

SYLLABUS
for
Choice Based Credit System
(CBCS)

On the basis of
Outcome Based Education
(OBE)

BOTANY HONOURS

PATNA WOMEN'S COLLEGE
PATNA UNIVERSITY

3rd Cycle NAAC Accredited at 'A' Grade with CGPA 3.58/4
"College with Potential for Excellence" (CPE) Status Accorded by UGC

Vision

Rooted in the life, vision, and teachings of Jesus Christ and inspired by Mother Veronica, the foundress of the Apostolic Carmel, Patna Women's College strives to become a centre of academic excellence in higher education, social responsibility, and empowerment of women.

Mission Statement

Patna Women's College, the first college for women in Bihar, is committed to the holistic development of women so as to make an effective contribution to the creation of a better society.

To this end, we strive

- To become a center of excellence in higher education for women in an atmosphere of autonomy.
- To excel in teaching-learning, research, and consultancy.
- To provide education that promotes capacity building and holistic development of a person.
- To offer subjects for competency building and motivate/animate a workforce imbued with human values.
- To promote patriotism, communal harmony and cultural integration to maintain a free and peaceful atmosphere on the campus.
- To train the students in creative arts, social service, critical thinking, and leadership in order to make an effective contribution to the creation of a new and value-based society.
- To create women leaders and to make them agents of social change.
- To develop skill oriented and value-based courses, for the all-round development of individuals.
- To promote academic exchange and academia-industry interface.
- To form young women who are 'always wise' and who will dare to 'go ahead and conquer knowledge' through, competence, commitment, delicate conscience, and compassion.

PATNA WOMEN'S COLLEGE
AUTONOMOUS
PATNA UNIVERSITY
3rd Cycle NAAC Accredited at 'A' grade with CGPA 3.58/4
'College with Potential for Excellence' (CPE) status accorded by UGC

Programme: B.Sc. Botany

Programme Outcomes

At the completion of the programme, the student will attain the ability to:

- PO1:** To provide thorough knowledge about various plant groups from primitive to highly evolved
- PO2:** To equip the students with skills related to laboratory as well as field-based studies
- PO3:** To highlight the potential of these studies to become an entrepreneur
- PO4:** To make the students aware about conservation and sustainable use of plants as well as to address the socio-economical challenges related to plant sciences
- PO5:** To make the students aware about conservation and sustainable use of plants as well as to address the socio-economical challenges related to plant sciences

Programme Specific Outcomes

At the completion of the programme, the student will attain the ability to:

- PSO1:** This program imparts excellence with an aptitude for higher studies, research and to meet competitive exams.
- PSO2:** Practical work in the field and laboratory experiments enhances skills in handling scientific instruments.
- PSO3:** This program is a Research oriented learning, so enhances presentation (oral and writing) skills.
- PSO4:** The study of Genetics has various applications, especially in development of genetically engineered crops.

PSO5: This program develops skills and ability to use knowledge efficiently in areas related to specializations and current updates in the subject.

PSO6: It also provides Entrepreneurship skill development for small scale start-ups.

B.Sc. (Honours) Botany

Note: 1 credit = 15 hours

- 1. Core Course paper: 6 credits each (4 Theory and 2 Practical)**
- 2. General Elective paper: 6 credits each (4 Theory and 2 Practical)**
- 3. Ability Enhancement Courses: 2 credits each (Theory/ Practical)**
- 4. Discipline Specific Elective paper: 6 credits each (4 Theory and 2 Practical)**
- 5. Dissertation: 6 credits (Project work and Project Report)**

Core Courses (BOT CC) (6 credits each)

Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

Semester I

1. Microbiology and Phycology
2. Biomolecules and Cell Biology

Semester II

3. Mycology and Phytopathology
4. Archegoniate

Semester III

5. Anatomy of Angiosperms
6. Economic Botany
7. Basics of Genetics

Semester IV

8. Molecular Biology
9. Plant Ecology and Phytogeography
10. Plant Systematics

Semester V

11. Reproductive Biology of Angiosperms
12. Plant Physiology

Semester VI

13. Plant Metabolism
14. Plant Biotechnology

Generic Elective Papers (BOT GE) (6 credits each)

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/ subject and vice versa and such electives may also be referred to as Generic Elective.

Semester I

1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)

Semester II

2. Plant Ecology and Taxonomy

Semester III

3. Plant Anatomy and Embryology

Semester IV

4. Plant Physiology and Metabolism

Ability Enhancement Compulsory Courses (AECC) (2Credits each)

Ability Enhancement Comulsory Courses (AECC): These courses are based upon the content that leads to **knowledge enhancement-** (i) English/Hindi communication, (ii) Environmental Science.

SEMESTER I

AEC 1 English/MIL communication

SEMESTER II

AEC 2 Environmental Science

Skill Enhancement Course (SEC) (2Credits each)

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide **value-based and/or skill-based knowledge**.

Semester III

IRS SEC 1 Inter Religious Studies (Value based)

Semester IV

BOT SEC 2. Mushroom Cultivation Technology (Skill based)

Discipline Specific Elective (BOT DSE) (6 credits each)

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

Semester V

BOT DSE-1

1. Genetics and Plant Breeding

BOT DSE-2

2. Biostatistics

Semester VI

BOT DSE-3

3. Research Methodology

BOT DSE-4

4. Dissertation

Sem .	Core Course (14) <u>6 Credits each</u>	Ability Enhancement Compulsory Course AECC (2) <u>2 Credits each</u>	Skill Enhancement Course SEC (2) <u>2 Credits each</u>	Discipline Specific Elective DSE (4) <u>6 Credits each</u>	Generic Elective GE (4) <u>6 Credits each</u>
I	BOT CC101: Microbiology and Phycology BOT CC102: Biomolecules and Cell Biology	AEC 101: English/ MIL Communication			BOT GE101: Biodiversity (Microbes, Algae, Fungi and Archegoniate)
II	BOT CC203: Mycology and Phytopathology BOT CC204: Archegoniate	AEC202: Environmental Science			BOT GE202: Plant Ecology and Taxonomy
III	BOT CC305: Anatomy of Angiosperms BOT CC306: Economic Botany		IRS SEC301: Inter-Religious Studies (Value based)		BOT GE303: Plant Anatomy and Embryology

	BOT CC307: Basics of Genetics				
IV	BOT CC408: Molecular Biology		BOT SEC402: Mushroom Cultivation Technology (Skill based)		BOT GE404: Plant Physiology and Metabolism
	BOT CC409: Plant Ecology and Phytogeography				
	BOT CC410: Plant Systematics				
V	BOT CC511: Reproductive Biology of Angiosperms			BOT DSE501: Genetics and Plant Breeding BOT DSE502: Biostatistics	
	BOT CC512: Plant Physiology				
VI	BOT CC613: Plant Metabolism			BOT DSE603: Research Methodology BOT DSE604: Dissertation	
	BOT CC614: Plant Biotechnology				

Course Structure for B.Sc. Botany (Hons.)

