-dipole interactions. Hydrogen bonds, Vanderwaal's force, water structure and its polarity, Weak interaction and stability of proteins, nucleic acid. Biomembrane and membrane models including micelles and liposomes. (13)

Unit-2

Photobiophysics: The laws of photochemistry. Light absorption and emission. Quantum yield and quantum transfer mechanisms. Photochemistry of photosynthesis and vision. Photochemistry of UV- induced damage of nucleic acids and their repair. Effects of ionising radiation on biomolecules. (13)

Unit-3

Biophysical chemistry: PH and buffers, ionic strength, buffer strength, buffering zone and preparation of buffers, molecularity and kinetic order of reaction, theories of reaction rate. Laws of thermodynamics and biological concept of free energy, entropy, Q10 and Arrhenious equation. (14)

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BOT – 204

PRACTICALS (Relevant to paper BOT-201, BOT-202, BOT-203)

Term End – 100 Marks

- A- Ecology: 1. Determination of water retaining capacity of soils.
2. Estimation of chloride, oxygen, bicarbonate, carbonate content of water.
- B- Physiology: Plasmolysis, Chromatography, Imbibition, and Transpiration. Experiments related to Photosynthesis and Respiration.
- C- Biochemistry:
1. Extraction and estimation of plant pigments (chlorophyll and carotenoids).
 2. Estimation of (a) Total sugar (b) Reducing sugar (c) Protein.
 3. Effect of substrate concentration on enzymatic activities.
 4. To find out titratable acidity of plant material.

THIRD SEMESTER

BOT – 301

TAXONOMY AND BIODIVERSITY, ECONOMIC BOTANY, DEVELOPMENTAL BOTANY

Term end - 40

Internal – 10

Unit-1

Taxonomy and Biodiversity:

Taxonomy- System of classification (Cronquist and Takhtajan) Taxonomy as a synthetic discipline: Cytotaxonomy, Chemotaxonomy, Histotaxonomy, Numerical taxonomy International Code of Botanical Nomenclature (Principles, Rules and Recommendation).

Biodiversity- Biodiversity concept: Species diversity, genetic diversity & ecosystem diversity Biodiversity status at global and national level, megadiversity countries. Endangered and rare species, Understanding biodiversity (Key stone species, redundancy, mutation), causes of extinction of species, Biodiversity conservation. Agenda 21 of International convention on Biodiversity (Earth Summit) at Rio, Biodiversity conservation and policy decision in India. (13)

Unit-2

Economic Botany: Origin of agriculture and plant domestication, Major cultivated plants and their wild relatives. Center of diversity and centre of origin of cultivated plants, Germplasm conservation of economic plants. General account (Origin, Botany, Varieties distribution and economic products) of the following groups of economic plants. Cereals: Oryza, Triticum. Pulses: Vigna radiata. Non-alcoholic beverages: Camelia chinensis, Coffea arabica. Timber Yielding Shorea, Tectona. Medicinal plants: Rawvolfia, Vinca, Azadirachta indica, Narcotics: Tobacco, Opium poppy, Cannabis. (13)

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Unit-3

Developmental Botany: Plant Anatomy- Meristems, classification, organisation of root and shoot apices and related theories. Mechanical tissue system Mechanical cells. Principles governing the construction of mechanical tissue system.

Conducting tissue system: Origin and differentiation of conducting tissue, Anomalous secondary growth in stem and roots. (14)

BOT – 302

BIOSTATISTICS, EMBRYOLOGY, DEVELOPMENTAL PHYSIOLOGY

Term end - 40

Internal – 10

Unit-1

Biostatistics: Concept of population and sample, measurement of central tendency-mean, median, mode and geometrical mean. Dispersion in biological data, measurement of dispersion (mean and absolute deviation, range variance, standard deviation, standard error of mean, coefficient of variation). Student t Test & Chi-Square Test. Linear co-relation and regression. (13)

Unit-2

Embryology: Ovary, ovule and nucellus culture-Effect of growth substances, role of floral organs in compatibility, barriers in hybridization. Induction of polyembryony.

In vitro endosperm culture-Growth requirements, culture of mature and immature endosperm, embryo factor, histological and cytological features. Embryo culture-Culture of pro-embryo comparative growth of embryos in vitro and in vivo.

(13)

Unit-3

Developmental Physiology:

Growth concept: Growth kinetics and cell differentiation- Hormonal control of growth-plant responses and molecular mechanism of action of auxins, gibberellins, Cytokinin, ethylene and abscissic acid.

Germination: Early events during germination, physiological and biochemical changes, inhibition of germination.

Flowering: Photoperiodism, florigen concept.

