CHRIST COLLEGE
(AUTONOMOUS) IRINJALAKUDA - KERALA

PG DEPARTMENT OF BOTANY

M. Sc. BOTANY COURCE PLAN

2020-2021

EVEN SEMESTER

Coordinator: Prof. E. J. Vincent

SECOND SEMESTER

PG DEPARTMENT OF BOTANY

M. Sc. BOTANY COURCE PLAN

2020-2021

CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

M. Sc. Programme in Botany (CBCSS) (from 2020 admissions onwards)

Programme, structure of courses and distribution of credits

SECOND SEMESTER

Sl. No.	Course	Title	Contact Hours	Credits	Internal	External	Total Credits
1.	**Core**	**BOT2C04:** Cell Biology, Molecular Biology and Biophysics	6	5	20%	80%	5
2.	**Core**	**BOT2C05:** Cytogenetics, Genetics, Biostatistics, Plant Breeding and Evolution	6	5	20%	80%	5
3.	**Core**	**BOT2C06:** Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	6	5	20%	80%	5
4.	**Core Practical**	**BOT2L03:** Practicals of Cell Biology, Molecular Biology, Biophysics and cytogenetics	3	2.5	20%	80%	2.5
5.	**Core Practical**	**BOT2L04:** Practicals of Genetics, Biostatistics, Plant Breeding, Plant Ecology, Conservation Biology, Phytogeography and Forest Botany	3	2.5	20%	80%	2.5
6.	**Seminar**		1	-	-	-	-
	Total		**25**	**-**			**5**

BOT2C04: CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOPHYSICS

(2.5+1.5+1+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

a) *To familiarize student with the structure of the biomolecules found in all living organisms.*
b) *To develop knowledge among students how RNA, DNA and proteins are synthesized.*
c) *To develop skills to choose appropriate biophysical methods to characterize biological systems and appreciate their limitations.*

Cell Biology

Module I: **(4 Hours)**

The nucleus. Interphase nucleus- Chromatin organization- nucleosomes, scaffold. Organization of eukaryotic chromosome. Heterochromatin- constitutive, facultative and condensed. Euchromatin. Satellite DNA. Chromosome banding and its significance.

Module II: **(5 Hours)**

Cell reproduction: Cell cycle. Specific events G1, S, G2 and M phases. Significance of G0. Control of cell cycle. Significance. Gene expression during cell cycle. Mitotic Inducers

Module III: **(5 Hours)**

Meiosis: types, synaptonemal complex, significance of meiosis. Genetic control and consequences of meiosis. Restriction points and check points. Cell cycle regulation of meiotic events- behaviour of sex chromosomes in meiosis- suppression of DNA replication between Meiosis I and II. Meiotic defects and human diseases.

Module IV: **(5 Hours)**

Programmed cell death- necessity, classes, signals. Genetic analysis of cell death. Proteins regulating apoptosis. Pathways leading to cell death- significance. Aging- cellular and extracellular. Cell signaling.

Module V: **(3 Hours)**

Cell interactions-communication, recognition and adhesion. Application.

Module VI: **(5 Hours)**

Cellular differentiation and specialization. General characteristics, intrinsic interactions- Nucleo-cytoplasmic. Extrinsic interactions. Molecular mechanisms of cellular differentiations.

Module VII: **(5 Hours)**

Cancer- carcinogenic agents. Phenotype of the transformed cell. Genetic basis of malignant transformation- oncogenes. Tumor suppressor genes. Cancer and cell cycle. Metastasis. Interaction of cancer cells with normal cells.

References:

1. Cooper Jeffrey M. The Cell- A Molecular Approach. ASM, Washington.
2. Karp Gerald. Cell Biology. JohnWiley and Sons.
3. Derobertis. Cell and Molecular Biology.
4. Sadava R.
5. Pollard T.D. and Earn Shaw W.C. Cell Biology. Saunders.

Molecular Biology

Module I: **(3 Hours)**

Molecular biology of gene: Structure of DNA: Repetitive DNA; c-value paradox.

Module II: **(8 Hours)**

Replication of DNA: Enzymology of replication. Replication in prokaryotes and eukaryotes. Primosomes and replisomes. Telomerase and its function.

Module III: **(4 Hours)**

Gene expression: regulation of gene expression- Operon concept- Gene regulation in prokaryotes and eukaryotes- enhancers and silencers.

Module IV: **(7 Hours)**

Protein synthesis: Transcription, post-transcriptional events. Introns and their significance. Translation. Post translational events. Role of chaperons.

Module V: **(4 Hours)**

Mutation: Spontaneous and induced. Physical and chemical mutagens. Molecular mechanism of mutation. Mutation and cancer. Mutator and antimutatór genes. DNA repairing mechanisms.

Module VI: **(6 Hours)**

Molecular evolution: The origin of genomes. Evolution of new genes. Origin of eukaryotic genomes. Phylogenetics. Application of molecular phylogenetics.

References:

1. Lewin Benjamin. Genes. Oxford University press.
2. Brown TA. Genomes. John Willey and Sons.
3. Snustad, Simmons and Jenkins. Principles of Genetics. John Willey and Sons.
4. Weaver and Hendrick. Genetics. Wm. C. Brown Publishers.
5. Hawkins J.D. Gene Structure and Expression. Cambridge University Press.

Biophysics

Module I: **(3 Hours)**

pH and buffer solutions- hydrogen ion concentrations and pH, dissociation of acids and bases. Measurement of pH using organic indicator molecule and potentometric method. Functions of buffers in a biological system. Use of buffers in biological and biochemical research. pH and life. Henderson and Hasselbalch equation

Module II: **(1 Hours)**

Chromatography: Principles of chromatography. Types of chromatography (Brief account).

Module III: **(3 Hours)**

Electrophoresis: Electrophoretic mobility, principles, PAGE, Agarose gel electrophoresis. Separation and detection of macromolecules by electrophoresis. Electrophoretic apparatus, technique and procedure

Module IV: **(2 Hours)**

Centrifugation - Theory of centrifugation. Centrifuge- Types, Methodology of centrifugation, applications.

Module V: **(2 Hours)**

Colorimetry and spectrophotometry: Beer-Lamberts law. Measurement of extinction. Calorimeters and spectrophotometers. Techniques and applications in biological and biochemical research. Comparison between colorimetry and spectrophotometry.

Module VI: **(2 Hours)**

Radioblology: Autoradiography. principles, types. Methods and applications in biological Research.

Module VI: **(1 Hour)**

immunochemistry: immune response. Antigens- Antibodies. Histo-incompatibility antigens; Structure of IgG. immunochemical assays - RIA, ELISA.

Module VII: **(1 Hour)**

Cryobiology: Freeze drying (lyophilization) - applications.

References:

1.Hoppe, W. (Ed.). Biophysics. Springer Verlag.
2.Rogers, A.W. Techniques of Autoradiography.
Elsevier.
3.Roy, R.N. A Text Book of Biophysics. New Central Book Agency Pvt.
Ltd, Calcutta. Sasidharan, A. Selected Topics of Biophysics. Frontier Area
Publishers.
4.Slayter, E.M. Optical methods in Biology. Wiley Intersciences.
5.Wong, C.H. Radiation Tracer Methodology in Biophysical Sciences.
6.Prentice Hall. Plummer, D. An introduction to Practical Biochemistry.
Tata Mc Graw Hill, New Delhi.

BOT2C04: CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOPHYSICS

(2.5+1.5+1+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

a) *To familiarize student with the structure of the biomolecules found in all living organisms.*
b) *To develop knowledge among students how RNA, DNA and proteins are synthesized.*
c) *To develop skills to choose appropriate biophysical methods to characterize biological systems and appreciate their limitations.*

LESSON PLAN: CELL BIOLOGY

Unit/ session/ hours (time Required	*Topics for student preparation (input)*	*Procedure (process) Student centric Method of teaching*	*Activity*	*Learning outcome (output*	*Assessment*
Module I The nucleus [4 hours]	Structure and organization of nucleus,Heterochromatin and Euchromatin. SatelliteDNA. Chromosome banding.	• Lecture • Discussion • **Experimental learning**	Lab sessions on cell divisions (Onion and Rheo)	To understand cell divisions and structure of chromosomes	Evaluation through test paper and Lab specimen preparations
Module II Cell reproduction [5 hours]	Cell cycle and events G1, S, G2 and M phases Gene expression during cell cycle and Mitotic Inducers.	• Lecture • Discussion • **Experimental learning**	Lab sessions on Cell divisions along with Inducer treatments. (Onion and Rheo)	To understand cell divisions and Endomitosis	Evaluation through test paper and Lab specimen preparations
Module III Meiosis [5 hours]	Types, Synaptonemal complex, Cell cycle regulation of meiotic events- behaviour of sex chromosomes Meiotic defects and human diseases	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the role of cell cycle regulations in meiosis and their importance in Human diseases	Evaluation through test paper

Module IV Programmed cell death [5 hours]	Genetic analysis and Pathways leading to cell death. Proteins regulating apoptosis. Aging and Cell signaling	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance of apotosis in ageing and cell signaling	Evaluation through test paper
Module V Cell interactions [5 hours]	Events in cell interactions-communication, recognition and adhesion.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the events in cell interactions	Evaluation through test paper
Module VI Cellular differentiation and specialization [5 hours]	General characteristics, intrinsic and Extrinsic interactions. Molecular mechanisms of cellular differentiations.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance of cellular differentiation s	Evaluation through test paper
Module VII Cancer [5 hours]	Carcinogenic agents. Genetic basis of malignant transformation-oncogenes. Tumor suppressor genes. Cancer and cell cycle. Metastasis. Interaction of cancer cells with normal cells.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the causes, mechanisms and the genes involved in Cancer.	Evaluation through test paper

LESSON PLAN: MOLECULAR BIOLOGY

Unit/ session/ hours (time Required	***Topics for student preparation (input)***	***Procedure (process) Student centric Method of teaching***	***Activity***	***Learning outcome (output***	***Assess ment***
Module I Molecular biology of gene [3 hours]	Structure of DNA: Repetitive DNA; c-value paradox.	• Lecture • Lecture with animation videos from U-tube • Discussion • **Problem**	Group discussion	To understand the structure of DNA and its molecular organization.	Evaluati on through test paper and MCQ

		solving			
Module II Replication of DNA 8 hours	Enzymology, Replication in prokaryotes and eukaryotes. Primosomes and replisomes. Telomerase and its function	• Lecture • Discussion • Lecture with animation videos from U-tube • **Participative learning**	Group discussion	To understand Replicative mechanism in prokaryotic and Eukaryotic mechanism.	Evaluation through test paper and MCQ
ModuleIII Gene expression [4 hours]	Regulation of gene expression- Operon concept- Gene regulation in prokaryotes and eukaryotes- enhancers and silencer	• Lecture • Discussion • Lecture with animation videos from U-tube • **Participative learning**	Group discussions	To understand Gene regulation in prokaryotes and eukaryotes	Evaluation through test paper and MCQ
Module IV Protein synthesis [7 hours]	Transcription, post-transcriptional events. Introns and their significance. Translation. Post translational events. Role of chaperons	• Lecture • Discussion • Lecture with animation videos from U-tube • **Participative learning**	Group discussions	To understand Transcription and Translation in Prokaryotes and Eukaryotes.	Evaluation through test paper and MCQ
Module V Mutation [4 hours]	Definitions and Types Molecular mechanism of m mutation. Mutation and cancer. Mutator and antimutatór genes. DNA repairing mechanisms.	• Lecture • Discussion • Lecture with animation videos from U-tube • **Participative learning** •	Group discussions	To understand Mutation and molecular mechanisms	Evaluation through test paper and MCQ
Module VI Molecular evolution	The origin of genomes. Evolution of new genes. Origin of eukaryotic genomes. Phylogenetics.	• Lecture • Discussion • **Participativ**	Group discussions	To understand the origin and evolution genomes and	Evaluation through test

6 hours	Application of molecular Phylogenetics.	**e learning**		significance of Molecular Phylogenetics.	paper and MCQ

LESSON PLAN: BIOPHYSICS

Unit/ session/ hours (time Required	*Topics for student preparation (input)*	*Procedure (process) Student centric Method of teaching*	*Activity*	*Learning outcome (output)*	*Assessment*
Module I pH and buffer solutions [3 hours]	Hydrogen ion concentrations and pH, dissociation of acids and bases. Measurement of pH using organic indicator molecule and potentometric method. Functions of buffers in a biological system. Use of buffers in biological and biochemical research. pH and life. Henderson and Hasselbalch equation.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand pH and buffer solutions	Evaluation through test paper
Module II Principles of chromatography [1 hours]	Definitions and Types of chromatography	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the Principles of chromatography	Evaluation through test paper
Module III Electrophoresis [3 hours]	Electrophoretic mobility, principles, PAGE, Agarose gel electrophoresis. Separation and detection of macromolecules by electrophoresis. Electrophoretic apparatus,	• . Lecture • Discussion • **Participative learning**	Group discussions	To understand the principle and mechanism of Electrophoresis:	Evaluation through test paper
Module IV Colorimetry and spectrophotometry [2 hours]	Beer-Lamberts law. Measurement of extinction. Calorimeters and spectrophotometers. Techniques and applications in biological and biochemical research. Comparison between colorimetry and spectrophotometry	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the technique and mechanism of colorimetry	Evaluation through test paper

Module VI Radioblology [2 hours]	Autoradiography. principles, types. Methods and applications in biological research.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand The principles, types. Methods and applications of Autoradiography.	Evaluation through test paper
Module VII immunochemistry [2 hours]	Immune response. Antigens- Antibodies. Histo-incompatibility antigens; Structure of IgG. immunochemical assays - RIA, ELISA.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand The mechanism of Immunobiology	Evaluation through test paper
Module VIII Cryobiology [1 hour]	Freeze drying (lyophilization) - applications	• Lecture • Discussion • **Participative learning**	Group discussions	To understand The significance of Cryobiology	Evaluation through test paper

COURSE OUTCOME

The students who complete this course will be able to:

CO	CO Statement
CO1	Analyses the dynamics of chromosome behavior and its interactions.
CO2	Evaluate the central dogma of life.
CO3	Evaluate the concept of biophysical techniques of instrumentation.
CO4	Describe the knowledge of biophysics and molecular biology in research studies.
CO5	Explain the role of various cell organelles and developed knowledge about various phases of cell division
CO6	Apply the knowledge of molecular evolution to decipher the phylogeny of gene families

BOT2C04: CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOPHYSICS

(2.5+2.5+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

UNITWISE BREAK UP: CELL BIOLOGY

LECTURE HOURS: 32

OBJECTIVES:

a) To understand the basic organization of the cell, cell cycle and its components and the molecular basis of cellular function
b) To acquaint the students with DNA topology and chromatin structure
c) To understand the process of cell communication and signaling.

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**The nucleus**	**4**	To read about nucleus and chromosome organization	Lecture and Discussion	To make short notes on interphase nucleus, chromosome organization and banding techniques.
Unit – 1	Interphase nucleus				
Unit – 2	Organization of eukaryotic chromosome				
Unit – 3	Satellite DNA				
Unit – 4	Chromosome banding and its significance				
Module II:	**Cell reproduction**	**5**	To understand cell cycle and events	Lecture and Discussion	To make short notes on Cell cycle and Specific events.
Unit – 1	Cell cycle and Specific events (G1, S, M and G0)				
Unit – 2	Gene expression during cell cycle.				
Unit – 3	Mitotic Inducers.				
Module III:	**Meiosis**	**5**	To learn about stages of Meiosis	Lecture and Discussion	To make short notes Meiosis and genetic defects
Unit – 1	MeoisisTypes significance of meiosis.				
Unit – 2	Synaptonemal complex,				
Unit – 3	Restriction points and check points and Cell cycle regulation of meiotic events-				
Unit – 4	Behaviour of sex chromosomes in				

	meiosis- suppression of DNA replication between Meiosis I and II				
	Meiotic defects and human diseases				
Module IV:	**Programmed cell death**.	**5**	To understand Programmed cell death	Lecture and Discussion	To make short notes on Programmed cell death.
Unit – 1	Necessity of Programmed cell death, classes, signals. Genetic analysis of cell death				
Unit – 2	Proteins regulating apoptosis				
Unit – 3	Pathways leading to cell death- significance.				
Unit – 4	Aging- cellular and Extracellular				
Unit – 5	Cell signaling.				
Module V:	**Cell interactions.**	**3**	To learn about Cell interactions**.**	Lecture and Discussion	To make short notes on Cell interactions
Unit – 1	Communication, recognition and adhesion				
Unit – 2	Application.				
Module VI:	**Cellular differentiation and specialization**.	**5**	To learn about Cellular differentiation and specialization	Lecture and Discussion	To make short notes on Cellular differentiation and specialization
Unit – 1	General characteristics of Cellular differentiation and specialization				
Unit – 2	Intrinsic (Nucleo-cytoplasmic) and Extrinsic interactions				
	Molecular mechanisms of cellular differentiations				
Module VII:	**Cancer**	**5**	To learn about causes and mechanisms of Cancer	Lecture and Discussion	To make short notes on Cancer
Unit – 1	Carcinogenic agents and Phenotype of the transformed cell				
Unit – 2	Genetic basis of malignant transformation (oncogenes and Tumor suppressor genes)				

Unit – 3	Cancer and cell cycle.				
Unit – 4	Metastasis. Interaction of cancer cells with normal cells.				