<u>Semester -I</u>	<u>Semester -II</u>
BOT CC101: Microbiology and Phycology	BOT CC203: Mycology and Phytopathology
BOT CC102: Biomolecules and Cell Biology	BOT CC204: Archegoniate
Practical based on BOT CC101 & BOT CC102	Practical based on BOT CC203 & BOT CC204
AEC101: English/ MIL Communication	AEC 202: Environmental Science
BOT GE101:	BOT GE202:

Biodiversity (Microbes, Algae, Fungi and Archegoniate)	Plant Ecology and Taxonomy
Practical based on BOT GE101	Practical based on BOT GE202
<u>Semester –III</u>	
BOT CC305: Anatomy of Angiosperm	BOT CC408: Molecular Biology
BOT CC306: Economic Botany	BOT CC409: Plant Ecology and Phytogeography
BOT CC307: Basics of Genetics	BOT CC410: Plant Systematics
Practical based on BOT CC305, BOT CC306 & BOT CC307	Practical based on BOT CC408, BOT CC409 & BOT CC410
IRS SEC 301: Inter-Religious Studies	BOT SEC402: Mushroom Cultivation Technology
BOT GE303: Plant Anatomy and Embryology	BOT GE404: Plant Physiology and Metabolism
Practical based on BOT GE303	Practical based on BOT GE 404
<u>Semester –V</u>	
BOT CC511: Reproductive Biology of Angiosperms	BOT CC613: Plant Metabolism
BOT CC512: Plant Physiology	BOT CC614: Plant Biotechnology
Practical based on BOT CC511 & BOT CC512	Practical based on BOT CC 613 & BOT CC 614
BOT DSE501: Genetics and Plant Breeding	BOT DSE603: Research Methodology
BOT DSE501: Biostatistics	BOT DSE604: Dissertation
Practical based on BOT DSE501 & BOT DSE502	Practical based on BOT DSE603 & Project work

BOT Botany

CC Core Course
Course

SEC Skill Enhancement

AECC Ability Enhancement Compulsory Course

Details of Credits for Courses under B.Sc. Honours

Botany

Semester	Course	Theor y	Practica l	Tutorial	Total Credits
<u>I. Core Course (BOT CC) (14 Papers) – 06 credits each</u>					
I	1. Microbiology and Phycology	4	2	-	6
	2. Biomolecules and Cell Biology	4	2	-	6
II	3. Mycology and Phytopathology	4	2	-	6
	4. Archegoniate	4	2	-	6
III	5. Anatomy of Angiosperms	4	2	-	6
	6. Economic Botany	4	2	-	6
	7. Basics of Genetics	4	2	-	6
IV	8. Molecular Biology	4	2	-	6
	9. Plant Ecology and Phytogeography	4	2	-	6
	10. Plant Systematics	4	2	-	6
V	11. Reproductive Biology of Angiosperms	4	2	-	6
	12. Plant Physiology	4	2	-	6
VI	13. Plant Metabolism	4	2	-	6
	14. Plant Biotechnology	4	2	-	6
<u>II. Elective Course – 06 credits each</u>					
A. 1. Discipline Specific Elective (BOT DSE) (4 papers)					
V	1. Genetics and Plant Breeding	4	2	-	6
	2. Biostatistics	4	2	-	6
VI	3. Research Methodology	4	2	-	6
	4. Dissertation	-	6	-	6
B. 1. Generic Elective (BOT GE) / Interdisciplinary (4 papers)					

I	1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4	2	-	6
II	2. Plant Ecology and Taxonomy	4	2	-	6
III	3. Plant Anatomy and Embryology	4	2	-	6
IV	4. Plant Physiology and Metabolism	4	2	-	6
III. Ability Enhancement Courses – 02 credits each					
A. Ability Enhancement Compulsory Course (AECC)					
I	1. English / Hindi Communication	2	-	-	2
II	2. Environmental Science	2	-	-	2
B. Skill Enhancement Course (SEC)					
III	1. Inter Religious Studies	2	-	-	2
IV	2. Mushroom Cultivation Technology	-	2	-	2
TOTAL					140

Institute should evolve a system/policy about ECA / General Interest / Hobby / Sports / NCC / NSS / related courses on its own.

*wherever there is practical there will be no tutorial and vice-versa.

Botany (Honours) Details of CBCS Syllabus

Core Courses Papers (CC) (6 credits each)

Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

SEMESTER - I

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Classify the Plant kingdom
- CO2:** Describe the diversity, structure and importance of viruses and bacteria
- CO3:** Describe the general account of Mycoplasma and diseases caused by them
- CO4:** Explain the thallus organization, economic importance and the life cycle of various algae

BOT CC101 Microbiology and Phycology PWC (Theory: 4 credits + Practical: 2 credit)		
Unit	Topics to be covered	No. of hours
1	Classification of Kingdoms and their criteria (Whittaker 1969)	04
2	Virus- Discovery, General structure, replication, DNA virus (T-phage); Lytic and lysogenic Cycle, RNA virus- TMV; Economic importance of viruses	12
3	Bacteria – Discovery, General characteristics, types-archaebacteria and eubacteria, Reproduction-Vegetative, asexual and recombination (conjugation, transformation and Transduction); Economic importance of bacteria with reference to their role in agriculture and industry (N ₂ fixation, fermentation and medicine) General account of Mycoplasma and diseases caused by them	20
4	Algae- General characteristics; Classification; Range of Thallus organization and Reproduction; Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar); Structure, Life history, and affinities of the following genera: <i>Nostoc</i> , <i>Volvox</i> , <i>Oedogonium</i> , <i>Chara</i> , <i>Vaucheria</i> , <i>Batrachospermum</i> and <i>Ectocarpus</i> ; Economic Importance of Algae	24
	Practical 1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle 2. Types of Bacteria to be observed from photographs 3. Gram staining. 4. Phycology: Study of vegetative and reproductive structures of the	30

	forms prescribed in the syllabus through temporary preparations and permanent slides	
	TOTAL	90

Reading List :

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
5. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
6. Vashishtha, B.R., Sinha, A.K. Singh, V.P. (2010). Botany for degree students: Algae, S. Chand & Company Ltd. 2nd edition
7. Srivastava, H.N. (2005). Algae, Pradeep Publication. 12th edition.
8. Dubey R.C., Maheshwari D.K. (2005). A Text Book of Microbiology, S. Chand & Company Ltd. 2nd edition.

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Describe the structure and properties of biomolecules

CO2: Explain the classification, properties and functions of enzymes

CO3: Describe cell wall, cell membrane and the structure, chemistry and functions of cellular organelles

CO4: Explain the eukaryotic cell cycle, mitotic and meiotic cell divisions; and regulation of cell cycle

BOT CC102		Biomolecules and Cell Biology	
PWC		(Theory: 4 credits + Practical: 2 credits)	
Unit	Topics to be covered	No. of hours	
1	Biomolecules: Carbohydrate proteins, lipids and nucleic acid	20	
2	Enzymes: Classification, nomenclature, physico-chemical properties, functions	14	
3	Cell: Cell theory, Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory); Cell wall and Cell membrane, Structure and function of cell organelles:nucleus, mitochondria, ribosomes, golgi apparatus, endoplasmic reticulum, lysosomes and plastids	20	
4	Cell division: Eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle	06	
	Practical 1. Estimation of organic acid 2. Estimation of fatty acid 3. Estimation of protein 4. Estimation of sugar 5. Estimation of enzyme activity 6. Detection of Tanin, alkaloid and flavonoid in the given plant sample. 7. Separation of amino acids by paper chromatography technique 8. Study of cell and its organelles with the help of electron micrographs 9. Study different stages of mitosis and meiosis	30	

	TOTAL	90
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Reading List :

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company.
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition.,W. H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R. E. (2009) The Cell: A Molecular Approach, 5th edition. ASM.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

SEMESTER- II

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Describe the thallus organization, nutrition and economic importance and life cycle of various fungi
- CO2:** Explain the diversity, structure and importance of lichen and mycorrhiza
- CO3:** Describe the terminologies, scope and importance of plant pathology
- CO4:** Describe the etiology, symptoms and control measures of plant diseases

<u>BOT CC203</u>		
Mycology and Phytopathology		
PWC		
(Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Fungi: General characteristics; Thallus organization; Nutrition; Cell wall composition; Reproduction and Classification General account of Lichens, types & economic importance; Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance	18
2	Structure and life history of the following genera: <i>Synchytrium, Rhizopus, Peziza, Albugo, Alternaria</i> and <i>Puccinia</i>	12
3	Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships; disease cycle and environmental relation; prevention and control of plant diseases	16
4	Etiology, symptoms and control of the following diseases: Citrus canker, Tobacco Mosaic Viruses, Little leaf of brinjal, Wart disease of potato, Early and Late blight of potato, Black stem rust of wheat and white rust of crucifers	14

	<p>Practical :</p> <ol style="list-style-type: none"> 1. Mycology: Study of vegetative and reproductive structures of <i>Rhizopus</i> and <i>Peziza</i> (ascocarp) through temporary preparations and permanent slides 2. Lichen: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates (Photographs); Mycorrhizae: ectomycorrhiza and endo mycorrhiza (Photographs) 3. Phytopathology: Study of Host-parasite relationship of <i>Synchytrium</i>, <i>Albugo</i>, <i>Alternaria</i> and <i>Puccinia</i> through temporary preparations and permanent slides 4. Photographs of fungal spores 5. Herbarium specimens/ Photographs of Citrus Canker; TMV, Early blight of potato, Black stem rust of wheat and White rust of crucifers 	30
	TOTAL	90

Reading List :

1. Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.
6. Vashishtha, B.R. Sinha, A.K. (2005). Botany for degree Students Part II, S. Chand & Company Ltd. 2nd edition.