Senescence: Type of senescence, triggering mechanism, hormonal and genetic control of senescence. (14)

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SPECIAL PAPERS (Select any one)

BIOCHEMISTRY

BOT – 303

BIOCHEMISTRY (Special Paper – I)

Term end - 40

Internal – 10

Unit-1

Bioenergetics Principles: Concept of free energy, standard free energy, change of chemical reactions and sample calculation of ΔG° . High-energy bond and key position of ATP, ADP, AMP and other high-energy phosphate compounds. Standard free energy, change of hydrolysis of ATP and factors affecting ΔG° ATP hydrolysis.

Substrate level phosphorylation. Transfer potential of phosphate group, enzymatic transfer of phosphate group to other compounds, Transfer of phosphate group through other nucleoside triphosphates. (13)

Unit-2

Enzyme catalysis: Concept and analysis of active site of enzymes, Enzyme kinetics. Transformation of the Michaelis- Menten equation-Kinetics of enzyme inhibition. Effect of temperature on enzyme kinetics. Arrhenius equation. Kinetics of enzyme reactions having two or more substrates. Allosteric enzymes, their models and kinetics. Isoenzymes and multi enzyme complexes, Regulatory enzymes examples Chemical modification of enzymes. (13)

Unit-3

Transport across membranes: Diffusion, facilitated diffusion, Characteristics of mediated transport, Mechanism of active transport, membrane potential and energetics of active transport. Examples and mechanism of cotransport (antiport and symport) and group translocation. (14)

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MICROBIOLOGY

BOT – 303

GENERAL MICROBIOLOGY (Special Paper – I)

Term end - 40

Internal – 10

Unit-1

Microbial Diversity: Evolution of diverse microbial species, microbial phylogeny, microbial taxonomy and classification, Bacterial diversity, archaeal diversity, Biodiversity of eukaryotic micro-organisms (algae, fungi and protozoa). (13)

Unit-2

Organisation and structure of micro-organisms: Cell wall (eubacterial and archeobacterial molecular structure) capsule and slime layer, prokaryotic inclusion bodies, structures involved with movement of cells (Flagella-arrangement, chemotaxis magnetotaxis, phototaxis). Structures involved in attachment: Glycocalyx, pili & fimbriae, Endospores. (13)

Unit-3

Microbial Growth: Definition of growth, kinetics of bacterial reproduction, mathematical expression of growth, growth phases, measurement of microbial growth, continuous and synchronous growth, factors affecting growth. (14)

ENVIRONMENTAL BIOLOGY

BOT – 303

COMMUNITY ECOLOGY, ECOSYSTEM ECOLOGY (Special Paper – I)

Term end - 40

Internal – 10

Unit-1

Community Ecology: Concept of Community, characteristic features of a community, composition, structure, species diversity, stratification, growth form Quantitative analysis of community (frequency, density, dominance and diversity index)
Community dynamics- Causes of succession, trends of succession, Basic types of succession. General process of succession, Hydrosere, Xerosere, Biome. (13)

Unit-2

Ecosystem Ecology: Kinds of Ecosystem. Structure and function of ecosystem structure of ecosystem (food chain, food web, ecological pyramids).
Major ecosystems: Aquatic (fresh water and marine water). Terrestrial (grassland and forest ecosystem).
Energy flow-Concept of energy flow in the ecosystem. Thermodynamic laws, Lindeman's energy flow model. Trophic dynamic concept and ecological efficiencies. Energy flow models. (13)

Unit-3

Biogeochemical cycle: Biogeochemical cycle like Carbon. Nitrogen. Phosphorus and Sulphur.
Primary Production: Primary production in terrestrial ecosystem, secondary production, Methods involving measurement of primary Productivity. (14)

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BOT – 304

PRACTICALS (Relevant to paper BOT-301, BOT-302)

Term End – 100 Marks

1. Description of commonly occurring plants and their identification with proper taxonomic judgment so far their nomenclature problems are concerned.
2. Preparation of permanent slides for the study of normal and abnormal secondary growth.
3. Identification and comments on plants / plant products with reference to their economic importance.
4. Identification of embryological slides.
5. Practical on Biostatistics.