UNITWISE BREAK UP: MOLECULAR BIOLOGY

LECTURE HOURS: 32

OBJECTIVE:

a) To acquaint the students with DNA structure and their effect on the processes of DNA replication, repair, and transcription.
b) To facilitate the learner in solving problems related to molecular biology.
c) To Understand the central dogma of life.

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Molecular biology of gene.**	**3**	To understand Structure of DNA	Lecture and Discussion	To make short note on Structure of DNA Problems related to DNA structure
Unit – 1	Structure of DNA:				
Unit – 2	Repetitive DNA				
Unit – 2	c-value paradox				
Module II:	Replication of DNA.	**8**	To learn about DNA replication in Prokaryotes and Eukaryotes	Lecture and Discussion	To make short note Replication of DNA. Word Problems related to DNA Replication
Unit – 1	Enzymology of replication.				
Unit – 2	Replication in prokaryotes and eukaryotes				
Unit – 3	Primosomes and replisomes				
Unit – 4	Telomerase and its function.				
Module III:	**Gene expression**: -	**4**	To understand Gene expression in prokaryotes and eukaryotes	Lecture and Discussion	To make short note on Gene expression
Unit – 1	regulation of gene expression- Operon concept				
Unit – 2	Gene regulation in prokaryotes and eukaryotes-				
Unit – 3	enhancers and silencers				
Module IV:	**Protein synthesis**			Lecture and	

Unit – 1	Transcription and post-transcriptional events	**7**	To understand Protein synthesis	Discussion	To make short note on Protein synthesis
Unit – 2	Introns and their significance.				
Unit – 3	Translation and Post translational events				
Unit – 4	Role of chaperons				
Module V:	**Mutation.**	**4**	To understand significance of mutation and repairing mechanisms and its role in cancer	Lecture and Discussion	To make short note Mutation**.**
Unit – 1	Types of Mutation-Spontaneous and induced, Physical and chemical mutagens.				
Unit – 2	Molecular mechanism of mutation.				
Unit – 3	Mutation and cancer. Mutator and antimutatór genes				
Unit – 4	DNA repairing mechanisms.				
Module VI	Molecular evolution	**6**	To understand Molecular evolution	Lecture and Discussion	To make short note Molecular evolution
Unit – 1	The origin of genomes				
Unit – 2	Evolution of new genes				
Unit – 3	Origin of eukaryotic genomes				
Unit – 4	Phylogenetics. Application of molecular phylogenetics				

UNITWISE BREAK UP: BIOPHYSICS

LECTURE HOURS: 16

OBJECTIVE:

a) *To acquaint the students about knowledge of biophysics and molecular biology in research studies.*
b) *To understand the biophysical techniques of instrumentation.*

Module Number	*Topic*	*No. of Lecture Hours*	*Pre-class activity*	*Pedagogy (in class)*	*Out of class assignment*
Module I:	**pH and buffer solutions**.	**3**	To understand pH and Buffer systems	Lecture and Discussion	To make short note on pH and buffer solutions
Unit – 1	hydrogen ion concentrations and pH, dissociation of acids and bases				
Unit – 2	Measurement of pH using organic indicator molecule and potentometric method				
	Functions of buffers in a biological system.				
	Use of buffers in biological and biochemical research				
	pH and life				
	Henderson and Hasselbalch equation				
Module II:	**Chromatography**	**1**	To understand Principle and Types of Chromatography	Lecture and Discussion	To make short notes on Chromatography
Unit – 1	Principle				
Unit – 2	Types of chromatography				
Module III:	**Electrophoresis**	**3**	To understand Principles of Electrophoresis	Lecture and Discussion	To make short note on Electrophoresis
Unit – 1	Electrophoretic mobility and principles				
Unit – 2	PAGE,				
Unit – 3	Agarose gel electrophoresis.				
Unit – 4	Separation and detection of macromolecules by electrophoresis.				
Unit – 5	Electrophoretic apparatus				
Unit – 6	Electrophoresis- Technique and procedure				
Module IV:	**Centrifugation**	**2**	To understand Methodology of Centrifugation	Lecture Illustration Discussion	To make short note on Centrifugation
Unit – 1	Theory of centrifugation.				
Unit – 2	Centrifuge- Types				
Unit – 3	Methodology of				

	centrifugation				
Unit – 4	applications.				
Module V:	**Colorimetry and spectrophotometry.**	**2**	To understand the principles of Colorimetry and spectrophotometry	Lecture Illustration Discussion	To make short note on Colorimetry and spectrophotometry
Unit – 1	Beer-Lamberts law.				
Unit – 2	Measurement of extinction				
Unit – 3	Calorimeters and spectrophotometers				
Unit – 4	Techniques and applications in biological and biochemical research.				
Unit – 5	Comparison between colorimetry and spectrophotometry				
Module VI:	**Radioblology**	**2**	To learn about Radiobiology	Lecture and Discussion	To make short note on Radiobiology
Unit – 1	Autoradiography-. principles, types. Methods				
Unit – 2	Autoradiography-applications in biological research.				
Module VII:	**Immunochemistry**	**2**	To understand Immunochemistry	Lecture Illustration Discussion	To make short note on Immune response
Unit – 1	Immune response				
Unit – 2	Antigens-Antibodies.				
Unit – 3	Histo-incompatibility antigens				
Unit – 4	Structure of IgG.				
Unit – 5	immunochemical assays - RIA, ELISA.				
Module VII:	**Cryobiology**	**1**	To understand Cryobiology	Lecture and Discussion	To make short note on Cryobiology
Unit – 1	Freeze drying (lyophilization) and Its applications				

Teacher in Charge: Mrs. Sweety M. S.

BOT2C05: CYTOGENETICS, GENETICS, BIOSTATISTICS, PLANT BREEDING AND EVOLUTION

(1+1.5+1.5+1+1 = 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

To study concepts of genetics,interaction of gene, different types of chromosomes, plant breeding techniques for crop improvement, statistical tools for analysis, interpretation and visualisation of data and concepts of evolution.

Cytogenetics

Module 1: **(8 hours)**

Cytogenetics of aneuplolds, euploids and structural heterozygotes: Effect of aneuploidy on phenotype. Transmission of monosomics and trisomics and their uses. Breeding behaviour and genetics of structural heterozygotes; translocation heterozygotes; Robertsonian translocation; B-A translocation. Karyotype- concepts and its importance. Structural chromosome aberrations- types and significance in evolution. Heteroploidy, aneuploidy, monosoly, trisomy (primary, secondary, tertiary and compensating). Nullisomy. Uses of aneuploidy in cytogenetics. Euploidy- autoploidy, alloploidy and segmental alopolyploicdiploidization. Role of aneuploidy and euploidy in evolution.

Module 2: **(4 hours)**

Molecular cytogenetics: Multigenic families and their evolution; in situ hybridization-concept. Computer assisted chromosome analysis, chromosome micro-dissection and micro-cloning; flowcytometry.

Module 3: **(1 hour)**

Polytene and lampbrush chromosomes- cytogenetic importance.

Module 4: **(1 hour)**

Supernumerary chromosomes: B-chromosomes.

References:

1. Alberts B., D. Bray, J. Lewis, K. Roberts and J.D.Watson. Molecular Biology of the Cell Gartand Publishing Inc. NewYork.
2. AtherlyA.G. ,J.R .Girtonand J.F. McDonald. TheScience of Genetics. SaundersCollegePublishing, Fort Worth, USA.
3. Burnharm C.R. Discussions in Cytogenetics. Burgess Publishing Co.,Minnesota.
4. De RobertisE.D.P. and De RobertisE.M.F. Cell and Molecular Biology ISBN, HongKong.
5. Dupraw E.J. DNA and Chromosomes. Holt, Rinehart and Winston lnc. NewYork.
6. Hart D.L and E.W. Jones. Genetics: Principles andAnalysis. Jones & Bartlett publishers, Massachusetts, USA.
7. Khush, G.S. Cytogenetics of Aneuploids. AcademicPress.

8. Karp G. Celland Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc.USA.
9. Lewin B. Gene. Oxford University Press, New York,USA.
10. Lewis R. Human Genetics: Concepts and Applications. WCB McGraw Hill,USA.
11. MalacinskiG.MandD.Freifelder.EssentialsofMolecularBiology.JonesandBastletPublisherslnc.,London
12. Rieger R., A.Michaelis and M.M.Green Glossary of Genetics and Cytogenetics -Classical and Molecular. Springer-Verlag, NewYork.
13. Swanson C.P., T. Merz, and J.W.Young. Cytogenetics. PrenticeHall.

Genetics

Module I: **(1hours)**

Relevance of Mendelism in modern genetics. A critical evaluation of Mendelism on the basis of modern concept of genes.

Module II: **(6 hours)**

Linkage and gene mapping. Three- point test cross; linkage map; interference; tetrad analysis and centromere mapping. Linkage in humans. Pedigree analysis. Genetic recombination and mapping of genes in bacteria and bacteriophages.

Module III: **(3 hours)**

Mobile genetic elements: Transposable elements in bacteria. lS elements. Tn elements. Compsite transposon. Cepia and P elements in Drosophila. Ac, DS and Mu elements in maize. Retrotransposons- Molecular characteristics and significance in development and evolution.

Module IV: **(2 hours)**

Extranuclear inheritance: Analysis of mitochondrial and chloroplast genomes and their utility. Cytoplasmic male sterility.

Module V: **(2 hours)**

Quantitative genetics: Polygenic inheritance, heritability and its measurements. QTL mapping.

Module VI: **(2 hours)**

Population genetics: Systems of mating. The Hardy- Weinberg principle . Estimation of gene frequencies. Factors affecting equilibrium: natural selection, mutation, migration and genetic drift.

Module VII: **(3 hours)** Human genetics: Human pedigree analysis, Lod score for linkage testing. Karyotype; genetic disorders.

References:

1. Snustad, Simmons and Jenkins. Principles of Genetics. John Willey and Sons. Weaver and Hendrck. Genetics. Wm. C Brown Publishers.
2. Goodenough. Genetics. Saunders College Publishing. Stansfield. Theory and Problems of Genetics. Mc Grow Hills. Strlckberger.
3. Genetics. Macmillan.

3. Burnet L.Essential Genetics. Cambridge University Press. Friefelder. Microbial Genetics. Narosa Publishing House.
4. Gardner, Simmons and Snustad. Principles of Genetics.John Wiley and Sons, New York, USA. Singh B.D. Fundamental of Genetics. Kalyani Publishers, New Delhi.

Biostatistics

Module I: **(1 hour)**

The science of statistics and its applications in biological research.

Module II: **(1 hour)**

Types and collection of data- Census and sampling- theory and methods.

Module III: **(2 hours)**

Tabulation and presentation of data- diagrammatic and graphic presentation.

Module IV: **(2 hours)**

Analysis of data- central tendencies.

Module V: **(2 hours)**

Measures of dispersion - Range, quartile deviation, mean deviation, standard deviation and standard error. Relative measures of dispersion - coefficient of variation.

Module VI: **(2 hours)**

Tests of significance- formulation and testing of hypothesis- testing the probability of committing type 1 and type 2 errors. z test, t test, chi-square test.

Module VII: **(2 hours)**

Analysis of variance- one way classification and two-way classification, F test, F value calculation, F table.

Module VIII: **(2 hours)**

Correlation and Regression analysis- coefficient of correlation- significance testing. Rank correlation. Lines of regression- coefficient of regression

Module IX: **(2 hours)**

Experimental designs- designing an experiment- CRD, RBD, LSD. Factorial experiments.

Module X: **(2 hours)**

Probability- application of the principles of probability- theorems of probability- applications- Probability distributions- binomial, multinomial, normal and poisson distributions.

Module XI: **(1 hours)**

Statistical softwares- SPSS, SPAR, MINITAB.

References:

1. Chandal S.R.S. A Handbook of Agricultural Statistics.AchalPrakashanMandir, Kanpur, India.
2. Das M.N. and N.C. Giri. Designs and Analysis of Experiments. Wiley EasternLtd.
3. Elhance and Elhance. Fundamentals of Mathematical Statistics. KithabMahal, New Delhi,lndia.
4. Gupta S.K and V.K. Kapoor. Fundamentals of Mathematical Statistics. Sultan Chand & Sons,

NewDelhi.
5. Gupta C.B. An Introduction to Statistical Methods. VikasPublishing House Pvt.Ltd.
6. Kempthrone,O. An ntroduction to Genetic statistics. John Wiley and Sons lnc. NewYork.
7. Mather K. and J.L. Links. Biometrical Genetics. Chapman and Hall,London.
8. Panse, V.G and P. Sukatme. Statistical Methods for Agricultural Workers. ICAR, NewDelhi.
9. Rao C.A. Advanced Statistical Methods in Biometrical Research. Wiley and Sons, NewYork.
10. Singh P. and S.S. Narayanan. Biometrical Techniques in Plant Breeding. Kalyani Publishers, NewDelhi.
11. Singh R.K. and Chaudhary B.D. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.
12. Daniel W.W. Biostatistics- A foundation for Analysis in HealthSciences.

Plant breeding:

Module I: **(1 hour)**

Introduction and objectives

Module II: **(1 hour)**

Organizations involved in plantbreeding.

Module III: **(1 hour)**

Breeding systems in sexually propagated plants- Floral Biology and its significance in plant breeding. Sterility and incompatibility systems.

Module IV: **(1 hour)**

Genetic resources- centers of crop genetic diversity. In situ and ex situ conservation; cryopreservation of germplasm.

Module V: **(5 hour)**

Conventional methods of plant breeding:

Domestication of wild plants- changes under domestication.

Plant introduction- history, types, principles, plant introduction agencies in lndia- rules and regulations. Major achievements

Selection- selection methods in sexually and vegetatively propagated species. Selection in segregating populations. Major achievements.

Hybridization- history, objectives, techniques, consequences and major achievements. Heterosis breeding- genetic basis of heterosis and inbreeding depression.

Module VI: **(3 hour)**

Modern methods of plantbreeding:

Mutation breeding- history, methodology, applications, merits, demerits and achievements. Polyploidy breeding- methodology, applications, merits, demerits and achievements.

Biotechnological approaches in plant breeding- Molecular markers and their uses- Transgenic plants- critical evaluation.

Module VII: **(2 hour)**

Breeding for special purposes: Resistance breeding- a brief account of disease resistance, pest resistance, stress resistance- achievements. Quality breeding- objectives

andachievements.

Module VIII: **(1 hour)**

Biometrical techniques in Plant Breeding- analysis of variability, heritability, genetic advance and combining ability.

Module IX: **(1 hour)**

IPR- Protection of plant variety and farmers'right Act

References:

1. Allard R.W. Principles of Plant Breeding. John Wiley and Sons, NewDelhi.
2. Chahal G.S. and Gosal S.S. Principles and Procedure of Plant Breeding. Narosa Publishing House, NewDelhi.
3. Jain H.K. and Kharkwal M.C. Plant Breeding- Mendelian to Molecular Approaches. Narosa Publishing House, New Delhi.
4. Roy D. Plant Breeding- Analysis and Exploitation of Variation. Narosa PublishingHouse.
5. Hayward M.D., Bosemark N.O. and Romagasa I. Plant Breeding- Principles and Prospects. Chapman &Hall.
6. Gupta S.K. Plant Breeding- Theory and Techniques. Agrobios (India),Jodhpur.
7. Khan M.A. Plant Breeding. Biotech Books, New Delhi.
8. Stoskopf N.C. Plant Breeding- Theory and Practice. Scientific Publishers (India),Jodhpur.
9. Sharma J.R. Principles and Practices of Plant Breeding. Tata McGrawHill.
10. Chopra V.L. Breeding Field Crops. Oxford &IBH.
11. MohananK.V. Essentials of Plant Breeding. PHI Ltd., NewDelhi.
12. MohananK.V. Essentials of Plantation Science. Penta Book Publishers, Calicut,Kerala.