7. Bilgrami, K.S. Dubey, H.C. (2005). A text book of Modern Plant Pathology, Vikas Publishing Home Pvt. Ltd. 2nd edition.

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Explain the morphological diversity and evolution of bryophytes, pteridophytes and gymnosperms
- CO2:** Compare the life cycle of various bryophytes, pteridophytes and

gymnosperms

CO3: Describe the economic importance of the bryophytes, pteridophytes and gymnosperms

CO4: Describe Fossil pteridophytes (*Rhynia* and *Calamites*)

BOT CC204		Archegoniate	
PWC		(Theory: 4 credits + Practical: 2 credits)	
Unit	Topics to be covered	No. of hours	
1	Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations	02	
2	Bryophytes: General Characteristics, adaptation to land habit, Classification (up to family); Vegetative reproduction; Range of thallus organization; Structure, life history & affinities of the following genera- <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> and <i>Funaria</i> ; Ecological and economic importance of bryophytes	18	
3	Pteridophytes: General characteristics, Classification (up to family), telome theory, stellar evolution, Apogamy and apospory, morphology, anatomy and reproduction of <i>Psilotum</i> , <i>Selaginella</i> with special reference to seed habit, <i>Equisetum</i> and <i>Marsilea</i> ; Ecological and economic importance; Fossil Pteridophytes – <i>Rhynia</i> & <i>Calamites</i>	20	
4	Gymnosperm: General characteristics, classification (up to family), morphology, anatomy and reproduction of <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> ; Ecological and economic importance	20	
	Practical : 1. Bryophytes: Study of vegetative and reproductive structures of <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> and <i>Funaria</i> through temporary preparations and permanent	30	

	slides 2. Pteridophytes: Study of vegetative and reproductive structures of <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> and <i>Marsilea</i> through temporary preparations and permanent slides 3. Gymnosperms: Study of vegetative and reproductive structures of <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> through temporary preparations and permanent slides	
	TOTAL	90

Reading List :

1. Vander-Poorteri 2009 Introduction to Bryophytes, COP.
2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta, S. Chand. Delhi, India.
3. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms,, New Age International (P) Ltd Publishers, New Delhi, India.
4. Vashistha, P.C., Sinha, A.K. Kumar, A. (2006). Botany for degree students: Gymnosperm, S. Chand & Company Pvt. Ltd.
5. Srivastava, H.N. (2002). Gymnosperm, Pradeep Publications. 10th edition.
6. Rashid A. (1999). An introduction to Pteridophyta Vikas Publishing Home Pvt. Ltd. 2nd edition.
7. Puri P. (1996). Bryophyta: Morphology, Growth and Differentiation, Atma Ram and Sons, 2nd edition..

SEMESTER – III

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Explain the tissue system in plants and their functions

CO2: Understand the normal and anomalous secondary growth in plants and their causes

CO3: Learn about the structural adaptations in plants growing in different environmental conditions

CO4: Describe the structure and function of periderm

BOT CC305		
Anatomy of Angiosperms		
PWC		
(Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Meristem and permanent tissue; Root and shoot meristem, simple and complex tissue Mechanical Tissues – Structure, distribution and function	24
2	Normal secondary growth; Anomalous secondary growth in <i>Tinospora</i> , <i>Bignonia</i> , <i>Boerhaavia</i> , and <i>Dracaena</i>	16
3	Organization of tissue in relation to environment: Hydrophytes, Xerophytes, Halophytes and Epiphytes	16
4	Periderm – Origin, structure and function	04
	Practical 1. Study of anatomical details through permanent slides/temporary stain mounts/ Photographs	30

	<p>2. Distribution and types of parenchyma, collenchyma and sclerenchyma through permanent slides/temporary stain mounts/ Photographs</p> <p>3. Study of anomalous secondary growth in <i>Tinospora</i>, <i>Bignonia</i>, <i>Boerhaavia</i>, and <i>Dracaena</i> through temporary preparations and permanent slides</p> <p>4. Study of morphological and anatomical adaptations in hydrophytes and xerophytes through specimens and temporary slide preparations</p>	
	TOTAL	90

Reading List :

1. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy, Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publisher, USA.
4. Esau, K. (1977). Anatomy of Seed Plants, John Wiley & Sons, Inc., Delhi.
5. Vasishtha, P.C. (2004). Plant Anatomy, Pradeep Publication. 17th edition.
6. Grewal, R.C. (2011). Plant Anatomy, Campus Book International. 1st edition.
7. Singh S.K. Srivastava. S. (2014). Anatomy of anigospersms, Campus Books International. 1st edition.

Course Outcomes

After the completion of the course, the student will be able to:

BOT CC306**Economic Botany**

PWC

(Theory: 4 credits + Practical: 2 credits)

CO1: Learn about the economically important plant products with special reference to the Botanical name, family, morphology of useful part and the uses

CO2: Increase the awareness and appreciation of plants & plant products encountered in everyday life

CO3: Appreciate the diversity of plants and the plant products in human use

CO4: Analyze the importance of economically important plants

Unit	Topics to be covered	No. of hours
1	Botanical characteristics, cultivation, processing and uses of Cereals, Legumes, Oil and fats	15
2	Botanical characteristics, cultivation, processing and uses of Spices, Fruits and vegetables	15
3	Botanical characteristics, cultivation, processing and uses of Beverages, Narcotics, Timber and Fiber yielding plant	15
4	Botanical characteristics, cultivation, processing and uses of Medicinal plants, Sugar and starch yielding plants	15
	Practical : 1. Study of botanical characteristics, cultivation, processing and uses of Cereals, Legumes, Oil & fats, Spices, Fruits and vegetables, Beverages, Narcotics, Timber and Fibre yielding plant, Medicinal plants, Sugar and starch yielding plants	30
	TOTAL	90

Reading List :

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices, Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture, Jones & Bartlett Publishers.
4. Pandey, B.P. (2005). Economic Botany, S. Chand & Company Pvt. Ltd. 6th edition.
5. Kochner, S.N. (2016). Economic Botany a Comprehensive Study, Cambridge University Press. 5th edition.
6. Sharma, V. K., Shenai, S. K. (2013). Economically Important Medicinal Plants, Campus Book International. 1st edition.
7. Arya, P.S. (2000). Spice Crops of India, Kalyani Publishers.