FOURTH SEMESTER

BOT – 401

BIOTECHNOLOGY AND GENETIC ENGINEERING

Term end - 40

Internal – 10

Unit-1

Tissue Culture: Principles and methods, cell lines, cell clones, somaclonal variation, micro propagation, protoplast fusion, somatic hybridization, transgenic plants and their role in crop improvement, terminator technology: Renewable sources of energy (waste materials, biogas, energy crop, cellulose). Energy & fuel using micro-organisms, hydrogen production using hydrogenase and nitrogenase. Hydrocarbon production. Conservation of energy. (13)

Unit-2

Genetic Engineering: Principles and methods of genetic engineering-Restriction enzymes, cloning vectors (plasmids, cosmids, phasmids). Gene cloning techniques in prokaryotes and eukaryotes, Southern, Northern and Western Blotting techniques, DNA finger printing, PCR technology. Hazards of genetic engineering. Genetic counseling prevention and cure of genetic disorder. (13)

Unit-3

Biotechnology: Human health-production of insulin Interferon and growth hormones. Hybridoma techniques & monoclonal antibodies, their uses.
Industry & Environment: Bioprocessing of organic compounds (ethanol, acetone, butanol, amino acids & vitamins) production of single cell protein (SCP).
Biotechnology in pollution control: Waste water and solid waste management. (14)

SEMESTER SYSTEM OF P. G. BOTANY

SPECIAL PAPERS (Select any one)

BIOCHEMISTRY

BOT – 402

BIOCHEMISTRY (Special Paper – II)

Term end - 40

Internal – 10

Unit-1.

Chloroplast biogenesis- Morphology of chloroplast. Ultra structure of thylakoid membrane and localization of membrane complexes. Energy transduction in chloroplast membranes, composition, structure of PS-I and PS-II. Structure and Composition of oxygen evolving complex (OEC) and chloroplast coupling factor, Electron transport in Thylakoid membranes, Mechanism of Photophosphorylation. Inhibitors and uncouplers. Photo regulation of Rubisco. (13)

Unit-2

Ultra structure of Mitochondria: Structure of Mitochondrial membrane, Structure of Electron transport complexes. Topography and asymmetry in membrane structure. Mitochondrial compartmentation, shuttle transporters in mitochondrial membrane. Coupling of metabolite transport to electron transport, inhibitors of electron transport and oxidative phosphorylation. Structure and function of coupling factor protein. Mechanism and energetics of oxidative phosphorylation. (13)

Unit-3

Biosynthesis of Carbohydrates- Gluconeogenesis from acetyl CoA in plants and microorganism. Gluconeogenesis from TCA cycle intermediates and amino acids. Regulation of gluconeogenesis. (14)

BOT – 403

BIOCHEMISTRY (Special Paper – III)

Term end - 40

Internal – 10

Unit-1

Lipid Metabolism: Degradation of odd and even carbon fatty acids. Oxidation of mono and polyenoic fatty acid. Minor pathways of fatty acid oxidation, energetic of α -Oxidation. The glyoxylate cycle, Biosynthesis of saturated and unsaturated fatty acids and triglycerides. Biosynthesis of phospholipids and cholesterol. Regulation of cholesterol biosynthesis. (13)

Unit-2

Nitrogen metabolism- Mechanism of biological nitrogen fixation. Nitrogenase and hydrogenase enzyme systems. Control of nitrogenase activity. Nitrate assimilation, incorporation of ammonia into organic compounds. Biosynthesis and degradation of protein, Biosynthesis of purines and pyrimidines. (13)

Unit-3

Metabolism of amino acids- Biosynthesis essential, non- essential and aromatic amino acids, Oxidative degradation of amino acids leading to acetyl CoA. α -ketoglutarate pathway, succinate pathway, fumarate pathway and oxaloacetate pathway of amino acid oxidation. Regulation of metabolic processes- Enzymatic regulation of glycolysis. Role of uridine diphosphate sugar in sucrose and starch synthesis. (14)

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BOT – 404

BIOCHEMISTRY (Special Paper) PRACTICALS

(Relevant to paper BOT-303, BOT-402, BOT-403 of Biochemistry special paper and project work to start from third semester)

Practical – 80

Project – 20

A) Practicals:

1. Determination of Chl. a and Chl. b content of leaves of two different ages and to find out the ratio of Chl. a and Chl. b.
2. Determination of crude lipid content of oily seed.
3. To find out the saponification value of the oil.
4. Estimation of reducing sugar content of plant material.
5. Estimation of total free amino acid content in the plant material.
6. Estimation of total protein content of a sample.

7. To find out the effect of substrate concentration on urease activity in the plant material to determine the K_m value by Line weaver Burke plot.
8. To find out the effect of enzyme concentration and incubation period on urease activity.
9. To determine the effect of incubation period and temperature on urease activity.
10. Practical record and viva-voce.

B) Project Report Evaluation

MICROBIOLOGY (Special Paper)

BOT – 402

MICROBIAL GENETICS AND METABOLISM (Special Paper – II)

Term end - 40

Internal – 10

Unit-1

Microbial genetics: Mutation- Occurrence, expression, types and practical application. Genetic recombination in bacteria, conjugation, (properties of F plasmid. fr strain. conjugation in Gram +ve and Gram -ve bacteria). Transformation and transduction. Use of bacteria in DNA technology. Viral replication, kinetics of viral replication, lysogeny.