Evolution

Module I: **(3 hours)**

The concept of evolution- evidences of evolution- geological time scale and evolution

Module II: **(3 hours)**

Origin of life- theories and experimental evidences- chemical evolution and biological evolution.

Module III: **(1 hours)**

Evidences of evolution.

Module IV: **(3 hours)**

Theories of evolution- Pre-Darwinian, Darwinian and Post Darwinian theories- Modern synthetic theory of evolution.

Module V: **(1 hours)**

Reproductive isolation and the origin of species.

Module VI: **(3 hours)**

Evolution at the molecular level.

BOT2C05: CYTOGENETICS, GENETICS, BIOSTATISTICS, PLANT BREEDING AND EVOLUTION

(1+1.5+1.5+1+1 = 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

To study concepts of genetics,interaction of gene, different types of chromosomes, plant breeding techniques for crop improvement, statistical tools for analysis, interpretation and visualisation of data and concepts of evolution.

LESSON PLAN: CYTOGENETICS

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Cytogenetics of aneuplolds, euploids and structural heterozygotes. (8 hours)	Effect of aneuploidy on phenotype. Transmission of monosomics and trisomics and their uses. Breeding behaviour and genetics of structural heterozygotes; translocation heterozygotes; Robertsonian translocation; B-A translocation. Karyotype- concepts and its importance. Structural chromosome aberrations- types and significance in evolution. Heteroploidy, aneuploidy, monosoly, trisomy (primary,	Lecture **Participative learning**	Group discussion	To understand monosomy, trisomy and its applications, different types of translocations, human karyotype, chromosomal aberrations and its significance in evolution	Evaluation through test papers

	secondary, tertiary and compensating). Nullisomy. Uses of aneuploidy in cytogenetics. Euploidy-autoploidy, alloploidy and segmental allopolyploic diploidization. Role of aneuploidy and euploidy in evolution				
Module II: Molecular cytogenetics (4 hours)	Multigenic families and their evolution; in situ hybridization-concept. Computer assisted chromosome analysis, chromosome micro-dissection and micro-cloning; flow cytometry	Lecture **Participative learning**	Group discussion	TO understand about multigene families,insitu hybridization. To understand the importance of computer assisted chromosome analysis. To study the procedure of chromosome micro-dissection and micro-cloning and flow cytometry	Evaluation through test papers
Module III: Polytene and lampbrush chromosomes (1 hours)	Cytogenetic importance.	Lecture **Participative learning**	Discussion	To understand the structure of polytene and lampbrush chromosomes and its cytogenetic importance	Evaluation through test papers
Module IV: Supernumerary chromosomes (1 hours)	. B-chromosomes	Lecture **Participative learning**	Discussion	To understand the structure and importance of B-chromosomes	Evaluation through test papers

LESSON PLAN: GENETICS

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Relevance of Mendelism in modern genetics (1 hours)	A critical evaluation of Mendelism on the basis of modern concept of genes.	Lecture **Participative learning**	Discussion	To understand the role of Gregor Johann Mendel in Genetics and to study about modern and classical concept of genes	Evaluation through test papers
Module II: Linkage and gene mapping (6hours)	Three- point test cross; linkage map; interference; tetrad analysis and centromere mapping. Linkage in humans. Pedigree analysis. Genetic recombination and mapping of genes in bacteria and bacteriophages	Lecture **Participative learning**	Discussion	To understand about linkage, how to draw a linkage mamand understand how,genetic recombination occur in bacteria and bacteriophages	Evaluation through test papers
Module III: **Mobile genetic elements: (3 hours)**	Transposable elements in bacteria. lS elements. Tn elements. Compsite transposon. Cepia and P elements in Drosophila. Ac, DS and Mu elements in maize. Retrotransposons- Molecular characteristics and significance in development and evolution.	Lecture **Participative learning**	Discussion	To study about transposable elements in bacteria, drosophila maize and retrotransposons. To understand the procedure of transposition and its significance in evolution.	Evaluation through test papers Evaluation through test papers
Module IV:	Analysis of mitochondrial	Lecture	Discussio	To understand	Evaluation

Extranuclear inheritance: (2 hours)	and chloroplast genomes and their utility. Cytoplasmic male sterility	**Participative learning**	n	the how inheritance transmited from one generation to other generation other than nucleus, its structure, cytoplasmic male sterility and its application	through test papers
Module V: Quantitative genetics (2 hours)	Polygenic inheritance, heritability and its measurements. QTLmapping.	Lecture Participative learning	Discussio n	To study about quantitative genetics, heritability, and the procedure of QTL mapping and its applications	Evaluation through test papers
ModuleVI: Population genetics: (2 hours)	Systems of mating. The Hardy-Weinberg principle. Estimation of gene frequencies. Factors affecting equilibrium: natural selection, mutation, migration and genetic drift.	Lecture Participative learning	Discussio n	To study about population genetics, and factors affecting population equilibrium	Evaluation through test papers
ModuleVII: Human genetics (3hours)	Human pedigree analysis, Lod score for linkage testing. Karyotype; geneticdisorders.	Lecture Participative learning	Discussio n	To study about human pedigree analysis, procedure of lod score, human karyotype and genetic disorders	Evaluation through test papers

LESSON PLAN: BIOSTATISTICS

Unit/session/hours (Time required)	***Topics for student preparation (Input***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning outcome (output)***	***Assessment***
Module I: **Introduction (1hours)**	The science of statistics and its applications in biological research.	Lecture Participative learning	Discussion	To understand the role of statistics in biological research	Evaluation through test papers
Module II: Types and collection of data (1hours)	Census and sampling- theory and methods**.**	Lecture **Participative learning**	Discussion	To study about theory and methods of census and sampling	Evaluation through test papers
Module III: Tabulation and presentation of data (2 hours)	Diagrammatic and graphical presentation	Lecture **Participative learning Problem solving**	Discussion	To understand about diagrammatic and graphic methods of data	Evaluation through test papers
Module IV: Analysis of data **(2hours)**	Central tendencies.	Lecture **Participative learning Problem solving**	Discussion	To understand about types of central tendencies	Evaluation through test papers
Module V: Measures of dispersion (2hours)	Range, quartile deviation, mean deviation, standard deviation and standard error. Relative measures of dispersion - coefficient ofvariation.	Lecture **Participative learning Problem solving**	Discussion	To understand about range, mean deviation, standard deviation standard error and Relative measures of dispersion	Evaluation through test papers
Module VI: Tests of significance (2 hours)	formulation and testing of hypothesis- testing the probability of committing type 1	Lecture **Participative learning Problem solving**	Discussion	To understand the significance of z test, t test, chi-square test	Evaluation through test papers

	and type 2 errors. z test, t test, chi-square test				
Module VII: Analysis of variance (2 hours)	one way classification and two-way classification, F test, F value calculation, F table	Lecture Participative learning Problem solving	Discussion	To understand about analysis of variance	Evaluation through test papers
Module VIII: Correlation and Regression analysis (2 hours)	coefficient of correlation-significance testing. Rank correlation. Lines of regression-coefficient of regression	Lecture Participative learning Problem solving	Discussion	TO umderstand the relation between dependent and independent variables	Evaluation through test papers
Module IX: Experimental designs (2 hours)	designing an experiment- CRD, RBD, LSD. Factorial experiments.	Lecture Participative learning	Discussion		Evaluation through test papers
Module X: Probability (2 hours)	Application of the principles of probability-theorems of probability-applications-Probability distributions-binomial, multinomial, normal and poisson distributions.	Lecture Participative learning	Discussion	To understand the significance and application of probability	Evaluation through Q&A
Module XI: Statistical softwares (1hour)	SPSS, SPAR, MINITAB.	Lecture Participative learning	Discussion	To understand the role of SPSS, SPAR, MINITAB in biological research	Evaluation through test papers

LESSON PLAN: PLANT BREEDING

Unit/session/hours (Time required)	*Topics for student preparation (Input*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning outcome (output)*	*Assessment*
Module I: **Introduction and objectives** **(1hour)**	Introduction and objectives of plant breeding	Lecture Participative learning	Discussion	To understand about the importance of plant breeding in crop improvement	Evaluation through Q&A
Module II: Organizations involved in plantbreeding. (1hour)	Organizations involved in plant breeding. **.**	Lecture Participative learning	Discussion	To understand about the organisations actively involved in plant breeding	Evaluation through test papers
Module III: Breeding systems in sexually propagated plants (1hour)	Floral Biology and its significance in plant breeding. Sterility and incompatibility systems.	Lecture Participative learning	Discussion	To understand the significance of floral biology in plant breeding	Evaluation through Q&A
Module IV: Genetic resources (1hour)	centers of crop genetic diversity. In situ and ex situ conservation; cryopreservation of germplasm.	Lecture Participative learning	Discussion	To understand about centers of crop genetic diversity, different types of conservation and cryopreservation	Evaluation through Q&A
Module V: Conventional methods of plantbreeding: (1hour)	Domestication of wild plants- changes under domestication. Plant introduction- history, types, principles, plant introduction agencies in lndia- rules and regulations. Major achievements	Lecture Participative learning	Discussion	To understand the importance and applications of conventional methods of plant breeding like hybridizationheterosis	Evaluation through test paper

	Selection- selection methods in sexually and vegetatively propagated species.Selection in segregatingpopulations.Major achievements. Hybridization- history, objectives, techniques, consequences,and major achievements. Heterosis breeding- genetic basis of heterosis and inbreeding depression.			breeding and inbreeding depression.	
Module VI: Modern methods of plantbreeding (3hours)	Mutation breeding- history, methodology, applications, merits, demerits and achievements. Polyploidy breeding- methodology, applications, merits, demerits and achievements. Biotechnological approaches in plant breeding- Molecular markers and their uses- Transgenic plants- critical evaluation.	Lecture Participative learning	Discussion	To understand the methodolgy and applications of mutation breeding,& polyploidy breeding. To understand the significance of molecular markers and their use in plant breeding. To understand about transgenic plants and their role in plant breeding	Evaluation through Q&A
Module VII: Breeding for special purposes (2 hours)	Resistance breeding- a brief account of disease resistance, pest resistance, stress resistance- achievements. Quality breeding- objectives and achievements.	Lecture Participative learning	Discussion	To understand about the significance of resistance breeding, Quality breeding and their objectives& achievements	Evaluation through Q&A
Module VIII:		Lecture	Discussion	To understand the	Evaluation

- Biometrical techniques in Plant Breeding (1hour)	Analysis of variability, heritability, genetic advance and combining ability.	Participative learning		significance of variability ,heritability, genetic advance and combining ability	through Q&A
Module IX: **IPR (1hour)**	Protection of plant variety and farmers' right act.	Lecture Participative learning	Discussion	To understand the importance of IPR and farmers right act	Evaluation through Q&A

LESSON PLAN: EVOLUTION

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning outcome (out put)***	***Assessment***
Module I: The concept of evolution. (3 hours)	Evidences of evolution- geological time scale and evolution.	Lecture Participative learning	Discussion	To understand about geological time scale and concept of evolution	Evaluation through Q&A
Module II: Origin of life- (3 hours)	Theories and experimental evidences- chemical evolution and biological evolution. **.**	Lecture Participative learning	Discussion	To understand about the theories and experimental evidences of evolution	Evaluation through test paper
Module III: Evidences of evolution. (1 hour)	. Evidences of evolution.	Lecture Participative learning	Discussion	To understand about the evidences of evolution	Evaluation through test paper
Module IV: **Theories of evolution (3 hours)**	Pre-Darwinian, Darwinian and Post Darwinian theories- Modern synthetic theory of evolution.	Lecture Participative learning	Discussion	To understand about the Theories of evolution i.e, pre darwinian, Darwinian and post Darwinian theories.	Evaluation through Q&A

Module V: Reproductive isolation and the origin of species. (1 hour)	Reproductive isolation and the origin of species	Lecture Participative learning	Discussion	To understand the significance of reproductive isolation and the origin of species	Evaluation through Q&A
Module VI: **Evolution at the molecularlevel (1 hour)**	Evolution at the molecular level.	Lecture Participative learning	Discussion	To understand the evolution at the molecular level	Evaluation through Q&A

COURSE OUTCOMES

The students who complete this course will be able to:

CO	CO Statement
CO1	Explain the importance of ecosystem, biodiversity and energy flow.
CO2	Identify the phytogeographical distribution patterns of Plants.
CO3	Recognize the different forest types and products and major and minor forest products for sustainable utilization of bio-resources.
CO4	Apply new strategies for in situ and ex situ conservation of biodiversity
CO5	Identify the population characteristics and its significance.
CO6	Identify the threatened plants and threats to global environment.
CO7	Demonstrate skill for Environmental Impact Assessment and awareness to Environmental laws.
CO8	Evaluate the role of different biodiversity conservation ventures at local/national and global levels.

BOT2C05: CYTOGENETICS, GENETICS, BIOSTATISTICS, PLANT BREEDING AND EVOLUTION

(1+1.5+1.5+1+1 = 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

UNITWISE BREAK UP: CYTOGENETICS

LECTURE HOURS: 14

OBJECTIVE:

a. *To understand the different chromosomal aberrations, chromosomal mechanisms and modern method of chromosome analysis.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Cytogenetics of aneuplolds, euploids and structural heterozygotes**	**8**	Check the knowledge of aneuploids and euploids	Lecture and discussion	To make short note on Monosomy and trisomy
Unit – 1	Effect of aneuploidy on phenotype. Transmission of monosomics and trisomics and their uses.		Check the knowledge of monosomy and trisomy, translocation,	Lecture and discussion Illustration	
Unit – 2	Breeding behaviour and genetics of structural heterozygotes; translocation heterozygotes; Robertsonian translocation; B-A translocation				
Unit – 3	Karyotype- concepts and its importance		Check the knowledge of human karyotype	Lecture and discussion	
Unit – 4	Structural chromosome aberrations- types and significance in evolution.		Check the knowledge of chromosomal aberrations	Illustration	

Unit-5	Heteroploidy, aneuploidy, monosoly, trisomy (primary, secondary, tertiary and compensating). Nullisomy. Uses of aneuploidy in cytogenetics..		Check the knowledge of monosomy.trisomy and nullisomy	Lecture and discussion	
Unit-6	Euploidy- autoploidy, alloploidy and segmental alopolyploicdiploidization. Role of aneuploidy and euploidy in evolution		Check the knowledge of polyploidy	Lecture and discussion	To make short note on polyploidy
Module II:	**Molecular cytogenetics:**	**4**			
Unit – 1	Multigenic families and their evolution;		Check the knowledge of multigene families Check the knowledge ofcomputer assisted techniques	Lecture and discussion	To make short note on Insitu hybridization, chromosome microdissection and microcloning
Unit – 2	in situ hybridization- concept.				
Unit – 3	Computer assisted chromosome analysis, chromosome micro-dissection and micro-cloning;				
Unit – 4	Flow cytometry				
Module III:	Polytene and lamp brush chromosome .	**1**	Check the knowledge of polytene and lampbrush chromosomes	Lecture and discussion	To make short note on Polytene and lampbrush chromosome Draw doagrams
Unit – 1	Cytogenetic importance of Polytene and lamp brush chromosomes				
Module IV:	Supernumerary chromosomes	**1**	Check the knowledge of B chromosomes	Lecture and discussion	To make short note on B-chromosomes
Unit – 1	B-chromosomes				

UNITWISE BREAK UP: GENETICS

LECTURE HOURS: 19

OBJECTIVE:

a. *To understand the role of genetics in human life, the mechanism of linkage, crossing over, pedigree analysis, maternal inheritance, karyotype and genetic disorders.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	Relevance of Mendelism in modern genetics	.	To read about the life history of Mendel and his contribution to genetics	Lecture and discussion	To make a short note on laws of Mendel
Unit – 1	A critical evaluation of Mendelism on the basis of modern concept of genes	**1**			
Module II:	Linkage and gene mapping	.	To check the knowledge of linkage, three point test cross, genetic recombination methods in bacteria	Lecture discussion and illustrations	Problems on linkage, interference coincidence and tetrad analysis
Unit – 1	Three- point test cross; linkage map; interference;	**6**			
Unit – 2	tetrad analysis and centromere mapping				
Unit – 3	Linkage in humans. Pedigree analysis				
Unit-4	Genetic recombination and mapping of genes in bacteria and bacteriophages				
Module III	**Mobile genetic elements:**	**3**	To check the knowledge of transposable elements	Lecture discussion and illustrations	To make a short note on transposons and retrotransposons
Unit – 1	Transposable elements in bacteria. lS elements. Tn elements. Compsite transposon				
Unit – 2	Copia and P elements in Drosophila. Ac, DS and Mu elements in maize.				
Unit-3	Retrotransposons- Molecular characteristics and significance in development and				

	evolution				
Module IV:	Extra nuclear inheritance	**2**	To read about maternal inheritance	Lecture discussion and illustrations	To make short note on cytoplasmic inheritance
Unit-1	Analysis of mitochondrial and chloroplast genomes and their utility.				
Unit-2	Cytoplasmic male sterility				
Module V	Quantitative genetics	**2**	To read an example of quantitative genetics	Lecture and discussion	To make short note on quantitative genetics
Unit-1	Polygenic inheritance				
Unit-2	Heritability and its measurements. QTL mapping.				
Module VI	Population genetics	**2**	To read about Hardy-Weinberg principle	Lecture and discussion	To make short note on population genetics
Unit-1	Systems of mating. The Hardy-Weinberg principle Estimation of gene frequencies.				
Unit-2	Factors affecting equilibrium: natural selection, mutation, migration and genetic drift.				
Module VII	Human genetics	**3**	To understand about pedigree analysis and check the knowledge about genetic disorders	Lecture discussion and illustrations	To make a short note on human karyotype and genetic disorders
Unit-1	Human pedigree analysis				
Unit-2	Lod score for linkage testing. Karyotype				
Unit-3	Genetic disorders.				