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Have conceptual understanding of Mendelian laws of inheritance, its variations and applications
- CO2:** Comprehend the effect of chromosomal abnormalities leading to genetic disorders
- CO3:** Analyze the effect of mutations on gene functions and dosage
- CO4:** Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels, sex determination and sex linked inheritance

BOT CC307		
Basics of Genetics		
PWC		
(Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Mendelian inheritance: Mendel's experiments and principles of inheritance: back cross and test cross; gene interactions and modified dihybrid ratio-complementary, supplementary, duplicate and epistatic factor and inhibitory genes	20
2	Linkage and crossing over: Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Sex determination and sex linked inheritance	16
3	Chromosomes: Physical and chemical characteristics, lampbrush chromosomes, B-chromosomes and polytene chromosomes; Chromosomal aberrations: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy, Polyploidy (types and role in evolution)	10
4	Mutations: Types and induction (physical and chemical mutagens); Molecular basis of mutations and their role	14

	Practical 1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis 2. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 9:3:4, 12:3:1, 13:3, 15:1)	30
	TOTAL	90

Reading List :

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, Benjamin Cummings, U.S.A. 10th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, W. H. Freeman and Co., U.S.A. 10th edition.
5. Verma, P.S. Agarwal, V.K. (2010). Genetics, S. Chand & Company Pvt. Ltd. 2nd edition.
6. Singh, B.D. (2014). Genetics, Kalyani Publishers. 2nd edition.
7. Gupta P.K. (2001). Genetics, Rastogi Publication. 3rd edition.

SEMESTER – IV

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Analyze the structures and chemical properties of DNA and RNA and their role
- CO2:** Know gene expression and regulation in prokaryotes and eukaryotes
- CO3:** Gain an understanding of various steps in transcription and translation in prokaryotes and eukaryotes
- CO4:** Gain knowledge of application of recombinant DNA technology for human welfare

<u>BOT CC408</u>		Molecular Biology
PWC		(Theory: 4 credits + Practical: 2 credits)
Unit	Topics to be covered	No. of hours
1	Nucleic acids, structures of DNA and RNA, forms of DNA, DNA replication and role of DNA polymerases, different forms of RNA and their role, Genetic code	18
2	Gene expression and regulation in prokaryotes and eukaryotes	10
3	Central dogma, Transcription and Translation in prokaryotes and eukaryotes	16
4	Recombinant DNA technology and its role in human welfare, Polymerase Chain Reaction	16
	Practical 1. DNA isolation from cauliflower head 2. DNA estimation by diphenylamine reagent/UV Spectrophotometry 3. Study of DNA replication mechanisms through	30

	photographs 4. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 5. Role of Genetic Engineering in human welfare through photographs/ Models	
	TOTAL	90

Reading List :

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, W. H. Freeman and Co., U.S.A. 10th edition.
6. Channarayappa (215). Molecular Biology, Universities Press. 1st edition.
7. Karp Gerald (2010). Cell Biology, John Willey and Sons., Inc. 6th edition

Course Outcomes

After the completion of the course, the student will have:

- CO1:** Knowledge of plant communities and ecological adaptations in plants
- CO2:** Knowledge about the soils on the basis of physical, chemical and biological components and states of water and their importance
- CO3:** Knowledge about the conservation of biodiversity, nonconventional energy, types and control of pollution; and the phytogeographical divisions of India
- CO4:** Knowledge about energy sources of ecological system

<u>BOT CC409</u> Plant Ecology and Phytogeography		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Environment, Ecology, Biosphere, Biome, habitat, niche; Adaptation of hydrophytes and xerophytes Biotic interactions: Beneficial and harmful interactions (symbiosis, commensalism, parasitism)	06
2	Population ecology: Characteristics and Regulations Community ecology: Concept of ecological amplitude; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession (Hydrosere and Xerosere) Ecosystem: Structure and function of ecosystem, food chains and webs, Principles and models of energy flow, ecological pyramids	12
3	Soil: Origin, Formation, Composition (Physical, Chemical and Biological) Soil profile and importance Water: States of water in the environment, Precipitation types (rain, fog, snow, hail, dew), Soil water, Water table and importance of water	20
4	Biogeochemical cycles: Gaseous and sedimentary cycles, Hydrological cycle Environmental pollution: Air pollution, water pollution, noise pollution, radioactive pollution and their control measures Phytogeography: Major vegetational belts of India	22

	<p>Practical :</p> <ol style="list-style-type: none"> 1. Determination of pH of various soil and water samples 2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid soil tests 3. Determination of organic matter of different soil samples by Walkley & Black titration method 4. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each) 5. (b). Study of biotic interactions of the following: Stem parasite (<i>Cuscuta</i>), Root parasite (<i>Orobanche</i>) Epiphytes, Predation (Insectivorous plants) through specimens/ photographs 6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law 7. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus 8. Field visit 	30
	TOTAL	90

Reading List :

1. Odum, E.P. (2005). Fundamentals of ecology, Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation, Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment, Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach, Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology, PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
6. Dash, M.C., Dash, S.P. (2009). Fundamentals of Ecology, Tata McGraw Hill. 3rd edition.
7. Shukla, R.S., Chandel, P.S. (2010). A text book of Plant Ecology, S. Chand & Company Pvt. Ltd. 2nd edition.

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Classify Plants and recognize the preparation and importance of herbarium

CO2: Interpret the rules of ICN in botanical nomenclature

CO3: Assess terms and concepts related to Phylogenetic Systematics

CO4: Generalize the characters of the families according to Bentham & Hooker's system of Classification

<u>BOT CC410</u>		Plant Systematics	
PWC		(Theory: 4 credits + Practical: 2 credits)	
Unit	Topics to be covered	No. of hours	
1	Systematics, Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary) Botanical nomenclature: Idea about important rules of plant nomenclature with special reference to ICBN	30	
2	Classification of plants as proposed by Bentham & Hooker and Hutchinson	10	
3	Floral characteristics and economic importance of following families: Ranunculaceae, Asclepiadaceae, Apocynaceae, Amaranthaceae, Euphorbiaceae, Lamiaceae, Cyperaceae and Poaceae	10	
4	Phylogeny of Angiosperms: Terms and concepts primitive and advanced, homology and analogy, origin & evolution of angiosperms, methods of illustrating evolutionary relationship (phylogenetic tree, cladogram)	10	
	Practical : 1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Ranunculaceae-	30	

	<i>Ranunculus</i> , Lamiaceae- <i>Ocimum sanctum</i> , Apocynaceae- <i>Vinca rosea</i> , Amaranthaceae- <i>Achyranthus aspera</i> , Asclepiadaceae- <i>Calotropis procera</i> <i>gigantica</i> 2. Preparation of Herbarium sheets (to be submitted in the record book)	
	TOTAL	90

Reading List :

1. Singh, G. (2012). Plant Systematics: Theory and Practice, Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach, Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). Flora of Delhi, CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of Plant Systematics, Harper and Row, New York.
6. Sharma, O.P. (2016). Plant Taxonomy, McGraw Hill Education Pvt. Ltd. 2nd edition.
7. Sambamurthy, A.V.S.S. (2005). Taxonomy of angiosperms, I.K. International Pvt. Ltd. 1st edition.

SEMESTER – V

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Recall the history of reproductive biology of angiosperms & recognize the importance of genetic and molecular aspects of flower development
- CO2:** Understand structure and functions of anther wall and pollen wall, pollen biology
- CO3:** Learn detailed study of structure of pistil, megasporangium, double fertilization and endosperm
- CO4:** Comprehend the causes of Polyembryony and apomixes with its classification

<u>BOT CC511</u> Reproductive Biology of Angiosperms		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Anther: Structure and functions of anther wall, microsporogenesis, callose deposition and its significance Pollen biology: Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen viability, germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia	16
2	Ovule: Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female Gametophyte (Types of Embryo sacs) and megagametogenesis (details of <i>Polygonum</i> type); Organization and ultra structure of mature embryo sac Pollination and Fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization Endosperm: Types, development, structure and functions	28

3	Embryo: General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo	10
4	Apomixis & Polyembryony – Definition, types and applications	06
	Practical : 1. Photographs of pollen grains of families: Malvaceae, Liliaceae, Asteraceae, Poaceae 2. Study of anther, ovule, double fertilization, endosperm and embryo through photographs/ ppt 3. Models of the above topics to be submitted by the students	30
	TOTAL	90

Reading List :

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
5. Johri, B.N. Ambegaokar, K.B., Srivastava, P.S. (2015). Comparative Embryology of Angiosperms, Vol. 1 & 2. Springer. 1st edition.