(13)

Unit-2

Fuelling reaction in Micro-organisms: Fueling reaction in aerobic heterotrophs and anaerobic heterotrophs (Anaerobic respiration and fermentation), fuelling reaction in autotrophs (Calvin Benson Cycle: synthesis of precursor metabolites). Generation of ATP and reduced pyridine nucleotides by chemoautotrophs. (13)

Unit-3

Microbial Metabolism: Anaerobic pathways (EMP and HMP cycle). fermentation pathway in specific group of microorganisms, yeast fermentation Homofermentative and heterofermentative pathways. Butyric acid and solvent producing fermentations. Fermentation of the mixed type propionic acid fermentation. Glyoxylate cycle in microbial system. (14)

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BOT – 403

APPLIED MICROBIOLOGY (Special Paper – III)

Term end - 40

Internal – 10

Unit-1

Environmental Microbiology: Bacteriological analysis of water. Microbiology of water. Sewage microbiology. Aeromicrobiology. Biodegradation, bioremediation and biodeterioration, Biogeochemical cycles. (13)

Unit-2

Microbiology of nitrogen and phosphorus cycle: Organisms involved and mode of nitrogen fixation root nodule formation in Rhizome-Legume association, enzymes involved, mechanism of nitrogen fixation, Biochemistry of N₂ fixation in root-nodules. Genetics of nitrogen fixation. Nitrogen fixation in Cyanobacteria micro-organism involved in phosphorous transformation VAM fungi and role in phosphorous cycle. (13)

Unit-3

Microbes as alternative source of energy, Biofertilizers and Biopesticides: Microbial conversion of solar energy, Hydrogen production Oxygenated Hydrocarbon production, Hydrocarbon production, Biogas production, Biofertilizers (Bacterial and cyanobacteria) Biopesticides. (14)

BOT – 404

MICROBIOLOGY (Special Paper) PRACTICALS

(Relevant to paper BOT-303, BOT-402, BOT-403 of Microbiology special paper and project work to start from third semester)

Practical – 80

Project – 20

A) Practicals:

1. Preparation of different types of synthetic media, agar slants.
2. Measurement of micro-organisms by the use of an ocular micrometer.
3. Measurement of cells concentration of bacterial or fungal conidia by the use of haemocytometer.
4. Gram staining of bacteria.
5. Acid fast staining of bacteria.
6. Isolation of fungi by Warcup method.
7. Isolation of algae from soil.
8. Isolation of micro organisms from air.
9. Isolation of Rhizobia from root nodules.
10. Methods of obtaining pure cultures of micro organisms by Streak plate/Pour plate methods.
11. Determination of bacterial growth by turbidity measurement.
12. Biochemical activities of micro-organisms by Casein hydrolysis/reactions in litmus milk/catalase test.
13. Demonstration of the bacterial flora of the skin.
14. Determination of BOD/COD of water.
15. Determination of quality of milk sample by methylene blue reductase test.
16. Practical Record & Viva-voce.

B) Project Report Evaluation

SEMESTER SYSTEM OF P. G. BOTANY

BOT – 402

ENVIRONMENTAL BIOLOGY (Special Paper)

RESOURCE ECOLOGY & CONSERVATION BIOLOGY (Special Paper – III)

Term end - 40

Internal – 10

Unit-1

Forest Resources: Concept of conservation in relation to resource conservation of biological diversity. Environmental impact analysis. Risk benefit and cost benefit analysis. Social forestry, Agro forestry, forest conservation through laws. World Conservation Strategy (WCS), National Conservation Strategy (NCS) conservation agencies IUCN, UNEP. (13)

Unit-2

Energy Resources: Conventional and non-conventional energy resources. Conventional-nuclear, thermal, coal, oil, hydro, Non-conventional biogas. Petro plant, dendrothermal, Bagass- based plant. (13)

Unit-3

Conservation Biology: Biological diversity conservation of biodiversity, Megadiversity, Hot-spot, Bioethics and Conservation, Causes of extinction. Endangered species. IUCN Red Data book. Man and Biosphere programme (MAB). (14)

BOT – 403

ENVIRONMENTAL POLLUTION & ENVIRONMENTAL LAWS (Special Paper – III)

Term end - 40

Internal – 10

Unit-1

Air pollution: Atmosphere and its composition, major and minor air pollutant and their sources (natural, anthropogenic), Oxides of carbon, oxides of nitrogen as pollutants, oxides of sulphur as pollutants, Acid rain, photochemical smog, green house effects of air pollution, Bio indicator of air pollutants. Control measures of air pollution. (13)