UNITWISE BREAK UP: BIOSTATISTICS

LECTURE HOURS: 19

OBJECTIVE:

a. *To understand the role and application of statistics in biological research.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	Introduction	.	Check knowledge about applications of biostatistics	Lecture and discussion	To make a short note on applications of biostatistics
Unit – 1	The science of statistics and its applications in biological research	**1**			
Module II:	Types and collection of data	**1**	To read about data types	Lecture discussion and illustrations	To make a short note on Census and sampling-theory and methods
Unit – 1	. Census and sampling-theory and methods				
Module III:	Tabulation and presentation of data	**2**	To learn about presentation of data	Lecture discussion and illustrations	To make a short note on graphic presentation of data
Unit – 1	diagrammatic and graphic presentation				
Module IV:	Analysis of data	**2**	To read about central tendencies	Lecture and discussion	Central tendencies problems
Unit – 1	Central tendencies				
Module V:	Measures of dispersion	**2**	To read about measures of dispersion	Lecture and discussion	Measures of dispersion problems
Unit – 1	Range, quartile deviation, mean deviation, standard deviation and standard error.				
Unit – 2	Relative measures of dispersion - coefficient of variation				
Module VI:	Tests of significance	**2**			
Unit – 1	**formulation and**				

	testing of hypothesis-testing the probability of committing type 1 and type 2 errors		Check the knowledge about probability	Lecture and discussion	Problems on chi square test
Unit – 2	**z test, t test, chi-square test**				
Module VII:	**Analysis of variance**	**2**	To realize the applications of ANOVA in biological experiment	Lecture discussion and illustrations	Analysis of variance problems
Unit – 1	one way classification and two-way classification				
Unit – 1	F test, F value calculation, F table				
Module VIII:	**Correlation and Regression analysis**	**2**	Check the knowledge about correlation and regression	Lecture discussion and illustrations	Correlation and regression problems
Unit – 1	**coefficient of correlation-significance testing. Rank correlation**				
Unit – 1	**Lines of regression-coefficient of regression**				
Module IX	**Experimental designs-**	**2**	To read about experimental designs	Lecture discussion and illustrations	To make a short note on experimental designs
Unit – 1	**designing an experiment- CRD, RBD, LSD.**				
Unit – 2	**Factorial experiments**				
Module X	**Probability**	**2**	To realize the importance of probability in biostatistics	Lecture discussion and illustrations	Probability problems
Unit – 1	application of the principles of probability- theorems of probability-applications				
Unit – 2	Probability distributions-binomial, multinomial, normal and poisson distributions.				
Module XI	**Statistical softwares**	**1**		Lecture and discussion	To make a short note on SPSS,

Unit – 1	SPSS,SPAR, MINITAB.		To read about statistical soft wares		SPAR and MINITAB

UNITWISE BREAK UP: PLANT BREEDING

LECTURE HOURS: 16

OBJECTIVE:

a. *To understand conventional and modern methods of plant breeding to improve crop development.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	Introduction	.	To realize about applications of plant breeding in crop improvement	Lecture and discussion	To make a short note on applications of plant breeding
Unit – 1	Introduction and objectives.	**1**			
Module II	Organizations involved in plant breeding.	**1**	To read about Organizations involved in plant breeding	Lecture and discussion	To make a short note on Organizations involved in plant breeding.
Unit – 1	Organizations involved in plant breeding.				
Module III:	**Breeding systems in sexually propagated plants**	**1**	To learn about floral biolgy and its significance	Lecture discussion	To make a short note on Floral Biology and its significance
Unit – 1	Floral Biology and its significance in plant breeding. Sterility and incompatibility systems				
Module IV:	Genetic resources	**1** .	To read about insitu and ex situ conservation; cryopreservation of germplasm	Lecture and discussion	To make a short note on cryopreservation

Unit – 1	centers of crop genetic diversity. In situ and ex situ conservation; cryopreservation of germplasm				
Module V:	Conventional methods of plantbreeding	. **5** .	To read about Conventional methods of Plant breeding	Lecture and discussion	To make a short note on Conventional methods of plantbreeding
Unit-1	Domestication of wild plants- changes under domestication.				
Unit-2	Plant introduction- history, types, principles, plant introduction agencies in lndia- rules and regulations. Major achievements				
Unit-3	Selection- selection methods in sexually and vegetatively propagated species.Selection in segregatingpopulations.Major achievements				
Unit-4	Hybridization- history, objectives, techniques, consequences,and major achievements				
Unit-5	Heterosis breeding- genetic basis of heterosis and inbreeding depression				
Module VI:	Modern methods of plantbreeding	**3**	To learn about modern methods of plant breeding	Lecture and discussion	To make a short note on Modern methods of

Unit-1	Mutation breeding- history, methodology, applications, merits, demerits and achievements				Plant breeding Molecular markers and Transgenic plants
Unit-2	Polyploidy breeding- methodology, applications, merits, demerits and achievements				
Unit-3	Biotechnological approaches in plant breeding- Molecular markers and their uses- Transgenic plants- critical evaluation.				
Module VII	**Breeding for special purposes**	**2**	To check knowledge about resistance and quality breeding	Lecture and discussion	To make a short note on resistance breeding
Unit-1	Resistance breeding- a brief account of disease resistance, pest resistance, stress resistance- achievements.				
Unit-2	Quality breeding- objectives and achievements				
Module VIII: -	Biometrical techniques in Plant Breeding	**1**	To learn about heritability	Lecture and discussion	To make a short note on Biometrical techniques
Unit-1	Analysis of variability, heritability, genetic advance and combining ability				
Module-IX	IPR	**1**	To learn about IPR	Lecture and discussion	To make a short note on IPR
Unit-	Protection of plant variety and farmers' right act.				

UNITWISE BREAK UP: EVOLUTION

LECTURE HOURS: 12

OBJECTIVE:

a. To learn about concept, theories, evidences, and evolution at molecular level

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**The concept of evolution**	**3**	To read about concept of evolution	Lecture and discussion	To write a assignment on The concept of evolution, Evidences of evolution , and geological time scale
Unit – 1	The concept of evolution.				
Unit – 2	Evidences of evolution				
Unit – 3	geological time scale and evolution				
Module II:	**Origin of life**	**3**	To read about urey miller experiment of evolution	Lecture discussion	To write a assignment on origin of life and biological evolution
Unit – 1	Theories and experimental evidences				
Unit-2	chemical evolution				
Unit-3	biological evolution				
Module III:	Evidences of evolution	**1**	To read about evidences of evolution	Lecture and discussion	To write a assignment on different evidences on evolution
Unit – 1	Evidences of evolution				
Module IV:	Theories of evolution	**3**	To read about Theories of evolution	Lecture and discussion	To write a assignment on Theories of evolution
Unit – 1	Pre-Darwinian theories				
Unit – 2	Darwinian theories				
Unit – 3	Post Darwinian theories- Modern synthetic theory of				

	evolution.				
Module V:	Reproductive isolation and origin of species	**1**	To read about Darwin's origin of species	Lecture and discussion	To write a assignment on Reproductive isolation and origin of species
Unit-1	Reproductive isolation and origin of species				
Module VI:	Evolution at molecular level	**1**	To read about molecular evolution	Lecture and discussion	To write a assignment on Evolution at molecular level
Unit-1	Evolution at molecular level				

Teacher in Charge: Mrs. Sabeena A. M.

BOT2C06: PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY

(2.5+1.5+1+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a. *To familiarize student with the ecological principals that link individuals at populations, community, landscape, and ecosystem levels.*
b. *To enable the students to evaluate the role of different biodiversity conservation ventures at local/national and global level.*
c. *To enable students to recognize the different forest types and products, major and minor products for sustainable utilization of bio-resources.*
d. *To able to identify the phytogeographical distribution patterns of plants.*

Plant Ecology & Conservation Biology

Module I: **[3 Hours]**

Habitat Ecology: Salient features of terrestrial (Biomes), fresh water (Limnology), wet land and marine habitats.

Module II: **[5 Hours]**

Productivity and Energy flow: Concepts, limits and process of primary production; methods of productivity measurements: global trends in primary productivity, energy flow models.

Module III: **[3 Hours]**

Population characteristics: density, natality, mortality, distribution, biotic potential, carrying capacity, aggregation and dispersal, ecotone and edge effect.

Module IV: **[5 Hours]**

The environment and its pollution- types (land, air and water). Effect on living organisms. Control with emphasis on biological methods. Environmental hazards.

Module V: **[3 Hours]**

Threats to the global environment- greenhouse effect, ozone depletion, El-Nino and La Nina effects.

Module VI: **[3 Hours]**

Environment impact assessment (EIA) and assessment of environmental hazards- remote sensing.

Module VII: **[5 Hours]**

Problems of conservation; causes of threat to environment- human interference, deforestation, habitat destruction, overexploitation of resources.

Module VIII: **[5 Hours]**

ldentiflcation of threatened plants; red list categories- extinct, endangered, vulnerable, rare and out of danger. Extinction process. Hot spots, keystone species and flagship species.

Module IX: **[6 Hours]**

Strategies for conservation: in situ and ex situ conservation, biosphere reserve, national parks, wildlife sanctuaries. Gene banks, cryopreservation, seed banks.

Module X: **[5 Hours]**

Afforestation- social forestry, agroforestry. International biological programme (lBP), Man and biosphere programme (MAB), IUCN, world environment day, wildlife preservation act (1972), Indian forest (conservation) act (1980) and United Nations Environment Programme. Environment Protection Acts.

Module XI: **[2 Hours]**

Environmental awareness- role of government and NGOs. -Gaia hypothesis

Module XII: **[3 Hours]**

Biodiversity- significance at Local, National and Global levels. Deep ecology (Paradigm shift from anthropocentric ecology to ecocentric ecology. National heritages.

References:

1. Negi, S.S. Handbook of National Parks and Sanctuaries in India.
2. M.P. Nair and P.K Sastry - Red data book of Indian plants.
3. Mehrotra and B.K Suri - Remote sensing for environment and forest management.
4. Negi S.S - Biosphere reserves in India.
5. Lucas and Synge - IUCN Red data book. IUCN, Stockholm
6. Dasman R.F - Environmental Conservation.
7. Odum E.P. Fundamentals of ecology
8. Odum E.P. Basic principles of ecology
9. Misra K.R. Ecology workbook.
10. Puri G.S. - Indian Forest Ecology Volumes I and ll. Oxford & IBH.
11. Clarke G.L - Elements of Ecology.
12. Chhatwal G.L. Encyclopedia of environmental biology.
13. Ray P.K. - Pollution and Health. Willey-Eastern Ltd, New Delhi.
14. MichaeL P.- Ecological methods for field and laboratory investigations.Tata McGraw Hill, New Delhi.
15. Kershaw K.A. Quantitative and Dynamic Plant Ecology. ELBS.

Phytogeography

Module I: **[3 Hours]**

Patterns of plant distribution: continuous distribution: circumpolar, circumboreal, circum austral, pan tropical.

Module II: **[4 Hours]**

Discontinuous distribution: Theory of land bridges, theory of continental drift, theory of glaciation.

Module III: **[3 Hours]**

Endemic distribution (neoendemic, paleoendemic), age and area hypothesis.

Module IV: **[6 Hours]**

Phytochoria of world and India.

References:

1. Ronald Good. The geography of flowering plants. Lcngmans.
2. Bharucha F.R. A textbook of plant geography of India. Oxford University Press.
3. Puri G.S. Indian Forest Ecology, Vol I, ll. Oxford, New-Delhi

Forest Botany

Module I: **[3 Hours]**

Forest- Definitions. Study of various types of forests in the world and in India.

Module II: **[10 Hours]**

Forest products- Major and minor with special reference to Kerala.

Module III: **[3 Hours]**

Influence of forests on environment. Consequence of deforestation and industrialization- sustainable utilization of bioresources.

References:

1. Agarwal A. P. Forests in India. Oxford & IBH.
2. Gregorv G. R. Forest products, production, trade and consumption, quantity and value of raw materials requirements. Ford foundation, New-Delhi.
3. Puri G.S. Indian Forest Ecology Vol. l& ll. Oxford & IBH.
4. Champion G. H. and Seth S.K. A revised survey of the forest types of India.

BOT2C06: PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY

(2.5+1.5+1+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

a. *To familiarize student with the ecological principals that link individuals at populations, community, landscape, and ecosystem levels.*
b. *To enable the students to evaluate the role of different biodiversity conservation ventures at local/national and global level.*
c. *To enable students to recognize the different forest types and products, major and minor products for sustainable utilization of bio-resources.*
d. *To able to identify the phytogeographical distribution patterns of plants.*

LESSON PLAN: PLANT ECOLOGY & CONSERVATION BIOLOGY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Habitat Ecology: [3 Hours]	Salient features of terrestrial (Biomes), fresh water (Limnology), wet land and marine habitats.	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand the salient features of habitat ecology	Evaluation through the test paper
Module II: Productivity and Energy flow: [5 Hours]	Concepts, limits, and process of primary production; methods of productivity measurements: global trends in primary productivity, energy flow models.	• Discussion • **Participative learning**	Group Discussion	To understand the productivity and Energy flow:	Evaluation through the test paper
Module III: Population characteristics: [3 Hours]	Density, natality, mortality, distribution, biotic potential, carrying	• Discussion • **Participative learning**	Group Discussion	To understand the population characteristics	Evaluation through the test paper

	capacity, aggregation and dispersal, ecotone and edge effect.				
Module IV: The environment and its pollution- [5 Hours]	Types (land, air and water). Effect on living organisms. Control with emphasis on biological methods. Environmental hazards.	• Discussion • **Participative learning**	Group Discussion	To understand the environment and its pollution and effect on living organisms. Control with emphasis on biological methods.	Evaluation through the test paper
Module V: Threats to the global environment- [3 Hours]	Greenhouse effect, ozone depletion, El-Nino and La Nina effects.	• Discussion • **Participative learning**	Group Discussion	To understand the impact of Greenhouse effect, ozone depletion, El-Nino and La Nina effects.	Evaluation through the test paper
Module VI: Environment impact assessment (EIA) and assessment of environmental hazards- [3 Hours]	EIA and assessment of environmental hazards and remote sensing.	• Lecture • Discussion • **Participative learning**	Peer Group Discussion	To understand the importance of EIA	Evaluation through the test paper
Module VII: Problems of conservation; causes of threat to environment- [5 Hours]	Human interference, deforestation, habitat destruction, overexploitation of resources.	• Discussion • **Participative learning**	Group Discussion	To understand the causes of threat to environment	Evaluation through the Q&A session
Module VIII: ldentiflcation of threatened plants; red list categories- [5 Hours]	Extinct, endangered, vulnerable, rare and out of danger. Extinction process. Hot spots, keystone species and flagship species.	• Discussion • **Participative learning**	Group Discussion	To understand the identification of threatened plants; red list categories	Evaluation through the test paper

Module IX: **Strategies for conservation:** **[6 Hours]**	In situ and ex situ conservation, biosphere reserve, national parks, wildlife sanctuaries. Gene banks, cryopreservation, seed banks.	• Discussion • **Participative learning**	Group Discussion	To understand the conservation strategies	Evaluation through the test paper
Module X: **Afforestation-** **[5 Hours]**	Social forestry, agroforestry. International biological programme lBP, MAB, IUCN, world environment day, wildlife preservation act (1972), Indian forest (conservation) act (1980) and United Nations Environment Programme. Environment Protection Acts.	• Discussion • **Participative learning**	Group Discussion	To understand the importance of Social forestry and agroforestry and also the rules to protect forests	Evaluation through the test paper
Module XI: **Environmental awareness-** **[2 Hours]**	Role of government and NGOs. -Gaia hypothesis	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand the Role of government and NGOs	Evaluation through the Q&A session
Module XII: **Biodiversity-** **[3 Hours]**	Significance at Local, National and Global levels. Deep ecology (Paradigm shift from anthropocentric ecology to ecocentric ecology. National heritages.	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand the Significance of biodiversity	Evaluation through the test paper

LESSON PLAN: PHYTOGEOGRAPHY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Patterns of plant distribution: [3 Hours]	Introduction continuous distribution: circumpolar, circumboreal, circum austral, pan tropical.	• Discussion • **Participative learning**	Group Discussion	To understand the continuous patterns of the plant distribution	Evaluation through the test paper
Module II: Discontinuous distribution: [4 Hours]	Theory of land bridges, theory of continental drift, theory of glaciation.	• Discussion • **Participative learning**	Group Discussion	To understand the discontinuous patterns of the plant distribution and related theories.	Evaluation through the Q&A session
Module III: Endemic distribution: [3 Hours]	Neoendemic, paleoendemic, age and area hypothesis.	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand the Endemic distribution and its types.	Evaluation through the test paper
Module IV: Phytochoria of world and India. [6 Hours]	World and India.	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand Phytochoria of world and India**.**	Evaluation through the test paper.