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand Water relation of plants with respect to various physiological processes

CO2: Explain chemical properties and deficiency symptoms in plants

CO3: Classify aerobic and anaerobic respiration, significance of respiration and Photosynthesis

CO4: Assess dormancy and germination in plants; learn about types and roles of phytohormones

<u>BOT CC512</u> Plant Physiology		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Plant water relationship: Imbibition, diffusion and osmosis; Water Potential and its components; Active and passive transport of water and solutes; Ascent of sap; Transpiration and factors affecting transpiration, mechanism of stomatal movement and factors controlling it Transport of organic substances, path of translocation, mechanism of translocation	22
2	Mineral nutrition: Macro and micronutrients and their role in plant nutrition; nutrient uptake and transport mechanisms. role of carriers	08
3	Phytohormones: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene	16
4	Physiology of flowering: Photoperiodism and vernalization; Plant movements	14

	<p>Practical :</p> <ol style="list-style-type: none"> 1. Determination of the rate of transpiration by using Farmer's Potometer 2. Determination of the amount of water absorbed and transpired by a plant, using T/A apparatus 3. To compare the rate of imbibition of oily and starchy seeds 4. Study of effect of sugar concentrations on leaf cell by plasmolytic method <p>Demonstration experiments</p> <ol style="list-style-type: none"> 1. Bell jar experiment 2. Demonstration of osmosis using potato 	30
	TOTAL	90

Reading List :

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology, John Wiley and Sons. U. S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development, Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual, Narosa Publishing House, New Delhi.
4. Jain V. K. (2014). Fundamentals of Plant Physiology, S. Chand & Company Ltd. 16th Revised edition
5. Verma V. (2016). Plant Physiology, Athena Academic. 2nd edition.
6. Mazumdar, B.C. (2005). Photoperiodism and Vernalization in Plants, Daya Publishing House. 1st edition.
7. Mukherji, S., Gosh, A.K. (1996). Plant Physiology, New Central Book Agency (P) Ltd. 1st edition.

SEMESTER – VI

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand the anabolic and catabolic pathways of metabolism

CO2: Recognize the importance of Carbon assimilation in photorespiration

CO3: Explain the ATP-Synthesis

CO4: Interpret the Biological nitrogen fixation in metabolism

<u>BOT CC613</u>		Plant Metabolism	
PWC		(Theory: 4 credits + Practical: 2 credits)	
Unit	Topics to be covered	No. of hours	
1	Concept of metabolism, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes)	06	
2	Photosynthesis; photosynthetic apparatus, pigments, photochemical reactions, electron transport pathways in chloroplast membranes, photophosphorylation, Calvin Cycle, Crassulacean Acid Metabolism, Hatch & Slack pathway	20	
3	Respiration: Glycolysis, TCA Cycle and its regulation, electron transport in Mitochondria, oxidative phosphorylation, Pentose Phosphate Pathway	20	
4	Biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation	14	

	<p>Practical</p> <ol style="list-style-type: none"> 1. Chemical separation of photosynthetic pigments by Paper Chromatographic Technique 2. To study the effect of light intensity on the rate of photosynthesis 3. To study the effect of carbon dioxide concentration on the rate of photosynthesis <p>Demonstration experiments</p> <ol style="list-style-type: none"> 1. Moll's half leaf experiment 2. Demonstration of light-screen experiment 	30
	TOTAL	90

Reading List :

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology, John Wiley and Sons. U. S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development, Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual, Narosa Publishing House, New Delhi.
4. Jain V. K. (2014). Fundamentals of Plant Physiology, S. Chand & Company Ltd. 16th Revised edition.
5. Verma V. (2016). Plant Physiology, Athena Academic. 2nd edition.
6. Harborne, J.B. (1973). Phytochemical Methods, John Wiley & Sons. New York.
7. Pathak, V.N., Khatri, N.K., Pathak, M. (2012). Fundamental of Plant Physiology, Agribios. 5th edition.

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Understand the principle and basic protocols for Plant Tissue Culture and its application
- CO2:** Explain the blotting techniques
- CO3:** Have knowledge about fundamentals of Recombinant DNA Technology
- CO4:** Describe role of transgenic in bioremediation; Genetically engineered products and bio safety concerns

<u>BOT CC614</u> Plant Biotechnology		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Plant Tissue Culture: Basic aspect, totipotency organogenesis, micro-propagation, anther culture, and their applications, Germplasm conservation Role of plant tissue culture in growth, development and differentiation, totipotency organogenesis, embryogenesis (somatic and zygotic); Germplasm conservation, Cryopreservation	26
2	Blotting techniques: northern, southern & western blotting, DNA fingerprinting, Molecular DNA markers, ELISA, Gel Electrophoresis	18
3	Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (Roundup Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products– Human Growth Hormone; Humulin; Biosafety concerns	16

	<p>Practical</p> <p>1. (a) Preparation of MS medium (b) Demonstration of <i>in vitro</i> sterilization and inoculation methods using leaf and nodal explants of tobacco, <i>Datura</i>, <i>Brassica</i> etc</p> <p>2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs</p> <p>3. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs</p> <p>4. Models on the above mentioned topics to be submitted by the students</p>	30
	TOTAL	90

Reading List :

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice, Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA, ASM Press, Washington.
3. Singh, B.D. (2012). Biotechnology : Expanding Horizons, Kalyani Publishers, 4th edition.
4. Rana, S.V.S. (2010). Environmental Biotechnology, Rastogi Publication. 1st edition.
5. Dubey R.C. (2006). A text book of Biotechnology, S. Chand & Company Pvt. Ltd. 4th edition.
6. Trivedi, P.C. (2006). Plant Biotechnology, Perspectives and Prospects, Printer Publisher. 1st edition.

Generic Elective Papers (GE) (6 credits each)

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/ subject and vice versa and such electives may also be referred to as Generic Elective.

SEMESTER – I

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Explain the fundamental concepts related to microbes, algae, fungi and archegoniate
- CO2:** Analyze the discovery and general structure of viruses and bacteria
- CO3:** Evaluate the significance of algae and fungi and its different types
- CO4:** Analyze the anatomy and reproduction of specified bryophytes, pteridophytes and gymnosperms along with their ecological and economical importance

<u>BOT GE101</u> Biodiversity (Microbes, Algae, Fungi and Archegoniate)		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Microbes: Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance	10
2	Algae: General characteristics; Range of thallus organization and Classification of algae; Morphology and life-cycles of the following: <i>Nostoc</i> , <i>Oedogonium</i> , <i>Ectocarpus</i> , <i>Batrachospermum</i> ; Economic importance of algae	12
3	Fungi: General characteristics, range of thallus organization, nutrition,	18

	reproduction and classification; Morphology and life cycle of <i>Peziza</i> and <i>Puccinia</i> ; Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance Bryophytes: General characteristics, adaptations to land habit, Range of thallus Organization; Classification (up to family), Morphology, anatomy and reproduction of <i>Marchantia</i> , and <i>Sphagnum</i>	
4	Pteridophytes: General characteristics, Classification (up to family), Stellar evolution, morphology, anatomy and reproduction of <i>Selaginella</i> with special reference to seed habit, <i>Equisetum</i> and <i>Marsilea</i> Fossil Pteridophytes – <i>Rhynia</i> Gymnosperm: General characteristics, classification (up to family), morphology, anatomy and reproduction of <i>Cycas</i> and <i>Pinus</i> , Economic importance	20
	Practical : 1.Study of vegetative and reproductive structures of algae, fungi, bryophytes, pteridophytes and gymnosperms specified in the syllabus through temporary preparations and permanent slides 2.Models and microphotographs of viruses and bacteria	30
	TOTAL	90

Reading List :

1. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
2. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
3. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
5. Vander-Poorteri (2009). Introduction to Bryophytes,COP.
6. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms, New Age International (P) Ltd Publishers, New Delhi, India.