Unit-2

Water pollution: Water pollution and their sources (Municipal, industrial, Agricultural) effects of pollutants. Eutrophication. Biological Oxygen Demand (BOD), Bioindicator of water pollutants. Prevention and control measures of water pollution. Soil pollution: Classification of soil waste, causes of soil pollution, disposal of soil waste, recovery and recycling, methods of compostion vermicomposting and cycling of organic waste. (13)

Unit-3

Environmental laws and protection: Constitutional provisions. Water and Air Act, Responsibility of an industry, Water cess Act, 1977, The Environment (Protection) Act, 1986 Functions and Responsibilities of the State Pollution Control Board, Functions and Responsibilities of the Central Pollution Control Board. Forest conservation Act, 1972. Participation of People in Environmental Protection. Role of Non-Governmental organizations (NGO). Grass-Root Environmental movements in India. Environmental movements in Orissa. (14)

SEMESTER SYSTEM OF P. G. BOTANY

BOT – 404

ENVIRONMENTAL BIOLOGY (Special Paper) PRACTICALS

(Relevant to paper BOT-303, BOT-402, BOT-403 of Env. Biol. special paper and project work to start from third semester)

Practical– 80

Project – 20

A) Practical's:

1. Comparative analysis of moisture content of different soil samples.
2. Estimation of carbon content of soil samples.
3. Estimation of nitrogen content of soil sample.
4. Estimation of pH, density and porosity of soil sample.
5. To study of the community by quadrat method by determining frequency, density and abundance of different plant species present in the community.
6. Measurement of water quality, based on dissolved oxygen content of different water sample.
7. Estimation of chloride content of different water samples.
8. Estimation of carbonate and bicarbonate content of soil samples.
9. Practical & Viva-voce.

B) Project Report Evaluation

BOOKS RECOMMENDED

FIRST SEMESTER

BOT-101

(Plant Physiology, Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms)

1. Structure and Reproduction in Algae Vol. I and II F. E Fritsch. (Cambridge Univ. Press)
2. The Algae-Review - G. W. Prescott Tata Mc. Graw Hill.
3. Introduction to study of Algae - V. J. Chapman. Mc. Millan New York. 1958.
4. Cryptogamic Botany. Vol. I. G.M Smith.
5. Introduction to Algae - Bold and Wynne. prentice Hall of India Pvt. Ltd New Delhi. 1978.
6. Algal physiology and Biochemistry - W.D.P. Stewart. University California press. New York.
7. Morphology and Taxonomy of Fungi - E. A. Bessey Hafner Pupliching Company. 1968.
8. Comparative Morphology of Fungi-gaumann and Dodge. Introduction to Mycology – C. J. Alexopoulos. John Wiley Publication New York.
10. Outlines of the Fungi - G. W. Martin.
11. Physiology of Fungi - Hawker L. E. Verlag Von. J. Crammer. 1968.
12. Fungi and Plant Disease - B. B .Mudkur. The Mc Milian & Co. 1967.
13. Primitive Land Plants - F. O. Bower. Mc Millan, London.
14. Evolution of Land plants - D. H. Campbell, Stanford University Press. 1961.
15. Cryptogamic Botany - Vol. II G. M. Smith. Mc Graw Hill Book Co. 1965.
16. Interrelationship of Bryophytes - F. C. Cavers S.R. Technico 1976.
17. An Introduction to Embryophyta. Vol.s I and II - N. S. Parihar. Central Book Depot. Allhabad.
18. Mosses and Ferns - D. H. Capbell. Stanford University Press.
19. Morphology of Lower Vascular Plants A. J. Eames, McGraw Hill. 1966.
20. Introduction to Pteridophyta - A. Rashid.
21. Introduction to Paleobotany - C. R. Arnold Tata Mc. Graw Hill Co. New York. 1962.

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22. Studies in Fossil Botany-Vol-I.D.H. Scott. Hafner Publishing Company. New York. 1962
23. Gymnosperms-Structure and Evolution G. J. Chamberlain. Dover Publication. 1965.
24. Morphology of Gymnosperms - J. M. Coulter and C. J. Chamberlain. Central Book Depot. Allhabad 1964.
25. The living Cycads - C. J. Chamberlain.
26. Fossil Botany Vol. I &II - Steward.

BOT-102

(Genetics, Cell Biology, Evolution and Plant Breeding)

1. Genetics by Srickberger
2. Principles and Genetics by Sinnot. Dunn and Dobzohansky.
3. Principles and Practices of Plant Breeding - J. R. Sharma.
4. Genetics, Evolution & Plant Breeding - U. Sinha & Sunita Sinha.
5. Genetics Evolution & Plant Breeding - P. C. Vasistha & P. S. Gill (Praeep Publication)
6. Processes of Organic Evolution by G. Ledyard Stebbings.
7. A Text Book of Cytology. Genetics & Evolution - P. K. Gupta
8. Plant Breeding – Prof. B. D. Singh (Principles and Methods) Kalyani publication.