LESSON PLAN: FOREST BOTANY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Forest- [3 Hours]	Definitions. Study of various types of forests in the world and in India.	• Discussion **Participative learning**	Group Discussion	To understand various types of forests in the world and in	Evaluation through the Q&A session

				India.	
Module II: Forest products- [10 Hours]	Major and minor with special reference to Kerala.	• Lecture • Discussion • **Participative learning**	Group Discussion	To understand Various Major and minor products (special reference to Kerala)	Identification Evaluation through the test paper.
Module III: Influence of forests on environment- [3 Hours]	Consequence of deforestation and industrialization-sustainable utilization of bioresources.	• Discussion • **Participative learning**	Group Discussion	To understand Consequence of deforestation and industrialization-sustainable utilization of bioresources.	Evaluation through the test paper.

COURSE OUTCOMES

The students who complete this course will be able to:

CO	CO Statement
CO1	Explain the importance of ecosystem, biodiversity, and energy flow.
CO2	Identify the phytogeographical distribution patterns of Plants.
CO3	Recognize the different forest types and products and major and minor forest products for sustainable utilization of bio-resources.
CO4	Apply new strategies for in situ and ex situ conservation of biodiversity
CO5	Identify the population characteristics and its significance.
CO6	Identify the threatened plants and threats to global environment.
CO7	Demonstrate skill for Environmental Impact Assessment and awareness to Environmental laws.
CO8	Evaluate the role of different biodiversity conservation ventures at local/national and global levels.

BOT2C06: PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY

(2.5+1.5+1+1= 6 hours)

Lecture Hours per week: 6, Credits: 5

Internal: 20%, External: 80%, Examination 3 Hours

UNITWISE BREAK UP: PLANT ECOLOGY & CONSERVATION BIOLOGY

LECTURE HOURS: 48

OBJECTIVE:

a. *To familiarize student with the ecological principals that link individuals at populations, community, landscape, and ecosystem levels.*
b. *To enable the students to grasp the importance of ecosystem, biodiversity, and energy flow.*
c. *To enable the students to Identify the threatened plants and threats to global environment and Apply new strategies for in situ and ex situ conservation of biodiversity.*
d. *To enable the students to evaluate the role of different biodiversity conservation ventures at local/national and global level.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Habitat Ecology: Salient features of -**	**3**			
Unit – 1	Terrestrial (Biomes)		Check the knowledge in salient features	Lecture and Discussion	To make short notes on salient features of habitat ecology
Unit – 2	Fresh water (Limnology)				
Unit – 3	Wet land				
Unit – 4	Marine habitats.				
Module II:	**Productivity and Energy flow:**	**5**			
Unit – 1	Concepts		Check the knowledge in concepts of productivity and energy flow	Lecture, discussion, and Illustration	To make short notes on Energy flow models.
Unit – 2	Limits and process of primary production;				
Unit – 3	Methods of productivity measurements				
Unit – 4	Global trends in primary productivity				

Unit – 5	Energy flow models.				
Module III:	**Population characteristics:**	**3**			
Unit – 1	Density, natality, mortality, distribution, biotic potential, carrying capacity, aggregation and dispersal		To read about Population characteristics	Lecture and Discussion	To make detailed notes on Population characteristics
Unit – 2	ecotone and edge effect.				
Module IV:	**The environment and its pollution-**	**5**			
Unit – 1	Pollution- types (land, air and water).		To understand the importance of the effect of pollution and control measures	Lecture and Discussion	To make detailed notes on Pollution- types (land, air and water). Effect on living organisms. Control with emphasis on biological methods.
Unit – 2	Effect on living organisms.				
Unit – 3	Control with emphasis on biological methods.				
Unit – 4	Environmental hazards.				
Module V:	**Threats to the global environment:**	**3**			
Unit – 1	Greenhouse effect		Check the knowledge in threats to the global environment	Lecture and Discussion	To make short notes on Greenhouse effect Ozone depletion El-Nino and La Nina effects.
Unit – 2	Ozone depletion				
Unit – 3	El-Nino and La Nina effects.				
Module VI:	**Environment Impact Assessment:**	**3**			
Unit – 1	EIA and assessment of environmental hazards		To realize the application of EIA	Lecture and Discussion	To make short notes on Environment Impact Assessment
Unit – 2	Remote sensing.				
Module VII:	**Problems of conservation; causes of threat to environment-**	**5**			
Unit – 1	Human interference		Check the knowledge in	Lecture and Discussion	To make short notes on problems of
Unit – 2	Deforestation				
Unit – 3	Habitat destruction				

Unit – 4	Overexploitation of resources.		Problems of conservation		conservation; causes of threat to environment.
Module VIII:	**Identification of threatened plants:**	**5**			
Unit – 1	Red list categories- extinct, endangered, vulnerable, rare and out of danger.		To read the importance of Red list categories, Extinction process and hot spots	Lecture and Discussion	To make short notes on threatened plants
Unit – 2	Extinction process.				
Unit – 3	Hot spots				
Unit – 4	Keystone species and flagship species.				
Module IX:	**Strategies for conservation:**	6			
Unit – 1	In situ and ex situ Conservation,		To read the importance of strategies for conservation	Lecture and Discussion	To make short notes on strategies for conservation.
Unit – 2	Biosphere reserve				
Unit – 3	National parks				
Unit – 4	Wildlife sanctuaries.				
Unit – 5	Gene banks				
Unit – 6	Cryopreservation				
Unit – 7	Seed banks				
Module X:	**Afforestation-**	**5**			
Unit – 1	social forestry and agroforestry		To read the term and definition of lBP, MAB, IUCN .	Lecture and Discussion	To make short notes on afforestation and rules to protect environment.
Unit – 2	International biological programme (lBP),				
Unit – 3	Man and biosphere programme (MAB)				
Unit – 4	IUCN				
Unit – 5	world environment day				
Unit – 6	wildlife preservation act (1972)				
Unit – 7	Indian forest (conservation) act (1980) and United Nations Environment Programme				
Unit – 8	Environment				

	Protection Acts.				
Module XI:	**Environmental awareness-**	**2**			
Unit – 1	role of government and NGOs.		To read the role of NGOs in Environmental awareness	Lecture and Discussion	To make the list of NGOs in Environmental awareness and note on Gaia hypothesis.
Unit – 2	Gaia hypothesis				
Module XII:	**Biodiversity-**	**3**			
	significance at Local, National and Global levels.		To read the importance of Biodiversity.	Lecture and Discussion	To make short notes on Biodiversity
	Deep ecology (Paradigm shift from anthropocentric ecology to ecocentric ecology) and national heritages.				

UNITWISE BREAK UP: PHYTOGEOGRAPHY

LECTURE HOURS: 16

OBJECTIVE:

a. To able to identify the phytogeographical distribution patterns of plants.
b. To able to understand the endemism and importance of endemic plant protection

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Patterns of plant distribution:**	**3**			
Unit – 1	Introduction		Check the knowledge in Patterns of plant distribution	Lecture and Discussion	To make short notes on Continuous distribution of plants and its types
Unit – 2	Continuous distribution: circumpolar, circumboreal, circum austral, pan tropical.				
Module II:	**Discontinuous distribution:**	**4**			
Unit – 1	Theory of land bridges,		Check the knowledge of		To make short notes on

Unit – 2	Theory of continental drift,		theories related to discontinuous plant distribution.	Lecture, Discussion, and Illustration	discontinuous distribution
Unit – 3	Theory of glaciation.				
Module III:	**Endemic distribution:**	**3**			
Unit – 1	Neoendemic, paleoendemic		To realize the importance of Endemic plants and its conservations.	Lecture and Discussion	To make short notes on Endemism
Unit – 2	Age and area hypothesis.				
Module IV:	**Phytochoria:**	**6**			
Unit – 1	World		To realize the importance of phytochoria of world and India	Lecture, Discussion, and Illustration	To make short notes on phytochoria of world and India
Unit – 2	India.				

UNITWISE BREAK UP: FOREST BOTANY

LECTURE HOURS: 16

OBJECTIVE:

a. *To enable students to recognize the different forest types and products, major and minor products for sustainable utilization of bio-resources.*
b. *To create the awareness of Influence of forests on environment and Consequence of deforestation and industrialization*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Forest-**	**3**			
Unit – 1	Definitions		Check the knowledge of various types of forests	Lecture and Discussion	To make short notes on various types of forests
Unit – 2	Study of various types of forests in the world and in India.				
Module II:	**Forest products-**	**10**			
Unit – 1	Major with special reference to Kerala.		Check the knowledge of forest products and its uses.	Lecture and Discussion	To collect the major and minor products
Unit – 2	Minor with special reference to Kerala.				
Module III:	**Influence of forests**	**3**			

	on environment:				
Unit – 1	Consequence of deforestation and industrialization		Check the knowledge of influences of forests on environment.	Lecture and Discussion	To make short notes on influences of forests on environment
Unit – 2	sustainable utilization of bioresources				

Teacher in Charge: Mrs. Sreelakshmi V. V.

BOT2C L03. PRACTICALS OF CELL BIOLOGY, MOLECULAR BIOLOGY, BIOPHYSICS, CYTOGENETICS,

(0.5 +1+ 0.5+1= 3 hours)
Practical Hours per week: 3, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *To develop knowledge about the preparation of buffers and use of pH merter.*
c. *To familiarize students with Solve the Problems from molecular genetics*
d. *To acquire knowledge about the importance and significance of colchicine in chromosomal studies*

Cell Biology

Module I

Study of Mitosis in root tip cells.

Module II

Pre-treatment of root tips with colchicine /hydroxy quinoline paradichlorobenzene and study of chromosomes in Chlorophytum, / Zea mays/ Crotalaria/ Cyanotis.

Module III

Isolation of plastids and mitochondria.

Module IV

Chromosome banding

Molecular Biology

Module I

Working out problems from molecular genetics.

Module II

lsolation of nucleic acid and identification of histones by SDS-PAGE.

Module III

lsolation of plant DNA and its quantification by spectrophotometric/ calorimetric method.

Module IV

lmmunological techniques: ELISA and Western BIot.

Biophysics

Module I

Preparation of buffers and measurement of pH using pH meter.

Module II

Determination of isoelectric pH.

Module III

Paper chromatography: Separation of sugars.

Module IV

Thin layer chromatography- separation of amino acid mixtures.

Module VI

Calorimetric and spectrophotometric elimination of proteins by Biuret / Lowry's method.

Module VII

Estimation of amino acid by ninhydrin method (colorimetric).

Cytogenetics

Module I

induction of polyploidy using colchicine; different methods of the application of colchicine

Module II

Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.

Module III

Preparation of karyotype and ideogram of plant meristematic cells

Module IV

Cytological studies in callus tissues

Module V

Study of meiosis in translocation heterozygotes (Rheo discolor)

Module VI

Study of polytene chromosomes.

- **Preparation of lab record and submission for valuation.**
- **Visit to a reputed molecular biology lab and submission of a report.**

BOT2C L03. PRACTICALS OF CELL BIOLOGY, MOLECULAR BIOLOGY, BIOPHYSICS, CYTOGENETICS,

(0.5 +1+ 0.5+1= 3 hours)
Practical Hours per week: 3, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *To develop knowledge about the preparation of buffers and use of pH merter.*
c. *To familiarize students with Solve the Problems from molecular genetics*
d. *To acquire knowledge about the importance and significance of colchicine in chromosomal studies*

LESSON PLAN: CELL BIOLOGY

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning Outcome (Output)***	***Assessment***
Module I: Study of Mitosis in root tip cells. [4 Hours]	Onion root preparation, Identifying characters in four stages of Mitosis	• Lecture • Discussion • **Participative learning**	Peer group discussion on theory and preparation of onion root tip	To understand the chromosome orientation in different stages of Mitosis	Evaluation through the Practical test papers.
Module II Pre-treatment of root tips with colchicine /hydroxy quinoline paradichlorobenzene and study of chromosomes in Chlorophytum, / Zea mays/ Crotalaria/ Cyanotis [4 Hours]	Flower bud Preparation, Significance of Colchicine in Cell Division	• Lecture • Discussion • **Participative learning**	Peer group discussion on theory and preparation of flower bud.	To understand the role of colchicine in cell division	Evaluation through the Practical test papers

LESSON PLAN: MOLECULAR BIOLOGY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Working out problems from molecular genetics [16 Hours]	DNA Structure, Replication, Transcription and Translation	• Lecture • Discussion • **Problem solving** • **Participative learning**	Peer group discussion on theory and Word Problems	To understand the various methods of calculations and application in Biology Science	Evaluation through the Practical test papers.

LESSON PLAN: BIOPHYSICS

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I **Preparation of buffers and measurement of pH using pH meter.** **[8 Hours]**	Buffer systems and Measurements of pH using pH Meter.	• Lecture • Discussion • **Experiential learning**	Peer group discussion ith theory and Calculation of pH	To understand the procedure of measurement pH of solution using pH Meter.	Evaluation through the practical test paper.

LESSON PLAN: CYTOGENETICS

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*

Module I: **induction of polyploidy using colchicine; different methods of the application of colchicine** **[4 Hours]**	Polyploidy	• Lecture • Discussion • **Experiential learning**	Illustration	To understand the role of colchicine in inducing polyploidy.	Evaluation through the practical test paper.
Module III **Preparation of karyotype and ideogram of plant meristematic cells** **[6 Hours]**	Karyotype and Idiogram	• Lecture • Discussion • Problem solving • Participative learning	Peer group discussion on theory and Problems.	To understand Karyotype and Idiogram	Evaluation through the practical test paper.
Module V **Study of meiosis in translocation heterozygotes (*Rheo discolor*)** **[6 Hours]**	Meiosis and Translocation heterozygotes in Rheo	• Lecture • Discussion • **Experiential learning**	Peer group discussion on theory and Illustrations.	To understand Chromosome orientation in Rheo discolor in Meiosis.	Evaluation through the practical test paper.

COURSE OUTCOMES

The students who complete this course will be able to:

CO	CO Statement
CO1	Develop skills for Preparation of root tip cells for mitotic studies.
CO2	Equipped with Preparation of buffers and measurement of pH using pH meter
CO3	Analyze the working out problems from molecular genetics.
CO4	Identify and analyze polytene chromosomes
CO5	Develop drawing skills good Idiogram from given data.