SEMESTER – II

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Comprehend the basic concepts of plant ecology and taxonomy and botanical nomenclature
- CO2:** Analyze the characteristics of different plant communities
- CO3:** Examine the structure and functions of eco-system
- CO4:** Analyze about environmental pollution

<u>BOT GE202</u>		
Plant Ecology and Taxonomy		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Introduction: Concept of Environment, Ecology, Biosphere, Biome, habitat, niche; Adaptation of hydrophytes and xerophytes Environmental pollution: Air pollution, water pollution, noise pollution, radioactive pollution and their control measures	20
2	Ecosystem: Structure and functions , food chains and webs, ecological pyramids Succession: Hydrosere and Xerosere	16
3	Introduction to plant taxonomy: Identification, Nomenclature; Taxonomic hierarchy and classification Botanical Nomenclature: Principles and rules (ICBN), binomial system	14
4	Classification: Types of classification-artificial, natural and phylogenetic; Bentham and Hooker (up to series), Hutchinson system of classification (up to series); A study of the diagnostic	10

	features and economic importance of following families: Apocynaceae, Amaranthaceae and Lamiaceae	
	Practical : 1. Study of morphological and anatomical adaptations of hydrophytes and xerophytes 2. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Lamiaceae- <i>Ocimum sanctum</i> , Apocynaceae- <i>Vinca rosea</i> , Amaranthaceae- <i>Achyranthus aspera</i> 3. Preparation of Herbarium sheets (to be submitted in the record book)	30
	TOTAL	90

Reading List :

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
4. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
5. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

6. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
7. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics- A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
8. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.

SEMESTER – III

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand the fundamental concepts of plant anatomy and embryology

CO2: Learn about the structural adaptations in plants growing in different environmental conditions

CO3: Analyze and recognize the different organs of plant and secondary growth

CO4: Evaluate the structural organization of flower and the process of pollination and fertilization

<u>BOT GE303</u> Plant Anatomy and Embryology		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Meristem and permanent tissue; Root and shoot meristem, simple and complex tissue	10
2	General account of adaptations in xerophytes and hydrophytes (morphological and anatomical)	10
3	Normal secondary growth; Anomalous secondary growth in <i>Tinospora</i> , <i>Boerhaavia</i> , and <i>Dracaena</i>	10

4	Structure of development of anther and pollen grain; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship	30
	Practical : 1. Study of anatomical details through permanent slides/temporary stain mounts/ Photographs 2. Study of anomalous secondary growth in <i>Tinospora</i> , <i>Bignonia</i> , <i>Boerhaavia</i> , and <i>Dracaena</i> through temporary preparations and permanent slides 3. Study of morphological and anatomical adaptations in hydrophytes and xerophytes through specimens and temporary slide preparations 4. Photographs of pollen grains 5. Study of anther, ovule, double fertilization, endosperm and embryo through photographs	30
	TOTAL	90

Reading List :

1. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy, Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy, The Benjammin/Cummings Publisher, USA.
4. Esau, K. (1977). Anatomy of Seed Plants, John Wiley & Sons, Inc., Delhi.
5. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
6. Shivanna, K.R. (2003). Pollen Biology and Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
7. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
8. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

SEMESTER – IV

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Understand Water relation of plants with respect to various physiological processes
- CO2:** Explain chemical properties and deficiency symptoms in plants
- CO3:** Classify aerobic and anaerobic respiration, significance of respiration and Photosynthesis
- CO4:** Interpret the Biological nitrogen fixation in metabolism

<u>BOT GE404</u>		Plant Physiology and Metabolism	
PWC		(Theory: 4 credits + Practical: 2 credits)	
Unit	Topics to be covered	No. of hours	
1	Plant-water relations: Transpiration and factors affecting transpiration, mechanism of stomatal movement and factors controlling it Mineral nutrition: Macro and micronutrients and their role in plant nutrition	14	
2	Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration	14	
3	Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway	14	
4	Nitrogen metabolism: Biological nitrogen fixation;	18	

	Hormone: A general account; Movements: Phototropic and Geotropic movements	
	<p>Practical</p> <ol style="list-style-type: none"> 1. Determination of the rate of transpiration by using Farmer's Potometer 2. Determination of the amount of water absorbed and transpired by a plant, using T/A apparatus 3. Chemical separation of photosynthetic pigments by Paper Chromatographic Technique 4. To study the effect of light intensity on the rate of photosynthesis 5. To study the effect of carbon dioxide concentration on the rate of photosynthesis <p>Demonstration experiments</p> <ol style="list-style-type: none"> 1. Bell jar experiment 2. Demonstration of osmosis using potato 3. Moll's half leaf experiment 4. Demonstration of light-screen experiment 	30
	TOTAL	90

Reading List :

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology, John Wiley and Sons. U. S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development, Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual, Narosa Publishing House, New Delhi.
4. Jain V. K. (2014). Fundamentals of Plant Physiology, S. Chand & Company Ltd. 16th Revised edition.
5. Verma V. (2016). Plant Physiology, Athena Academic. 2nd edition.
6. Harborne, J.B. (1973). Phytochemical Methods, John Wiley & Sons. New York.
7. Pathak, V.N., Khatri, N.K., Pathak, M. (2012). Fundamental of Plant Physiology, Agribios. 5th edition.

Ability Enhancement Compulsory Courses (AECC) (2 Credits each)

Ability Enhancement Compulsory Courses (AECC): These courses are based upon the content that leads to knowledge enhancement-(i) English/Hindi communication, (ii) Environmental Science.

SEMESTER - I

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Communicate effectively using the techniques in the area of spoken as well as written communication.

CO2: Hone their LSRW skills within their communication.

CO3: Design and answer job interview questions.

CO4: Demonstrate the ability to craft professional messages that are clear yet courteous.

<u>ENG AEC101</u>		English Communication
PWC		(Theory :2 credits)
Units	Topics to be covered	No. of hours
1	<u>Communication</u> (a) Definition of Communication (b) Stages of Communication (c) Barriers of Communication (d) Verbal and Non-verbal Communication (e) Skills of Communication – Listening, Reading, Writing, Speaking	5
2	<u>Listening Skill</u> (a) Meaning and Importance of Listening (b) Principles of Good listening	5

3	<u>Writing Skills</u> (a) Notice, Agenda, Minutes of the meeting (b) Report writing, Circulars (c) Writing Resume (d) Building vocabulary	15
4	<u>Speaking Skill</u> (a) Interview (b) Meeting (c) Situational Conversation	5
	TOTAL	30

Reading List :

1. Scot, O.; *Contemporary Business Communication*. Biztantra, New Delhi.
2. Lesikar, R.V. & Flatley, M.E.; *Basic Business Communication Skills for Empowering the Internet Generation*, Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. Ludlow, R. & Panton, F.; *The Essence of Effective Communications*, Prentice Hall Of India Pvt. Ltd., New Delhi.
4. R. C. Bhatia, *Business Communication*, Ane Books Pvt Ltd, New Delhi

HINAEC101– हिंदी-व्याकरण और सम्प्रेषण

परिणाम - 1. विभिन्न प्रतियोगी परीक्षाओं के लिए तैयार करना |

२. सम्प्रेषण-क्षमता की वृद्धि करना |

३. कार्यालयी-पत्र लेखन की क्षमता विकसित करना |

४. हिंदी के व्याकरणिक एवं सैद्धांतिक स्वरूप की जानकारी हासिल करना ||

HIN AEC101

हिन्दी व्याकरण और सम्प्रेषण

PWC

(Theory: 2 credits)