BOT-103

(Molecular Biology, Microbiology, Plant Pathology, Immunology)

1. The Biochemistry and physiology of plant diseases R. N. Goodmann. Kiraley. M. Zaitllin. D. Van. Mostrand co. New Jersey. London.
2. Plant Pathology - J. C. Walker.
3. Plant Pathology - O. P. Meherotra. Oxfard & IBH publication.
4. Fungi and Diseases in plant - E. G. Butler.
5. Plant Pathology - E. J. Butler and S. C. Jones.
6. Principles of plant infection - E. A. Gauman.
7. Genetics of Host Parasite Interaction - Peter R. Day. The Connecticut Agril. Experiment. 1982.
8. Plant diseases - R. S. Singh.
9. Plant Pathology and Plant Pathogen - C. H. Dickinson and J. A. Locas. Blackwell scientific pub. 1997.
10. Plant Diseases- R. S. Singh. Oxford and IBH Pub. 1968.
11. Principles of Plant Diseases-R.S. Singh Oxford and IBH Publication. 1980.
12. Principles of Plant Pathology - M. K. Dasgupta. Allied Publishers Pvt. Ltd. New Delhi. 1983.
13. General Microbiology: Pelzar & Reid . Tata Mc. Graw Hill publication.
14. Microbiology: R.Y. Stanier. M. Doudoraft and E. A. Adelbarg Mc. Milian, India. 1982.
15. Microbiology Vol. I and Vol. II: Power and Dagainawalla.
16. Microbiology Vo. I and Vol. II: Power and Dagainawalla.
17. Experiments in Microbiology. Plant Pathology. Tissue Culture and Mishroom Cultivation K. R. Aneeja. Wishwa Prakashan.
18. Microbiology: Fundamentals and Applicaation (New Vth Edn) S. S. Purohit. Agro Botanical Publishers Bikaner.
19. Microbial Gentics - David Freitelder - Narosa.
20. General Microbiology - Water & Mc. Bec.
21. Molecular Biology David freifelder Narose Publishing House.

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22. Genes V - Benjamin Lewin - Oxford University and Cell Press.
23. Molecular Cell Biology (3rd Edn) 1995 H. Lodish. D. Baltimore. A. Berk. S. Lawrence Zipursky, P. Matsudainra. J. Darnell: Scientific American Books.
24. Principles of Gene Manipulation: An Introduction to Genetic Engineering (6th Edn) 1996. R. W. Old and S. B. Primorose Blackwell Sci. Pub.
25. Molecular Mechanism of Protein Synthesis-Weisbach & Pestakacds: Academic Press.
26. Nucleic Acid in Chemistry and Biology 1996 G. M. Blackburn & M. J. Gait: Oxford Univ. Press.
27. Essentials of Molecular Biology (211d Edn). 1993 D. Freifieder and G. Malacimsky. Jones and Bartlett Publisher.
28. Principles of Gene Manipulation: An Introduction to Genetic Engineering - R.W. Old and S. B. Primrus. Blackwell Science Publication.

SECOND SEMESTER

BOT-201

(Instrumental Techniques, Environmental Biology and Physiology)

1. Forest Ecology Vol. I and II G. S. Puri. R. K. Gupta. V. H. Meher Homji & S. Puri
2. Fundamentals of Ecology 3rd Edition by E. P. Odum E. B. Saunders Co. philadelphia.
3. Methods of Soil physics by S. K. Jalota, R. Khera. B. S. Ghuman.
4. Ecology and Environment by P. D. Sharma Rastogi Pub.
5. Nature and Properties of Soil by Buckman and C. Brady.
6. Plant and Environment by F. F. Dubenmire.
7. Dynamics of Vegetation by F. E. Clements.
8. Fundamental of Ecology-by Waver and Clements
9. A Text Book of Plant Ecology - by R. S. Ambasht.
10. Elements of Ecology - P. D. Sharma
11. Plant Ecology - W. D. Bellings.
12. Instrumental Analysis for Science & Technology W. Ferren, Agrobotanical Publication.
13. Biochemical Methods by S. Sadasivan & A. Manidean.
14. Biophysical Chemistry - Upadhyay. Upadhyay & Nath.
15. Useful Techniques for plant Scientists by Dhopte.
16. Plant Physiology - F. B. Salisbury and C. W. Ross. CBS Publishers (India Edn. 1992).
17. Introductory Plant Physiology - C. R. Noggle and G. J. Fritz. Prentice Hall (India Edn.1992)
18. Advanced Plant Physiology - M. B. Wilkings. ELBS. 1987
19. Plant Physiology - R. G. S. Bidwell. Collier Mc Millan, 1979.
20. Plant Cell structure and Metabolism J. L. Hall. T. J. Flowers and R. M. Roberts. EOBs/Longman. 1982.
21. Plant Physiology - Levitt.
22. Transport Phenomenon in Plants by K. Raman Narosa Publishing House.
23. Photophysiolgy - Giese (Ed).
24. Plant growth and Development - Wilkins.
25. Growth and Development in plants - Leopold and Kriedmann.
26. Plant Physiology - Meyer & Anderson.
27. Plant Physiology - Mallick and Srivastava, Kalyani Publishers.