BOT2C L03. PRACTICALS OF CELL BIOLOGY, MOLECULAR BIOLOGY, BIOPHYSICS, CYTOGENETICS,

(0.5 +1+ 0.5+1= 3 hours)
Practical Hours per week: 3, Credits: 5

Internal: 20%, External: 80%, Examination: 3 Hours

UNITWISE BREAK UP: CELL BIOLOGY

LECTURE HOURS: 8

OBJECTIVE:

a) *Develop skills for Preparation of root tip cells for mitotic studies.*
b) *To acquire knowledge about the importance and significance of colchicine in chromosomal studies.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	Study of Mitosis in root tip cells.	4	Check the knowledge of Mitosis	Lecture and Illustrations	Write notes on stages of Mitosis
Unit – 1	Onion root tip preparation and Identification of stages of Mitosis				
Module II	Pre-treatment of root tips with colchicine /hydroxy quinoline paradichlorobenzene and study of chromosomes in Chlorophytum, / Zea mays/ Crotalaria/ Cyanotis	4	Check the knowledge about Colchicine in cell division.	Lecture and Illustrations	Write notes on Significance of Colchicine in cell division.
Unit - 1	Colchicine treatment and Chromosome study				

UNITWISE BREAK UP: MOLECULAR BIOLOGY

LECTURE HOURS: 16

OBJECTIVE:

a. *To familiarize students with Solve the Problems from Molecular Genetics*
b. *To acquire knowledge about Central dogma of molecular Biology*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I	**Working out problems from molecular genetics**	16	Check the knowledge in central dogma of Biology .	Lecture Problem solving	To Work out more related problems
Unit – 1	DNA Structure, Replication, Transcription and Translation				

ITWISE BREAK UP: BIOPHYSICS

LECTURE HOURS: 8

OBJECTIVE:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories*
b. *To enable the students about preparation of buffers and measurement of pH using pH meter*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Preparation of buffers and measurement of pH using pH meter.**	**8**	Check Knowledge about buffer systems	Lecture Demonstration Problem Solving	To work out Problems relayed to buffer systems and Calculation of pH
Unit – 1	Buffer preparations, Measurement pH and Calculations				

UNITWISE BREAK UP: CYTOGENETICS

LECTURE HOURS: 16

OBJECTIVE:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *Develop skills for Preparation of root tip cells for mitotic studies.*
c. *Develop drawing skills for Idiogram from given data.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Induction of polyploidy using colchicine; different methods of the application of colchicine**	4	Check knowledge about the role of colchicine in cell division	Lecture Discussion Illustrations	To find out different methods of the application of colchicine
Unit – 1	Onion root tips with Colchicine Treatments				
Module III	**Preparation of karyotype and ideogram of plant meristematic cells**	6	Check the knowledge in Karyotyping and idiogram	Lecture Discussion Solve problems	To find the importance of Karyotyping and Idiogram
Unit – 1	Karyotype and Idiogram				
Module V	**Study of meiosis in translocation heterozygotes (Rheo discolor**	6	Check the knowledge in Stages of Meiosis	Lecture Discussion Illustrations.	Write a note on Translocation heterozygotes
Unit – 1	Flower Bud Preparation for Meiosis and stage Identification				

Teacher in Charge: Mrs. Sweety M. S.

BOT2L04. GENETICS, BIOSTATISTICS, PLANT BREEDING, PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY (0.5+0.5+0.5+0.5+0.5+0.5=3 hours)

Lecture Hours per week: 3, Credits: 2.5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *To develop the skill in hybridization technique and help to produce new varieties.*
c. *To familiarize students with Solve the Problems from Measures of dispersion, tests of significance and correlation analysis.*

Genetics

Module I:

Problems from linkage, tetrad analysis, quantitative genetics and population genetics.

Biostatistics

Module I:

Problems from Mean, standard deviation, Coefficient of variation, tests of significance and correlation analysis.

Module II:

Use of computer programmes for statistical analysis.

Plant Breeding

Module I:

Study of floral morphology and flower structure in crop plants- rice, cashew, pulses, Solanum, Capsicum.

Module II:

Practice of hybridization technique in self- and cross-pollinated plants mentioned in (1).

Module III:

Biometrical techniques in Plant Breeding- analysis of variability.

Ecology and Conservation biology:

Module I:

Determination of food chains and food web in aquatic ecosystem.

Module II:

Determination of the minimum size of the quadrat suitable for an area using species

area curve method.

Module III:

Determination of the Importance Value Index (lVl) of plant species in the community by quadrat, line and belt transect methods.

Module IV:

Comparative study of polluted and non-polluted aquatic ecosystems.

Module V:

Visit to a meteorological station, national park or wild life sanctuary, sewage treatment unit and major construction site.

Module VI:

Estimation of dissolved oxygen content in the water sample by Winkler's method.

Module VII:

Determination of primary production in water samples by light and dark bottle method (Winkler's method).

Module VIII:

Determination of dissolved carbon dioxide content in water samples.

Module IX:

Determination of frequency of plant species of an area and heterogeneity of vegetation using transect method.

Phytogeography

Module I:

Identification of the various floristic and vegetational regions of the world and India in maps.

Forest Botany

Module I:

Study of the major and minor forest products of Kerala and their uses.

- **Preparation and submission of lab record**
- **Visit to one plant breeding station and one ecologically sensitive area and submission of reports.**

BOT2L04. GENETICS, BIOSTATISTICS, PLANT BREEDING, PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY (0.5+0.5+0.5+0.5+0.5+0.5=3 hours)

Lecture Hours per week: 3, Credits: 2.5

Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *To develop the skill in hybridization technique and help to produce new varieties.*
c. *To familiarize students with Solve the Problems from Measures of dispersion, tests of significance and correlation analysis.*

LESSON PLAN: GENETICS

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning Outcome (Output)***	***Assessment***
Module I: Problems of Genetics: [8 Hours]	Problems from linkage, tetrad analysis, quantitative genetics and population genetics.	• Lecture • Discussion • Problem solving • Participative learning	Peer group discussion on theory and calculation	To understand the Problems from linkage, tetrad analysis, quantitative genetics and population genetics.	Evaluation through the test papers.

LESSON PLAN: BIOSTATISTICS

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning Outcome (Output)***	***Assessment***

Module I: **Problems of from Statistics** **[8 Hours]**	Mean, standard deviation, Coefficient of variation, tests of significance and correlation analysis.	• Lecture • Discussion • **Problem solving** • **Participative learning**	Peer group discussion on theory and calculation	To understand the various methods of calculations and application in Biology Science	Evaluation through the test papers.

LESSON PLAN: PLANT BREEDING

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning Outcome (Output)***	***Assessment***
Module I: **Floral morphology of plants** **[3 Hours]**	Study of floral morphology and flower structure in crop plants- rice, cashew, pulses, Solanum, Capsicum.	• Lecture • Discussion • **Experiential learning**	Dissection and Illustration	To understand the floral morphology	Evaluation through the practical exam
Module II: **Practice of hybridization technique** **[5 Hours]**	Practice of hybridization technique in self- and cross-pollinated plants mentioned in (1).	• Lecture • Discussion • **Experiential learning**	Dissection and Illustration	To understand the hybridization technique	Evaluation through the practical exam

LESSON PLAN: PLANT ECOLOGY AND CONSERVATION BIOLOGY

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning Outcome (Output)***	***Assessment***
Module I: **Aquatic ecosystem.** **[1 Hours]**	Determination of food chains and food web in aquatic ecosystem.	• Lecture • Discussion • **Experiential learning**	Illustration	To understand the	Evaluation through the practical exam
Module II: **Species area curve method.** **[1 Hours]**	Determination of the minimum size of the quadrat suitable for an area using species	• Lecture • Discussion • **Experiential**	Peer group discussion on theory	To understand the minimum size of the quadrat	Evaluation through the practical exam

	area curve method.	**learning**	and calculation	suitable for an area using species area curve method.	
Module III: Importance Value Index (lVl). [1 Hours]	Determination of the Importance Value Index (lVl) of plant species in the community by quadrat, line and belt transect methods.	• Lecture • Discussion • **Experiential learning**	Peer group discussion on theory and calculation Illustration	To understand the Importance of Value Index (lVl) of plant species in the community by quadrat	Evaluation through the practical exam
Module IV: Comparative study: [1 Hours]	Comparative study of polluted and non-polluted aquatic ecosystems.	• Lecture • Discussion • **Experiential learning**	Peer group discussion on theory and calculation Lab sessions	To understand the Importance of Comparative study of polluted and non-polluted aquatic ecosystems.	Evaluation through the practical exam
Module VI: Estimation of dissolved oxygen content in the water sample: [1 Hours]	By Winkler's method.	• Lecture • Discussion • Lab sessions • **Experiential learning**	Peer group discussion on theory and calculation Lab sessions	To understand the Importance of estimation of dissolved oxygen content in water	Evaluation through the practical exam
Module VII: Determination of primary production in water samples: [1 Hours]	By light and dark bottle method (Winkler's method).	• Lecture • Discussion • Lab sessions • **Experiential learning**	Peer group discussion on theory and calculation Lab sessions	To understand the Importance of determination of primary production in water samples	Evaluation through the practical exam
Module VIII: Determination of dissolved carbon dioxide content in water samples: [1 Hours]	In water samples.	• Lecture • Discussion • Lab sessions • **Experiential learning**	Peer group discussion on theory and calculation Lab sessions	To understand the Importance of estimation of dissolved carbon dioxide content in water	Evaluation through the practical exam
Module IX: Transect method: [1 Hours]	Determination of frequency of plant species of an area and heterogeneity of	• Lecture • Discussion • Lab sessions • **Experiential**	Peer group discussion on theory	To understand the Importance Determination	Evaluation through the practical exam

	vegetation	**learning**	and calculation Lab sessions	of frequency of plant species in greenland ecosystem.	

LESSON PLAN: PHYTOGEOGRAPHY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Floristic and vegetational regions [4 Hours]	Identification of the various floristic and vegetational regions of the world and India in maps.	• Lecture • Discussion • **Participative learning**	Illustration	To understand the various floristic and vegetational regions of the world and India in maps.	Evaluation through the drawing tests

LESSON PLAN: FOREST BOTANY

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning Outcome (Output)*	*Assessment*
Module I: Forest products of Kerala [4 Hours]	Study of the major and minor forest products of Kerala and their uses.	• Lecture • Discussion • **Participative learning** • **Experiential learning**	Collection of Specimens Illustations	To understand the various major and minor forest products of Kerala and their uses.	Evaluation through the test papers.

COURSE OUTCOMES

The students who complete this course will be able to:

CO	CO Statement
CO1	Describe Plant Population Details.
CO2	Demonstrate hybridization technique in different crop plants.
CO3	Solve the Problems from Measures of dispersion, tests of significance and correlation analysis.
CO4	Develop skills for estimation of dissolved oxygen content in the water sample by Winkler's method
CO5	Develop skills for estimation of primary production in water samples by light and dark bottle method (Winkler's method).
CO6	Identify of the various floristic and vegetational regions of the world and India in maps

BOT2L04. GENETICS, BIOSTATISTICS, PLANT BREEDING, PLANT ECOLOGY, CONSERVATION BIOLOGY, PHYTOGEOGRAPHY AND FOREST BOTANY (0.5+0.5+0.5+0.5+0.5+0.5=3 hours)

Lecture Hours per week: 3, Credits: 2.5

Internal: 20%, External: 80%, Examination: 3 Hours

UNITWISE BREAK UP: GENETICS

PRACTICAL HOURS: 8

OBJECTIVE:

a. *To familiarize students with Genetics and its application*
b. *To solve the problems related to linkage, tetrad analysis, quantitative genetics and population genetics.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Problems of Genetics:**	**8**	Check the knowledge in Genetics	Lecture Illustrations	To Work out more related problems
Unit – 1	Linkage				
Unit – 2	Tetrad analysis,				
Unit – 3	Quantitative genetics				
Unit – 4	Population genetics.				

UNITWISE BREAK UP: BIOSTATISTICS

PRACTICAL HOURS: 8

OBJECTIVE:

a. *To familiarize students with Solve the Problems from Measures of dispersion, tests of significance and correlation analysis.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Problems of from Statistics**	**8**	Check the knowledge	Lecture Illustrations	

			in Central tendencies and Measures of dispersion. To read the formulas of correlation analysis.	Group discussions	To Work out more related problems
Unit – 1	Mean				
Unit – 2	standard deviation				
Unit – 3	Coefficient of variation				
Unit – 4	tests of significance				
Unit – 5	correlation analysis.				

UNITWISE BREAK UP: PLANT BREEDING

PRACTICAL HOURS: 8

OBJECTIVE:

a. To develop the skill in hybridization technique and help to produce new varieties.

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Floral morphology of plants**	**3**			
Unit – 1	Study of floral morphology and flower structure in crop plants- rice, cashew, pulses, Solanum, Capsicum.		Collect the Specimen	Demonstration and Lecture	Draw the diagrams and label the parts
Module II:	**Practice of hybridization technique**	**5**			
Unit – 1	Practice of hybridization technique in self- and cross-pollinated plants mentioned in (1).		Collect the Specimen	Demonstration and Lecture	Draw the diagrams and label the parts

UNITWISE BREAK UP: PLANT ECOLOGY AND CONSERVATION BIOLOGY

LECTURE HOURS: 8

OBJECTIVE:

a. *To familiarize students with various techniques and develop skill in practical session for laboratories.*
b. *To familiarize Winkler's method and its applications in various fields.*
c. *To familiarize IVI and its applications in environment related studies.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Aquatic ecosystem.**	**1**			
Unit – 1	Determination of food chains and food web in aquatic ecosystem.		To read about food chains and food web in aquatic ecosystem.	Lecture Illustrations Group discussions	To find the more examples of food chains and food web in aquatic ecosystem.
Module II:	**Species area curve method.**	**1**			
Unit – 1	Determination of the minimum size of the quadrat suitable for an area using species area curve method.		To check the knowledge in species area curve method	Demonstration and Lecture	To draw the species area curve method based on provided data
Module III:	**Importance Value Index (lVl).**	**1**			
Unit – 1	Determination of the Importance Value Index (lVl) of plant species in the community by quadrat, line and belt transect		To check the knowledge in lVl and its important features.	Demonstration and Lecture	To draw the graph based on collected data and calculated values.
Module IV:	**Comparative study**	**1**			
Unit – 1	Comparative study of polluted and non-polluted aquatic ecosystems.		To read about the effect of pollution in	Demonstration and Lecture	To write the comment on effect of pollution in aquatic

			aquatic ecosystems.		ecosystems based on compared value.
Module VI	**Estimation of dissolved oxygen content in the water sample**	**1**			
Unit – 1	Winkler's method.		To check the knowledge in dissolved oxygen content	Demonstration and Lecture	To repeat the procedure with different samples collected from different areas.
Module VII:	**Determination of primary production in water samples:**	**1**			
Unit – 1	By light and dark bottle method (Winkler's method).		To check the knowledge in Winkler's method	Demonstration and Lecture	To repeat the procedure with different samples collected from different areas
Module VIII:	**Determination of dissolved carbon dioxide content in water samples:**	**1**			
Unit – 1	In water samples		To check the knowledge in dissolved carbon dioxide content in water samples	Demonstration and Lecture	To repeat the procedure with different samples collected from different areas
Module IX:	**Transect method:**	**1**			
Unit – 1	Determination of frequency of plant species of an area and heterogeneity of vegetation		To check the knowledge in heterogeneity of vegetation	Demonstration and Lecture	To collect the samples from different sites and mention the importance of heterogeneity of vegetation

UNITWISE BREAK UP: PHYTOGEOGRAPHY

PRACTICAL HOURS: 4

OBJECTIVE:

a. *To familiarize students with the various floristic and vegetational regions of the world and India in maps.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Floristic and vegetational regions**	**4**	To check the knowledge in Identification of the various floristic and vegetational regions of the world and India in maps	Lecture Illustrations Group discussions	To draw the maps of India and World and label various floristic and vegetational regions.
Unit – 1	Identification of the various floristic and vegetational regions of the world and India in maps				

UNITWISE BREAK UP: FOREST BOTANY

PRACTICAL HOURS: 4

OBJECTIVE:

a. *To familiarize students with the major and minor forest products of Kerala and their uses.*

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Forest products of Kerala**	**4**	To read the Scientific names, Family and Uses of major and minor forest products of Kerala.	Lecture Demonstration Illustrations Group discussions	Draw the major and minor forest products of Kerala and write the scientific names, Family and Uses.
Unit – 1	Study of the major and minor forest products of Kerala and their uses.				

Teacher in Charge: Mrs. Sreelakshmi V. V.