Unit	Topics to be covered	No. of hours
1	हिन्दी व्याकरण और रचना : संज्ञा, सर्वनाम, विशेषण, क्रिया, अव्यय, उपसर्ग, प्रत्यय, समास, सन्धि, पर्यायवाची शब्द, विलोम शब्द, अनेक शब्दों के लिए एक शब्द, मुहावरे एवं लोकोक्तियाँ, पल्लवन, संक्षेपण, शब्द शुद्धि, वाक्य शुद्धि, विविध प्रकार के पत्र-लेखन	15
2	सम्प्रेषण : भाषिक सम्प्रेषण : स्वरूप और सिद्धांत, संप्रेषण की अवधारणा और महत्व, संप्रेषण की प्रक्रिया, संप्रेषण के विभिन्न मॉडल, संप्रेषण की चुनौतियाँ	05
3	सम्प्रेषण के प्रकार : मौखिक और लिखित, वैयक्तिक और सामाजिक, व्यावसायिक, भ्रामक संप्रेषण, संप्रेषण बाधाएँ और रणनीति	05
4	सम्प्रेषण के माध्यम : एकालाप, संवाद, सामूहिक चर्चा, प्रभावी संप्रेषण	05
	Total :	30

SEMESTER - II

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand multidisciplinary nature of environmental studies.

CO2: Understand the concept and types of natural resources and environmental pollution.

CO3: Evaluate the anomalies created due to haphazard population growth and its impact on environment.

CO4: Understand about the organizations, conventions and legislations working on mitigation of environmental issues.

<u>EVS AEC202</u> Environmental Science		
PWC (Theory: 2 Credits)		
Unit	Topics to be covered	No. of hours
1	(a) Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance.	07

	(b) Concept of Ecosystem: - Components, Elementary Idea of Major Ecosystem:	
2	<p>(a) Natural Resources : Land, Water, Forest And Mineral Resources : Introduction; Earth's Resources and Man; Renewable and Non-Renewable Resources ; Natural Resources and Associated Problems ; Non-Renewable Resources ; Renewable Resources ; Non-Renewable Energy; Renewable Energy, Conservation of Natural Resources</p> <p>(b) Biodiversity and its conservation: Hotspots and threats to Biodiversity : Biodiversity ; Definition ;Keystone Species ; Conservation of Biodiversity ; Methods For The Conservation of Wildlife ; Hot Spots ; Types of Biodiversity ; Genetic, Species and Ecosystem Diversity, Threats to Biodiversity ; Endangered And Endemic Species ; Conservation of Biodiversity: In Situ And Ex-Situ ; Wildlife Sanctuaries and National Parks of India ; The Need for An Integrated Protected Area System (IPAS) ; Beej BachaoAndolan ; List of Biosphere Reserves in India ; Tiger Reserves in India.</p>	10
3	<p>Environmental Pollution:</p> <p>(a) Causes, Effects, and Control Measures; Types and sources of Pollution.</p> <p>(i) Air Pollution; Sources of air pollution and its impact on human health.</p> <p>(ii) Water Pollution and contamination: Introduction, Types and sources; Classification of Water Pollutants. Impact on human health</p> <p>(iii) Soil Pollution: Introduction: Contaminants and Degradation; Impact on human health.</p> <p>(iv) Noise Pollution: Effects of Noise Pollution on Physical Health; Permitted Noise Levels; Noise-Control Techniques. Impact on human health.</p> <p>(b) Public Awareness about Greenhouse Effects; Acid Rain; Effects; Ozone Layer Depletion, Ganga Action Plan (GAP); Chipko Movement; Chernobyl disaster; Bhopal Gas Tragedy.</p> <p>(c) Environment and Human Health: Outcome of Unhygienic Environmental Conditions</p>	05

4	<p>Human Population and Environment and Important Organizations:</p> <p>(a) Population Growth, Variation Among Nations : Global Population Growth ; Population Explosion – Family Welfare Program ; Urban Poverty and The Environment ; Environment and Human Health ; Environmental Health ; Examples of Linkages ; Definition of Health Impact Assessment (HIA) by WHO ; Climate and Health ; Infectious Diseases; Water borne and water related diseases, Mitigation Strategies to control adverse health impact, Role of Information Technology in Environment and Human Health.</p> <p>(b) Important Organizations : IUCN ; WWF ; BNHS ; PETA; Important Dates and Years; Some Important Environmental Conventions ; Atmospheric conventions ; Biodiversity conventions ; Land conventions ; Hazardous wastes ; Some important Acts and Notifications in India ; Environment Action Programme – India (EAP) ; Environment Protection Act ; Penalties ; Air (Prevention and Control of Pollution) Act 1981 ; Penalties ; Water (Prevention and control of Pollution) Act ; Penalties ; Wildlife Protection Act ; Penalties ; Forest Conservation Act ; Penalties ; Issues involved in enforcement of environmental legislation.</p>	08
	TOTAL	30

Reading List :

1. Chandna R. C., 2002: Environmental Geography, Kalyani Publications, Ludhiana.
2. UNEP, 2007: Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme
3. Odum, E. P. et al, 2005: Fundamentals of Ecology, Ceneage Learning India.
4. Singh S., 1997: Environmental Geography, Prayag Pustak Bhawan. Allahabad.

5. Baskar Sushmita and Baskar R. 2007 :Environmental studies for Undergraduate Courses, Unicorn Books, Bangalore

Skill Enhancement Course (SEC)(2Credits)

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide **value-based and/or skill-based knowledge**.

SEMESTER – III

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Develop Inter-religious harmony & better understanding of other religions.

CO2: Interpret the different religions of the world.

CO3: Identify the common elements that bind different religions together.

CO4: Acquaint with the salient features of different religions.

<u>PHIL SEC301</u> Inter-Religious Studies (Value Based)		
PWC (Theory :2 credits)		
Units	Topics to be covered	No. of hours
1	Nature and Need of Inter-Religious study, Scope of Comparative Religion.	05
2	Salient Features of Hinduism, Jainism and Buddhism, Salient Features of Christianity, Islam and Sikhism.	10
3	Similarities and Differences among Religions, Conflicting Truth claims of different religions and inter-religious Harmony.	10
4	Religious Tolerance, Secularism.	05
	TOTAL	30

Reading List :

1. Chaudhary, C. Neeraj (1979)-“Hinduism”,B.I.Publication,New Delhi.
2. Devraj,N.K., (1917)-“Hinduism and Christianity”Asian Publishing House.
3. Gordh, George, -“Christian Faith and its Cultural Exoperssion”, Printed in USA.
4. Hick, John, - “Philosophy of Religion”, Prentice Hall of India.
5. Hopfe, M.Lewis (1983)- “Religion of the World”, Macmillan Publishing Co. Inc, New York
6. Masih,Y. (1990)- “Comparitive study of Relgion”,Motilal Banarasidass.
7. Sethi,S. Arijit, Pummer, Reinhard, (1979)-“Comparitive Religion”, Vikas Publishing House pvt. ltd, Delhi.
8. Singh, B.N., (1994)-“Vishwa Dharma Darshan ki Samasyain”, Ratna Printing Works.
9. Tiwari, Nath Kedar,(1983)-“Comparative Religion”, Motilal Banarasidass.
- 10.Ward, CHS (1998) – ‘Early Buddhism”, Caxton Publication, Delhi.

SEMESTER – IV

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Recall various types and categories of mushrooms.