BOT-202 (Biochemistry) and

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BOT-203 (Biophysics and Biophysical Chemistry)

1. Biochemistry - Garret and Grisham 1995.
2. Basic Biophysics for Biologists - M. Daniel. Agro Botanica. Bikaner.
3. Physical Chemistry - Principles and Application in Biological Science – (Trinoco, sauer and Wangeds) 1995. Prentic Hall. New Jersey.
4. Outlines of Biochemistry - E. E. Conn and P. K. Stumpf. Wulley Eastern. India. Edn. 1992.
5. Principles of Biochemistry – A. L. Lehninger. Kalyani Pub.
6. Biochemistry (2nd Edition) - Lubert stryer. Freeman and SBS. 1995.
7. Biological Chemistry - Mehler and Cordes, Harper and Row.
8. Plant Biochemistry - A Comprehensive Treatise (Vol. 116) - P. K. Stumpf and E. E. Conn. Acad. Press 1980-88.
9. Dynamics of Protein and Nucleic acid - J. A. Mc Cammon and S. C. Harvery. Cambridge University Press. 1987.
10. Principles of Nucleic acid structure - W. Saenger (C. R. Cantro ed) 1983. Springer Verlag. NY.
11. Enzymes - M. Dixan and E. C. Webb. Longman Group. 1979.
12. Understanding Enzymes - T. Palmer, Ellis Haewood, 1985.
13. Principles of Bioenergetics - A. L. Lehninger
14. Biochemistry – L.A. Moran and K. G. Scrimgear, 2nd Edn. 1994. Prentice Hall New York.
15. Introduction to plant Biochemistry – T.W. Goodwin and E. J. Mercer. Prentice Hall York.
16. Principles of Physical Biochemistry - K. E. Van Holde. W. C. Johnson and O. Shing Ho. Prentice Hall of India Pvt. Ltd. New Delhi.
17. Plant Biochemistry - J. Bonner and J. Vamer 196. Academic Press
18. Photosynthesis - R. M. Devlin and Baker. India Offset Press. New Delhi.
19. Plant cell Structure and Metabolism – J. L. Hall, T. J. Flowers and R. M. Roberts ELBS/Longman. 1982.
20. Botanical Metabolism (3rd Edn) 1996-Gottschalk. Springer Verlag, Germany.

THIRD SEMESTER

BOT-301

(Taxonomy and Biodiversity, Economic Botany, Developmental Botany)

1. The Classification of Flowering plants Vol. I & II A. B. Rendle.
2. Families of Flowering Plants - J. Hutchinson
3. Taxonomy of Vascular Plants - G. H. M. Lawrence
4. The Botany of Bihar and Orissa - H. H. Haines
5. Flora of Orissa - Saxena and Brahmam. Orissa, Forest Development Corporation.
6. Supplement of Botany Of Bihar and Orissa - Mooney.
7. An Aid to the International Code of Botanical Nomenclature – A. N. Henry and Chandra Bose.
8. Plant Taxonomy - Haywood
9. An Introduction to Plant Taxonomy - C. Jeffrey.
10. Taxonomy of Angiosperms - V. N. Naik
11. An Introduction to Systematic Botany and Ecology - J. N. Mitra
12. Economic Botany - A. P. Hill
13. Field Crops - E. N. Lyer
14. Medicinal Plants of India and Pakistan - Dastur

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15. Economic Botany – V. Verma
16. Economic Botany – B. P. Pandey
17. Economic Botany in the Tropics – S. L. Kochhar, Mc Millan India Ltd.
18. An Introduction to Plant Anatomy - A. J. Eames and L. H. Mac Daniels
19. Plant Anatomy – K. Esau
20. Physiological Plant Anatomy - Haberlandt
21. Plant Anatomy - B. P. Pandey
22. Plant Anatomy - P. C. Vasistha

BOT - 302

(Biostatistics, Embryology, Dev. Physiology)