FOURTH SEMESTER

PG DEPARTMENT OF BOTANY

M. Sc. BOTANY COURCE PLAN

2020-2021

CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

M. Sc. Programme in Botany (CBCSS) (from 2020 admissions onwards)

Programme, structure of courses and distribution of credits

FOURTH SEMESTER

Sl. No.	Course	Title	Contact Hours	Credits	Internal	External	Total Credits
1.	**Elective**	**BOT4E01**: Elective I	6	5	20%	80%	5
2.	**Elective**	**BOT4E02**: Elective II	6	5	20%	80%	5
3.	**Practicals of Electives**	**BOT4L07**: Practicals of Electives	6	2	20%	80%	2
4.	**Dissertation**	**BOT4D01**: Dissertation	6	5	20%	80%	5
5.	**Viva voce**	**BOT4V01**: Viva voce		3	20%	80%	3
6.	**Seminar**		1	-	-	-	-
	Total		**25**	-			**5**

ELECTIVE: 1

BOT4E01: ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

Lecture Hours per week: 6, Credits: 5
Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

To understand about the need of conservation, Laws, organizations actively involved in conservation, global climate changes and its impacts and population studies

Module I: **(8 hours)**

Population ecology: Properties (concepts of rate, intrinsic rate of natural increase, carrying capacity, population fluctuations and cyclic oscillations, density independent and density dependent mechanisms of population regulation, patterns of dispersion, Allee principle of aggregation and refuging, home range and territoriality, energy partitioning and optimization, *r* and Kselection.

Module II: **(8 hours)**

Community ecology: Types of interaction between two species, coevolution, evolution of cooperation, group selection, interspecific competition and coexistence, positive and negative interactions, concepts of habitat, ecological niche and guild.

Module III **(5 hours)**

Human population: Expansion and its causes, rich and poor nations, consequences, dynamics, Cairo conference 1994.

Module IV: **(5 hours)**

Major global environmental challenges: Acid rain, Ozone depletion, climate disruption, deforestation, land degradation and desertification, freshwater degradation and shortage, marine fisheries decline, loss of biological diversity and excessnitrogen.

Module V: **(6 hours)**

Global initiatives: Stockholm conference (1972), Rio (1992), Ramsar convention (1971), Kyoto (199 7), Johannesburg (2002), Stockholm (2011).

Module VI: **(6 hours)**

Environmental Law- International and National: The Environment Protection Act & Rules 1986; Water (Prevention & Control of Pollution) Act 1974; Biodiversity Act(2002).

Module VII: **(7 hours)**

Thoughts on ecology: Contributions of Buddha, RabindranathaTagore, Mahatma Gandhi, Rachel Carson, GroHerlemBrundtland, VandanaSiva, Edward O Wilson, AldoLeopald.

Module VIII: **(10 hours)**

Biodiversity: a). Genetic diversity, agrobiodiversity and cultivated taxa, causes of decline, value of wild species, conservation practices- traditional (*upavanavinoda*, sacred groves, *sthalavrikshas*) and modern (*in situ* and *ex situ*). b). Biodiversity information management and communication- libraries, databases (taxonomic database working groups for plant sciences, data bases on biodiversity); distribution of biodiversity information, metadatabases, virtual libraries.

Module IX: **(4 hours)**

Ecosystem capital- use and restoration: Global perspective on biological systems; conservation, preservation and restoration. Biomes and ecosystems under pressure (forest biomes, ocean ecosystems).

Module X: **(5 hours)**

Habitat studies: Wetlands (Ramsar sites), mangroves and forest types of Kerala.

Module XI: **(6 Hours)**

Brief study of the following: Cybernetics, ecological foot print, sustainable development, deep ecology, Gaia hypothesis, conservation ethics, peoples' movements for biodiversity conservation, role of NGOs and educational institutions in biodiversity conservation, trade related IPR,ecotourism.

Module XII:

Climate change and its impacts- brief study. **(5 Hours)**

Module XIII:

Disaster management- basic aspects. **(5 Hours)**

References

Champion H.G. and Seth S.K. A Revised Classification of Forest Types of India. Govt. of India, New Delhi. GadgilMadhav. Ecological Journeys. Permanent Black, Delhi.

Jaiswal P.C. Soil Plant and Water Analysis. Kalyani Publishers, Ludhiana.

Krishnamurthy K.V. An Advanced Text Book on Biodiversity Principles and
Practice. Oxford IBH. Misra R. Ecology Workbook. Oxford IBH.
Odum E.P. and Barrett G.W. Fundamentals of Ecology. Thomson
Books, Bangalore. Palmer J.A. Fifty Thinkers on the Environment.
Routledge, London.
Puri G.S. Indian Forest Ecology. Oxford IBH.
Pushpangadan P. and Nair K.S.S. Biodiversity and Tropical Forests- The Kerala Scenario. STEC, Thiruvananthapuram.
Sarngdharacharyar. (Translated by Vishnu B.). *Vrukshaayurvedam*JanapriyaPusthakasala, Kottayam.
Sivadasan M. and Mohanan K.V. Biodiversity and Ecology: Concepts and Facts. Department of Botany, University of Calicut, Kerala.
SpethGustave James and Haas M. Peter. Global Environmental Governance. Pearson Longman, New Delhi.

ELECTIVE: 1

BOT4E01: ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION
Lecture Hours per week: 6, Credits: 5
Internal: 20%, External: 80%, Examination 3 Hours

OBJECTIVES:

To understand about the need of conservation, Laws, organizations actively involved in conservation, global climate changes and its impacts and population studies

LESSON PLAN- ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

Unit/session/hours (Time required)	*Topics for student preparation (Input)*	*Procedure (Process) Student centric Method of teaching*	*Activity*	*Learning outcome (out put)*	*Assessment*
Module I: **Population ecology** **(8 Hours)**	Properties (concepts of rate, intrinsic rate of natural increase, carrying capacity, population fluctuations and cyclic oscillations, density independent and density dependent mechanisms of population regulation, patterns of dispersion, Allee principle of aggregation and refuging, home range and territoriality, energy partitioning and optimization, r and Kselection.	Lecture Participative learning	Discussion	To understand about properties and mechanisms with in a population	Evaluation through Q&A

Module II: **Community ecology**: **(8 hours)**	Types of interaction between two species, coevolution, evolution of cooperation, group selection, interspecific competition and coexistence, positive and negative interactions, concepts of habitat, ecological niche andguild	Lecture Participative learning	Discussion	To understand about community ecology and interactions between two species	Evaluation through test paper
Module III **Human population** **(5 hour)**	. Expansion and its causes, rich and poor nations, consequences, dynamics, Cairo conference 1994.	Lecture Participative learning	Discussion	To understand about the human population expansion consequences, and preventive measures	Evaluation through test paper
Module IV: **Major global environmental challenges** (5 hours)	**:**Acid rain, Ozone depletion, climate disruption, deforestation, land degradation and desertification, freshwater degradation and shortage, marine fisheries decline, loss of biological diversity and excessnitrogen.	Lecture Participative learning	Discussion	To understand about the environmental challenges	Evaluation through test papers

Module V: Global initiatives . (6 hour) .	Stockholm conference (1972), Rio (1992), Ramsar convention (1971), Kyoto (199 7), Johannesburg (2002), Stockholm(2011).	Lecture Participative learning	Discussion	To understand the significance of global initiatives in biodiversity conservation	Evaluation through test papers
Module VI: Environmental Law- International and National (5 hours)	**:** The Environment Protection Act & Rules 1986; Water (Prevention & Control of Pollution) Act 1974; Biodiversity Act(2002).	Lecture Participative learning	Discussion	To understand the Laws of conservation of environment	Evaluation through Q&A
Module VII: Thoughts on ecology: (7 Hours)	Contributions of Buddha, RabindranathaTagore, Mahatma Gandhi, Rachel Carson, GroHerlemBrundtland, VandanaSiva, Edward O Wilson, AldoLeopald.	Lecture Participative learning	Discussion	To understand thoughts of ecologyby eminent persons	Evaluation through test papers
Module VIII: Biodiversity: (10 hours)	a). Genetic diversity, agrobiodiversity and cultivated taxa, causes of decline, value of wild species,	Lecture Participative learning	Discussion	To understand the traditional and modern concepts of conservation of biodiversity	Evaluation through Q&A

	conservation practices- traditional (*upavanavinoda*, sacred groves, *sthalavrikshas* and modern (*in situ* and *ex situ*). b). Biodiversity information – management and communication libraries,databases (taxonomic database working groups for plant sciences, data bases on biodiversity) distribution of biodiversity information, metadatabases, virtual libraries				
Module IX Ecosystem capital- use and restoration: (4 Hours)	Global perspective on biological systems; conservation, preservation and restoration. Biomes and ecosystems under pressure (forest biomes, oceanecosystems).	Lecture Participative learning	Discussion	To understand the ecosystem capital significance of conservation	Evaluation through Q&A
Module X: Habitat studies (5 Hours)	Wetlands (Ramsar sites), mangroves and forest types of Kerala	Lecture Participative learning	Discussion	To understand the structure and ecology of different ecosystems	Evaluation through test papers
Module XI: Brief study of the following: **(6 Hours)**	Cybernetics, ecological foot print, sustainable development, deep ecology, Gaia hypothesis, conservation ethics, peoples' movements for biodiversity conservation, role of	Lecture Participative learning	Discussion	To familiarize the terms cybernetics, deep ecology, Gaia hypothesis and study the role of NGO s in biodiversity conservation	Evaluation through test papers

	NGOs and educational institutions in biodiversity conservation, trade related IPR,ecotourism.				
Module XII: Climate change and its impacts-(5 Hours)	Brief study.	Lecture Participative learning	Discussion	To understand the consequences and preventive measures of climate change	Evaluation through test papers
Module XIII: Disaster management-.(5 Hours)	basic aspects	Lecture Participative learning	Discussion	To study the basic aspects of disaster management	Evaluation through Q&A

COURSE OUTCOME

The students who complete this course will be able to:

CO	CO Statement
CO2	Explain about global and regional initiatives for Climate change and Environmental Protection.
CO3	Analyze ecofriendly culture and to familiarize them with environmental ethics.
CO4	Describe the impact of climate change on ecosystem and role of people movements for biodiversity conservation
CO5	Aware different biodiversity information resources, meta-databases and virtual libraries.
CO6	Analyze biodiversity in terms of wild and agro biodiversity and its traditional conservation practices.
CO7	Identify and define about different types of habitats with reference to Kerala and India.
CO8	Apply the principles of conservation strategies in global perspective for the use and restoration of threatened ecosystem and sustainable development.

UNIT WISE BREAK UP: ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

Lecture hours: 80 hours

OBJECTIVES:

To understand about the need of conservation, Laws, organizations actively involved in conservation, global climate changes and its impacts and population studies

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Population ecology**	**(8 Hours)**	To learn about population characteristics	Lecture and discussion	To make short note on Population ecology
Unit – 1	Properties, concepts of rate, intrinsic rate of natural increase, carrying capacity,				
Unit – 2	population fluctuations and cyclic oscillations.				
Unit – 3	density independent and density dependent mechanisms of population regulation, patterns of dispersion				
Unit-4	Allee principle of aggregation and refuging, home range and territoriality				
Module II	**Community ecology**	**(8 hours)**	To check the knowledge of community ecology	Lecture and discussion	To make short note on Population ecology
Unit-1	Types of interaction between two species, coevolution,				
Unit-2	evolution of cooperation, group selection,				

Unit-3	interspecific competition and coexistence, positive and negative interactions,				
Unit-4	concepts of habitat, ecological niche andguild				
Module III	**Human population**	**(5 hours)**	To learn about human population	Lecture and discussion	Write a short note on human population
Unit-1	Expansion and its causes Cairo conference 1994				
Unit-2	rich and poor nations, consequences, dynamics,				
Unit-3	Cairo conference 1994				
Module IV:	**Major global environmental challenges**	(**5 hours)**	To check the knowledge of environmental challenges	Lecture and discussion	Write an assignment on Major global environmental challenges
Unit-1	Acid rain, Ozone depletion, climate disruption				
Unit-2	deforestation, land degradation and desertification, freshwater degradation and shortage				
Unit-3	marine fisheries decline, loss of biological diversity and excessnitrogen				
Module V:	**Global initiatives**	**(6 hours)**	To learn about global initiatives	Lecture and discussion	To write a note on global initiatives

Unit-1	Stockholm conference (1972), Rio (1992),				
Unit-2	Ramsar convention (1971), Kyoto (199 7)				
Unit-3	Johannesburg (2002), Stockholm(2011).				
Module VI:	**Environmental Law-International and National**	**(5 hours)**	To check the knowledge of environmental laws	Lecture and discussion	To write a note on environmental laws
Unit-1	The Environment Protection Act & Rules 1986;				
Unit-2	Water (Prevention & Control of Pollution) Act 1974;				
Unit-3	Biodiversity Act(2002).				
Module VII:	**Thoughts on ecology:**	**(7 Hours)**	To read about the views of eminent personalities	Lecture and discussion	To write a note on thoughts of Mahatma Gandhi
Unit-1	Contributions of Buddha, RabindranathaTagore				
Unit-2	Mahatma Gandhi, Rachel Carson,				
Unit-3	Edward O Wilson, AldoLeopald				
Unit-4	GroHerlemBrundtland, VandanaSiva				

Module VIII	**Biodiversity**	**(10 hours)**	To learn about conservation practices	Lecture and discussion	To Write a short note on conservation practices
Unit-1	a). Genetic diversity, agrobiodiversity and cultivated taxa,				
Unit-2	causes of decline, value of wild species,				
Unit-3	conservation practices-traditional (*upavanavinoda*, sacred groves, *sthalavrikshas*				
Unit-4	and modern (*in situ* and *ex situ*				
Unit-5	Biodiversity information –management and communication libraries,				
Unit-6	databases (taxonomic database working groups for plant sciences, data bases on biodiversity) distribution of biodiversity information				
Unit-7	metadatabases, virtual libraries				
Module IX	Ecosystem capital- use and restoration	**(5 hours)**	To learn about ecosystem capital	Lecture and discussion	TO write a short note on ecosystem capital
Unit-1	Global perspective on biological systems conservation, preservation and restoration.				
Unit-2	Biomes and ecosystems under pressure (forest biomes, ocean ecosystems				
Module X:	**Habitat studies**	(**5 Hours)**	To learn about different habitats	Lecture and discussion	Write an assignment on wetlands, mangroves and forest types of kerala
Unit-1	Wetlands (Ramsar sites),				

Unit-2	mangroves				
Unit-3	forest types of Kerala				
Module XI:	Brief study of the following	**(6 Hours)**	To read about cybernetics	Lecture and discussion	Write an assignment on cybernetics,IPR Ecotourism, NGOs, ecological foot print
Unit-1	Cybernetics, ecological foot print, sustainable development				
Unit-2	deep ecology, Gaia hypothesis, conservation ethics				
Unit-3	peoples' movements for biodiversity conservation,				
Unit-4	role of NGOs and educational institutions in biodiversity conservation,.				
Unit-5	trade related IPR,ecotourism				
Module XII: .	**Climate change and its impacts**	**(5 Hours**)	To read about climate change	Lecture and discussion	To write an assignment on climate change and its impacts
Unit-1	brief study on Climate change and its impacts				
Module XIII:	**Disaster management**	**(5 Hours)**	To read about disasters	Lecture and discussion	To write an assignment on disaster management
Unit-1	basic aspects of disaster management				

Teacher in Charge: Mrs. Sabeena A. M.

ELECTIVE: II

BOT4E01: GENETIC ENGINEERING

Lecture Hours per week: 6, Credits: 5
Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a) To familiarize student with the general procedure of gene cloning.
b) To develop knowledge among students about various techniques employed in the creation of transgenic crops and the ethical issues involved.
c)To familiarize student with gene therapy strategies and its application in medical field.

Module I: **[8 Hours]**

Structure of genes in prokaryotes and eukaryotes. Genetic code and codons. Gene expression.

Module II: **[12 Hours]**

Recombinant DNA technology: Tools of rDNA technology, methods of creating rDNA molecules, restriction mapping, isolation and separation of genetic material, southern, northern, western, southwestern and northwestern blotting techniques. Gene transfer techniques in plants- Agrobacterium mediated transfer, gene gun method, electroporation, microinjection, chemical methods.

Module III: **[10 Hours]**

Molecular markers- RAMPO, SSCP, RFLP, RAPD, AFLP, EST markers, Repetitive DNA, Microsatellite and Minisatellite.

Module IV: **[8 Hours]**

DNA sequencing- chemical and enzymatic methods. Importance of DNA sequencing.