CO2: Demonstrate mushroom cultivating technology

CO3: Examine various types of food technologies associated with mushroom industry

CO4: Value the economic factors associated with mushroom cultivation

<u>BOT SEC 402</u> Mushroom Culture Technology		
PWC (Theory + Practical :2 credits)		
Unit	Topics to be covered	No. of hours
1	Introduction, history; Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms; Types of edible mushrooms available in India- <i>Volvariella volvacea</i> , <i>Pleurotus citrinopileatus</i> , <i>Agaricus bisporus</i>	05
2	Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, composting technology in mushroom production	10
3	Storage and nutrition: Short-term storage (Refrigeration – up to 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions; Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins	06

4	Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level; Cost benefit ratio - Marketing in India and abroad, Export Value.	05
	Practical 1. Mushroom cultivation	04
	TOTAL	30

Reading List :

1. Pathak V. N., Yadav N. and Gaur M. (2013). Mushroom production and processing technology, Agrobios (India), Jodhpur.
2. Dey S. C. (Reprint 2010). Gardening Series. Mushroom Growing, Agrobios (India).
3. Quaesitor P. (2015). Magic Mushroom Grower's Guide- Simple Steps to Bulk Cultivation, The Psychonautical Society.
4. Anantanarayanan R., Nimmagadda J. (2006). A hand book of Research Process, McMillan Publishers India Ltd. 3rd edition.
5. Janarthanan, S., Vincet, S. (2009). Practical Biotechnology, Universities Press Pvt. Ltd. 1st edition.

Discipline Specific Elective (DSE) (6 credits each)

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

SEMESTER – V

Course Outcomes

After the completion of the course, the student will be able to:

CO1: Understand the patterns of inheritance in different organisms

CO2: Outline basics of linkage of genes, sex determination and quantitative inheritance

CO3: Examine the methods of crop improvement

CO4: Describes the various methods of plant propagation and its importance in human welfare

<u>BOT DSE501</u>		
Genetics and Plant Breeding		
PWC (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Heredity: Brief life history of Mendel; Terminologies; Laws of Inheritance; Modified Mandelian Ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7, 9:6:1, 9:3:4, 12:3:1, 13:3 and 15:1; Chi Square; Pedigree Analysis; Male sterility; Multiple allelism; Pleiotropism; Chromosome theory of Inheritance, Balance theory Quantitative inheritance: Concept, mechanism, examples; Monogenic vs polygenic Inheritance	22
2	Linkage and Crossing over: Linkage: concept & history; complete & incomplete linkage, bridges experiment, coupling & repulsion,	10

	recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over; Sex-determination and Sex-linked Inheritance	
3	Mutations and Chromosomal Aberrations: Types of mutations, effects of physical & chemical mutagens Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions and Translocations	10
4	<p>Plant Breeding: Introduction and objectives; Breeding systems: modes of reproduction in crop plants; Important achievements and undesirable consequences of plant breeding</p> <p>Methods of crop improvement: Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations</p> <p>Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement</p> <p>Inbreeding depression and heterosis: History, genetic basis of inbreeding depression and heterosis; Applications</p>	18

	<p>Practical :</p> <ol style="list-style-type: none"> 1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis 2. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 9:3:4, 12:3:1, 13:3 and 15:1) 3. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs 4. Hybridization techniques - Emasculation, Bagging (For demonstration only) 	30
	TOTAL	90

Reading List :

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics, 8th Ed. Wiley - India.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, W. H. Freeman and Co., U.S.A. 10th edition.
5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.
6. Singh, B.D. (2005). Plant Breeding: Principles and Methods, Kalyani Publishers. 7th edition.
7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding, Oxford - IBH. 2nd edition.
8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding, Blackwell Publishing.

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Comprehend the fundamental concepts related to descriptive and inferential biostatistics
- CO2:** Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data
- CO3:** Analyze the implications of inferential statistics in biology
- CO4:** Develop the competence in hypothesis testing and interpretation

Unit	Topics to be covered	No. of hours
1	Biostatistics: Definition, statistical methods-basic principles Variables -measurements, functions, limitations and uses of statistics Collection of data (primary and secondary), types and methods of data collection, merits and demerits; Classification of data, tabulation and presentation, sampling methods	24
2	Measures of central tendency - mean, median, mode, geometric mean - merits & Demerits; Measures of dispersion - range, standard deviation, mean deviation, quartile deviation –merits and demerits; Co- efficient of variations	14
3	Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression	12
4	Statistical inference - hypothesis - simple hypothesis - student 't' test - chi square test	10
	Practical : 1. Calculation of mean, standard deviation and standard error 2. Calculation of correlation coefficient values and finding out the probability 3. Calculation of 'F' value and finding out the probability value for the F value	30
	TOTAL	90

Reading List :

1. Dannel, W.W. (1987). Biostatistics, New York, John Wiley Sons.
2. Selvin, S. (1991). Statistical Analysis of epidemiological data, New York University Press.
3. Campbell, R.C. (1998). Statistics for Biologists, Cambridge University Press.
4. Arora, P.N. Malhan, P.K. (2006). Biostatistics, Himalaya Publishing House. 9th edition.
5. Pagano, M. Gauvrean K. (2004). Principles of Biostatistics, Duxbury. 1st edition.
6. Bhuyan, K.C. (2017). Advanced Biostatistics, New Central Book Agency (P) Ltd. 1st edition.

SEMESTER – VI

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Understand the concept of research and different types of research in the context of biology
- CO2:** Develop laboratory experiment related skills
- CO3:** Develop competence on data collection and process of scientific documentation
- CO4:** Analyze the ethical aspects of research

<u>BOT DSE603</u>		
Research Methodology		
PWC (Theory:4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	Basic concepts of research: Research-definition and types of research (Descriptive vs. analytical; applied vs. fundamental; quantitative vs. qualitative; conceptual vs. empirical); Research methods vs. methodology; Literature-review and its consolidation; Library research; field research; laboratory research; Key biology research areas	16
2	General laboratory practices: Common calculations in botany laboratories; Understanding the details on the label	16

	of reagent bottles; Molarity and normality of common acids and bases; Preparation of solutions; Dilutions; Percentage solutions; Molar, molal and normal solutions; Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling	
3	Data collection and documentation of observations: Maintaining a laboratory record; Tabulation and generation of graphs; Imaging of tissue specimens and application of scale bars; The art of field photography	08
4	The art of scientific writing and its presentation: Numbers, units, abbreviations and nomenclature used in scientific writing; Writing references; Powerpoint presentation; Poster presentation; Scientific writing and ethics; Introduction to copyright-academic misconduct/plagiarism	20
	Practical : 1. Experiments based on chemical calculations 2. The art of imaging of samples through microphotography and field photography 3. Poster presentation on defined topics 4. Technical writing on topics assigned	30
	TOTAL	90

Reading List :

1. Narayana P. S., Varalakshmi D. and Pullaiah T. (2016). Research Methodology in Plant Sciences, Scientific Publisher.
2. Arumugam N. (2015). Research Methodology, Saras Publication.
3. Napoleon D. (2014). Research Methodology: A Theoretical Approach, Laxmi Publication.
4. Sadasivam, S., Manickam, A. (2011). Biochemical Methods, New Age International Publishers. 3rd edition.
5. Raman. A., Mimmagadda J. (2009). A hand book of Research Process, McMillan Publishers India Pvt. Ltd. 1st edition.
6. Bhaskar A. (2014). Biochemical Methods : A Practical Approach, Narosa Publishing House. 1st edition.

Course Outcomes

After the completion of the course, the student will be able to:

- CO1:** Acquire special/advanced knowledge through a project work with an advisory support by a teacher/faculty member
- CO2:** Apply knowledge involving / analyzing /exploring a real life situation / difficult problem
- CO3:** Enhance presentation (oral and writing) skills
- CO4:** Practical work in the field and laboratory experiments will enhance skills in handling scientific instruments

<u>BOT DS604</u> Dissertation (6 Credits)		
PWC		
Unit	Topics to be covered	No. of hours
1	<p>Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6th Semester.</p> <p>Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his/her own with an advisory support by a teacher/ faculty member is called dissertation/project.</p> <p>Project work/Dissertation is considered as a special course involving application of knowledge involving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper</p>	
	TOTAL	90