1. An Introduction to the Embryology of Angiosperms P. Maheswari. T.M.H. Publication
2. Recent Advanced in Embryology of Angiosperms P. Maheswari
3. The Embryology of Angiosperms - S. S. Bhojwani and S. P. Bhatanagar. Vikas Publishing House Pvt. Ltd.
4. Experimental Embryology - B. M. John
5. Introductory Embryology – G. P. Dawar and S. K. Sharma
6. Biostatistics - Parker
7. Biostatistics in theory and practice – T. K. Saha. Emkay Publications
8. Practical Biostatistics - Mishra and Mishra
9. Fundamentals of Biostatistics (Biometry) - Satguru prasad, Emkay Publications
10. Plant growth and Development - Leopold
11. Plant growth and Development - Leopold and Kriedeman

FOURTH SEMESTER

BOT-401

(Biotechnology and Genetic Engineering, Photo morphogenesis)

1. A Textbook of Biotechnology - H. D. Kumar
2. Elements of Biotechnology - P. K. Gupta
3. Textbook of Biotechnology - R. C. Dube
4. Biotechnology and Tissue Culture – Chopra, Narosa Publishing House
5. Plant Cell Tissue and Organ Culture - Gamborg
6. Tissue Culture - Dodds
7. Principle of Gene manipulation - Primrose Old

SPECIAL PAPER

(BOT-303, BOT-402 & BOT-403)

BIOCHEMISTRY

1. Principle of Biochemistry – Al. Lehninger, D. L. Nelson and M. M. Cox. 1993. CBS Publishers, New Delhi.
2. Biochemistry - Lubert Stryer - (41 Edn) 1995. Freeman and CBS. New Delhi.
3. Biochemistry - Gart and Grisham. 1995.

4. Enzyme Structure and Mechanism - Fresht and Freeman.
5. Enzyme Structure and Function - W.B. Bernard.
6. Understanding Enzymes -T. Plamer. Ellis Harwood. 1985.
7. Basic principles of Membrane Transport - S.G. Schultz. 1980. Cambridge University Press.

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8. A new look to the Mechanism in Bioenergetics - E. Racker.
9. Structure and Function of Biological Membrances - Rothfield. Academic Press.
10. Mechanism of Bioenergetics - E. Racker. A. P.
11. Membranes of Mitochondria and Chloroplasts - E. Racker. Academic Press.
12. Photosynthesis - Rabinowitch and Govindjee – Willey Eastern. New Delhi.
13. Photosynthesis - Govindjee (Ed) 1984. A. P.
14. Chloroplast Biogenesis (Vol. 5) Baker and Baker.
15. Bioenergetics of Photosynthesis - Govindjee (Ed) 1984.
16. Nucleic Acids in Chemistry and Biology - G. M. Blackburn
17. Biochemistry - K. Trehan.
18. Botanical Metabolism (3rdEdn) 1996 - Gottschalk. Springer Verlag. Germany.

MICROBIOLOGY

1. A Manual of Soil Fungi - J. C. Gilman. Oxford and IBH Publication
2. CRC Hand Books of Microbiology Vol. I & II-A. I. Laskin & H. A. Lechevalier (Eds)
CRC Press Inc. Florida.
3. Bacterial Metabolism - W.W. Doyle. Academic Press.
4. Microbial Ecology - Mann Alexander. John welly Eastern.
5. Advances in Agricultural Microbiology: N. S. Subbarao. Oxford IBH Publication.
6. Nitrogen Fixation by Free-Living Organism: W. D. Steewart. Cambridge University Press.
7. Biotechnology Vol. 3 - H. J. Rhem & Reed. Verlag Chemic.
8. Experiments in Microbiology - Plant Pathology. Tissue Culture and Mushroom Cultivation
– K. R. Aneja. Wishwa Prakashan.
9. A text book of Microbiology (19 Edn.) William Burrows.
10. Microbiology (2nd Edn.) - Carpenters. Phillips.

ENVIRONMENTAL BIOLOGY

1. Fundamentals of Ecology by E. P. Odum 31d Edition E. B. Saunders Co. Philadelphia
2. Ecology and Environment by P.D. Sharma, Rastogi Publication
3. Nature and properties of soil by Buckman and C. Brady
4. Methods of soil physics by S. K. Jalota. R. Khera, B. S. Ghuman
5. Dynamics of vegetation by F. E. Clement
6. Fundamentals of Ecology by Weaver and Clement
7. A text book of plant Ecology by R. S. Ambsh
8. Elements of Ecology by P. D. Sharma, Rastogi Publication
9. Plant Ecology by W.D. Bellings
10. Men and Environment by M. C. Dash and P. C. Mishra
11. Fundamentals of Ecology by. M. C. Dash

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