Module V: **[7 Hours]**

Gel electrophoresis- techniques for visualization and reading sequences.

Module VI: **[6 Hours]**

Polymerase Chain Reaction- history, methodology of PCR. Variations from Basic PCR- reverse transcriptase PCR, nested PCR, inverse PCR- applications of PCR.

Module VII: **[4 Hours]**

DNA profiling- history, methodology of genetic fingerprinting- applications.

Module VIII: **[10 Hours]**

Genetic engineering for crop improvement – transgenic plants.

Module IX: **[3 Hours]**

Cloning of genes and production of vaccines, drugs, growth hormones and chemicals.

Module X: **[4 Hours]**

Gene therapy- types of gene therapy. Getting transgenes in to patients- viral and non-viral approaches. Success of gene therapy.

Module XI: **[4 hours]**

Abatement of pollution through genetically engineered microorganisms- an emerging approach towards environmental clean-up programmes.

Module XII: **[4 hours]**

Nanotechnology and its applications in genetic engineering.

References

1. Hartl D.L. and Jones E.W. Genetics- Analysis of genes and genome. Jones and Bartlett Publishers. Nicholl Desmond S.T. An Introduction to Genetic Engineering. Cambridge Pub.
2. Brown T.A. Gene Cloning and and DNA Analysis. Blackwell Science Pub. Dubey R.C. A Text Book of Biotechnology. Chand Pub.
3. Singh B.D. Biotechnology. Kalyani Publishers.
4. Walker and Rapley. Molecular Biology and Biotechnology. Panima Pub. Chrispeels M.J. and Sadava D.E. Plants, Genes and Agriculture.
5. Lewin B. Genes. Oxford University Press.
6. Mason A.C. Principles of Gene Manipulation and Genomics.
7. Rissler J. and Mellon M. The Ecological Risks of Engineered Crops. MIT Press, Cambridge. Avice, John C. The Hope, Hype and Reality of Genetic Engineering.
8. McYYan R.P. Genetics and Genetic Engineering. Saras Publications. Narayana L.M. Molecular Biology and Genetic Engineering.
9. Khadpekar N.R. The Age of Nanotechnology. ICFAI University Press, Hyderabad. Nalwa H.R. Encyclopedia of Nanoscience and Technology.

ELECTIVE: II

BOT4E01: GENETIC ENGINEERING
Lecture Hours per week: 6, Credits: 5
Internal: 20%, External: 80%, Examination: 3 Hours

OBJECTIVES:

a) To familiarize student with the general procedure of gene cloning.
b) To develop knowledge among students about various techniques employed in the creation of transgenic crops and the ethical issues involved.
c)To familiarize student with gene therapy strategies and its application in medical field.

LESSON PLAN: GENETIC ENGINEERING

Unit/ session/ hours (time Required	***Topics for student preparation (input)***	***Procedure (process) Student centric Method of teaching***	***Activity***	***Learning outcome (output***	***Assessment***
Module I Structure of genes in prokaryotes and eukaryotes [8 Hours]	Genetic code and codons. Gene expression.	• Lecture • Discussion • **Experimental learning**	Group discussions	To understand Structure of genes in prokaryotes and eukaryotes	Evaluation through test paper
Module II Recombinant DNA technology [12 Hours]	Tools and methods of rDNA technology, Restriction mapping, Isolation and separation of genetic material, Blotting techniques- southern, northern, western, southwestern and northwestern. Gene transfer techniques in plants-	• Lecture • Discussion • **Experimental learning** • **Participative learning**	Group discussions. Lab sessions (Isolation and separation of genetic material from onion)	To understand the significance of recombinant DNA technology	Evaluation through test paper
Module III Molecular markers [10 Hours]	RAMPO, SSCP, RFLP, RAPD, AFLP, EST markers, Repetitive DNA, Microsatellite and Minisatellite.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the role of different molecular markers	Evaluation through test paper

Module IV DNA sequencing [8 Hours]	Chemical and enzymatic methods. Importance of DNA sequencing	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance DNA sequencing	Evaluation through test paper
Module V Gel electrophoresis [7 Hours]	Techniques for visualization and reading sequences.	• Lecture • Discussion • **Participative learning** • **Experimental learning**	Group discussions Lab sessions (Gel preparations)	To understand application of Gel electrophoresis	Evaluation through test paper
Module VI Polymerase Chain Reaction. [6 Hours]	History and methodology of PCR. Reverse transcriptase PCR, nested PCR, inverse PCR and applications	• Lecture • Discussion • **Participative learning**	Group discussions	To understand application of various types of PCR	Evaluation through test paper
Module VII DNA profiling [4 Hours]	History, Methodology and applications.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the Methodology and applications.	Evaluation through test paper
Module VIII: Genetic engineering for crop improvement [10 Hours]	Transgenic plants.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the Importance of GMOs.	Evaluation through test paper
Module IX: Cloning of genes and production of vaccines, drugs, growth hormones and chemicals [3 hours]	Vaccines, drugs, growth hormones and chemicals	• Lecture • Discussion • **Participative learning**	Group discussions	To understand Applications of gene cloning in different fields.	Evaluation through test paper
Module X: Gene therapy. [4 hours]	Types, of gene therapy, viral and non-viral approaches and Success of gene therapy Getting transgenes in to patients-	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance and importance of gene therapy	Evaluation through test paper

				in Medical field.	
Module XI: Abatement of pollution through genetically engineered microorganisms. [4 hours]	Definitions – Classifications- Superbugs, Bioremediation- an emerging approach towards environmental clean-up programmes using genetically engineered microorganisms.	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance and importance of Bioremediation and and use of Genetically Modified Organisms in Environment cleanup programmes	Evaluation through test paper
Module XII: Nanotechnology [4 hours]	Definition- Classification- Applications	• Lecture • Discussion • **Participative learning**	Group discussions	To understand the significance and importance of Nanotechnology	Evaluation through test paper

COURSE OUTCOME

CO	CO Statement
CO1	Outline the general procedure of gene cloning and Prospects, achievements and demerits of Transgenic Organisms.
CO2	Aware of gene therapy strategies and its application in medical field.
CO3	Evaluate the basic concepts of genome organization in plants. and about different molecular markers and its application
CO4	Evaluate the merits and demerits of different tools used in Recombinant DNA technology
CO5	Describe the importance of bio-nanotechnology in medicine and bioremediation and its biosafety concerns.

UNITWISE BREAK UP: GENETIC ENGINEERING

LECTURE HOURS: 80

OBJECTIVE:

a) To familiarize student with the general procedure of gene cloning.
b) To develop knowledge among students about various techniques employed in the creation of transgenic crops and the ethical issues involved.
c)To familiarize student with gene therapy strategies and its application in medical field.

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Structure of genes in prokaryotes and eukaryotes**	**8**	Check the knowledge in Genetic code and codons	Lecture and Discussion Illustration	To make short notes on Characteristics of Genetic code and codons.
Unit – 1	Genetic code and codons.				
Unit – 2	Gene expression				
Module II:	**Recombinant DNA technology**	**12**	To read on the Concepts of rDNA technology	Lecture and Discussion Illustration	To make notes on restriction mapping and blotting technique.
Unit – 1	Tools and methods of rDNA technology				
Unit – 2	Restriction mapping				
Unit – 3	Isolation and separation of genetic material				
Unit – 4	Blotting techniques -southern, northern, western, southwestern and northwestern.				
Unit – 5	Gene transfer techniques in plants				
Module III:	**Molecular markers**	**10**	To learn the steps in RFLP and RAPD	Lecture and Discussion	To prepare the notes on molecular markers.
Unit – 1	RAMPO, SSCP, RFLP, RAPD, AFLP, EST markers				

Unit – 2	Repetitive DNA- Microsatellite and Minisatellite				
Module IV:	**DNA sequencing**	**8**	To read the Concepts and Importance of DNA sequencing	Lecture and Illustration Discussion	To Write about chemical and enzymatic methods of sequencing.
Unit – 1	Chemical and enzymatic methods. Importance of DNA sequencing				
Module V:	**Gel electrophoresis**	**7**	To learn the steps in Gel electrophoresis	Lecture and Illustration Discussion	To prepare detailed notes on techniques for visualization and reading sequences
Unit – 1	Techniques for visualization and reading sequences				
Module VI	**Polymerase Chain Reaction**	**6**	To read the steps in PCR and its applications.	Lecture and Illustration Discussion	To make short note various types of PCR
Unit – 1	History and methodology of PCR				
Unit – 2	Reverse transcriptase PCR, nested PCR, inverse PCR and applications				
Module VII	**DNA profiling**	4	Check the knowledge in DNA profiling and its applications	Lecture and Illustration Discussion	To make short notes on Methodology and applications.
Unit – 1	History, Methodology and applications				
Module VIII	**Genetic engineering for crop improvement**	10	Check the knowledge in GMOs	Lecture and Illustration Discussion	To make short notes on GMOs
Unit – 1	Transgenic plants.				
Module IX:	**Cloning of genes and production of vaccines, drugs, growth hormones and chemicals**	3	To learn about gene cloning	Lecture and Discussion	To make short note on applications of about gene cloning
Unit – 1	vaccines, drugs, growth hormones and chemicals				
Module X:	**Gene therapy**	4	To learn about gene therapy	Lecture and Discussion	To make short note on applications of

Unit – 1	Types, viral and non-viral approaches and Success of gene therapy Getting transgenes in to patients				about gene therapy
Module XI:	**Abatement of pollution through genetically engineered microorganisms**	**4**	To learn about pollution and its causes and Bioremediation	Lecture and Discussion	To make short note on significance of GMOs in environment cleanup programes
Unit – 1	Pollution abatement and superbugs				
Unit – 2	Bioremediation				
Unit – 2	Xenobiotic compounds and significance of Genetically modified organism in pollution abatement.				
Module XII:	**Nanotechnology**	**4**	To learn about nanoparticles	Lecture and Discussion	To make short note on Nanotechnology and its application in human life.
Unit – 1	Definition-Classification and Applications				

Teacher in Charge: Mrs. Sreelakshmi V. V.

PRACTICALS OF ELECTIVES

BOT4L07- PRACTICALS OF ENVIRONMENTAL BIOLOGY & BIODIVERSITY CONSERVATION AND GENETIC ENGINEERING

Lecture Hours per week:(3 + 3 = 6 hours), Credits: 5

Internal: 20%, External: 80%, Examination: 6 Hours

PRACTICALS OF ENVIRONMENTAL BIOLOGY & BIODIVERSITY CONSERVATION

1. Studies on the following and submission of reports: Waste water treatment plant, local environmental peculiarities (such as hillocks and forest patches), wet land ecosystem, alien invasive plants, degraded ecosystem, different forest types, effluent treatment system).
2. Physical and chemical analysis of soil and water: Particle size analysis of soil, estimation of particle density using relative density or volumetric flask; Air capacity analysis of soil by field method; Soil pH analysis of soil using pH meter. Water analysis for pH using pH meter, estimation of BOD by Winkler's method (dark and light bottles).
3. Study of community structure: Charting and mapping of vegetation, Raunkiaer's life forms, biological spectrum, profile diagram (soil).
4. Study of ecological succession: Different types of ecological successions.
5. Visit to an ecological sensitive area and submission of a report.

COURSE OUTCOME

The students who complete this course will be able to:

CO	CO Statement
CO1	Develop Skills on determination of Physical and chemical analysis of soil and water.
CO2	Understand different forest Types and Ecosystems.
CO3	Familiarize with invasive plants and degraded ecosystems.
CO4	Understand the estimation of BOD
CO5	Understand charting and mapping of Vegetation.

PRACTICALS OF GENETIC ENGINEERING

1. Working out problems in genetic engineering.
2. Isolation of plant DNA and its quantification by spectrophotometer.
3. Isolation of plasmid DNA from E.coli.
4. Gel electrophoresis- gel preparation, casting, elution and staining.
5. Visualization of DNA by agarose gel electrophoresis and gel reading.
6. Construction of coding sequence of DNA using amino acid sequence.
7. Visit to a genetic engineering lab and submission of a report.

COURSE OUTCOME

The students who complete this course will be able to:

CO	CO Statement
CO1	Develop skills on DNA Isolation and Gel casting.
CO2	Understand the problem-solving methods in to Restriction Mapping.
CO3	Solve problems related to central dogma of Biology.
CO4	Understand the tools and Equipment's used in Recombinant DNA Technology.
CO5	Understand about dyes used in visualization of DNA.

LESSON PLAN- PRACTICALS OF ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION AND GENETIC ENGINEERING

OBJECTIVE:

Develop Skills on determination of Physical and chemical analysis of soil and water, understand charting and mapping of Vegetation, and develop skills on DNA Isolation and Gel casting.

Unit/session/hours (Time required)	***Topics for student preparation (Input)***	***Procedure (Process) Student centric Method of teaching***	***Activity***	***Learning outcome (out put)***	***Assessment***
Module I: Soil pH analysis **(5 Hours)**	Soil pH analysis of soil using pH meter	Experimental learning	Discussion	To understand how pH of soil is calculate using pH meter	Evaluation through Q&A Write notes in record
Module II: Estimation of BOD (5 Hours)	Estimation of BOD by Winkler's method	Experimental learning	Discussion	To understand about how BOD of water samples is measure by Winkler's method	Evaluation through practical test paper Write notes in record
Module III: Study of community structure (7Hours)	Charting and mapping of vegetation, Raunkiaer's life forms,profile diagram (soil).	Experimental learning	Discussion	To understand mapping of vegetation and IVI calculation	Evaluation through practical test paper and problems Write notes in record

Module IV : Study of ecological succession (3Hours)	Different types of ecological successions	Experimental learning	Discussion	To understand ecological succession	Evaluation through practical test paper Write notes in record
Module V: Working out problems in genetic engineering. (8 Hours)	Problems in genetic engineering.	Experimental learning	Discussion	To understand pboblems	Evaluation through practical test paper and problems Write notes in record
Module VI: Gel electrophoresis (8 Hours)	Gel preparation, casting, elution and staining.	Experimental learning	Discussion	To understand gel electrophoresis	Evaluation through practical test paper Write notes in record
Module VII: Construction of coding sequence of DNA using amino acid sequence. (4 hours)	Construction of coding sequence of DNA using amino acid sequence.	Experimental learning	Discussion	To understand construction of coding sequence of DNA using amino acid sequence.	Evaluation through practical test paper, problems Write notes in record

UNIT WISE BREAK UP: PRACTICALS OF ENVIRONMENTAL BIOLOGY & BIODIVERSITY CONSERVATION AND GENETIC ENGINEERING

PRACTICAL HOURS: 40

OBJECTIVE:

Develop Skills on determination of Physical and chemical analysis of soil and water and Understand charting and mapping of Vegetation and develop skills on DNA Isolation and Gel casting.

Module Number	***Topic***	***No. of Lecture Hours***	***Pre-class activity***	***Pedagogy (in class)***	***Out of class assignment***
Module I:	**Soil pH analysis**	**5**	To learn about procedure of pH analysis	Discussion and practical	To write short note on soil pH
Unit-1	Soil pH analysis of soil using pH meter				
Module II:	**Estimation of BOD**	**5**	To learn about procedure of Winkler's method	Discussion and practical	To write short note on winkler's method
Unit-1	Estimation of BOD by Winkler's method				
Module III:	**Study of community structure**,	**7**	To read the procedure of mapping of vegetation	Discussion, illustrations and practical	To write short note on Raunkaier;s life forms Problems on IVI Draw soil profile
Unit-1	Charting and mapping of vegetation, Raunkiaer's life forms				
Unit-1I	Profile diagram (soil).				
Module IV:	**Study of ecological successions**	**3**	To learn ecological successions	Discussion, illustrations	To write short note on ecological successions
Unit-1	Different types of ecological successions				
Module V:	**Working out problems in genetic engineering.**	**8**	To learn about problems in genetic engineering	Discussion	Problems on genetic engineering

Unit-1	Working out problems in genetic engineering				
Module VI:	**Gel electrophoresis**	**8**	To learn about Gel electrophoresis	Discussion practical	To write short note on Gel electrophoresis
Unit-1	Gel preparation, casting, elution and staining				
Module VII:	**Construction of coding sequence of DNA using amino acid sequence.**	**4**	To learn about Construction of coding sequence	Discussion practical	To write short note on Construction of coding sequence of DNA using amino acid sequence
Unit-1	Construction of coding sequence of DNA using amino acid sequence.				

Teacher in Charge: Mrs. Sabeena A. M.