Learning Outcomes-based Curriculum Framework (LOCF) for

Post-graduate Programme

NAME OF THE PROGRAMME

M.Sc. GENETICS AND PLANT BREEDING

(Syllabus effective from 2020 Admission)

UNIVERSITY OF KERALA

DEPARTMENT OF BOTANY

2020

PREAMBLE

The role of higher education is vital in securing the gainful employment and providing further access to higher education comparable to the best available in the world-class institutions elsewhere. The improvement in the quality of higher education, therefore, deserves to be given tom-most priority to enable the young generation of students to acquire skill, training and knowledge to enhance their thinking, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce and professional streams of higher education.

One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. The University Grants Commission (UGC) took the initiative of implementing the LOCF in the Colleges and the Universities of the country. Accordingly, the University of Kerala has decided to implement the LOCF in all its departments under the auspices of Internal Quality Assurance Cell (IQAC). A series of teacher training workshops were organised by IQAC and the office of the Credit and Semester System (CSS), and the departments have revised the syllabus accordingly, through workshops and in consultation with academic experts in the field.

GRADUATE ATTRIBUTES (GAs)

The Graduate Attributes (GAs) reflect particular qualities and abilities of an individual learner including knowledge, application of knowledge, professional and life skills, attitudes and human values that are required to be acquired by the graduates of University of Kerala. The graduate attributes include capabilities to strengthen one's professional abilities for widening current knowledge and industry-ready skills, undertaking future studies for global and local application, performing creatively and professionally, in a chosen career and ultimately playing a constructive role as a socially responsible global citizen. The Graduate Attributes define the characteristics of learners and describe a set of competencies that are beyond the study of a particular area and programme.

The GAs of University of Kerala

- Continue life-long learning as an autonomous learner
- Continuously strive for excellence in education
- Apply and nurture critical and creative thinking
- Promote sustainable development practices
- Promote co-operation over competition
- Balance rights with responsibilities
- Understand and respect diversity & difference
- Not be prejudiced by gender, age, caste, religion, or nationality.
- Use education as a tool for emancipation and empowerment of humanity

ABOUT THE DEPARTMENT

Department of Botany, University of Kerala, was established in the year 1959 at Kariavattom, Thiruvananthapuram, Kerala by Late Prof. (Dr.) A. Abraham, a visionary, an institution builder and a doyen in Cytogenetics and Plant Breeding. The Department actively serves the society through dissemination of knowledge and training the younger generation through unique courses and offering training in frontier areas of Plant Sciences. The Department is internationally known for its major contributions in Cytogenetics and Cytotaxonomy and for running a novel postgraduate programme in Genetics and Plant Breeding. The Department is also active in Plant Biotechnology research and has well established Cell/Tissue culture and Molecular Biology Laboratories. More than 250 students/teachers have taken PhD from the Department on various and diverse topics and more than 280 students have successfully completed their M. Phil programme in Advanced Botany.

The Vision….

- To serve the society through dissemination and field orientation of knowledge and training the best talents in Plant Sciences.

The Mission….

- To provide quality education in Plant Sciences;
- To develop human resources with hands on experience on basic/ applied Plant Science research;
- To act as a centre for mining of biomolecules, genes and technologies of immense practical application for human welfare;
- To undertake basic, strategic and applied research for generating fool-proof technologies for the advancement of plant science
- Create social awareness in biodiversity conservation and sustainable utilization of bioresources and
- To become a Center of Excellence in Plant Science teaching and research in next five years

UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY

Syllabus for M.Sc. Programme in Genetics and Plant Breeding
Programme code: 815

Programme Specific Outcomes (PSO) for M Sc Genetics and Plant breeding

PSO 1	**Understand the interdisciplinary approach of Genetics and Plant breeding**
PSO 2	**Develop skills in breeding practices, crop management strategies, improvement in crop characters under stress**
PSO 3	**Gain experience in technology rich and integrated research and training**
PSO 4	**Pursue a career in Academic and Research Institutes as well as Industry**

Programme Structure of M.Sc Genetics and Plant Breeding
Programme Code 815

Semester	Course Code	Name of the course	Credits
I	Core Courses (CC)		
	BOT-CC- 511	Mendelian Genetics	4
	BOT-CC- 512	Biophysics, Biological Techniques and Research Methodology	4
	BOT-CC- 513	Cytology	4
	Discipline-Specific Elective (DE)		
	BOT-DE- 514	Diversity in Cryptogamae and Gymnospermae	**2**
II	Core Courses (CC)		
	BOT-CC-521	Molecular Genetics	4
	BOT-CC-522	Cytogenetics	4
	BOT-CC-523	Plant Breeding	4
	BOT-CC-524	Plant Physiology and Biochemistry	4
	Discipline-Specific Elective (DE)		
	BOT-DE-525	Bioinformatics	**2**
III	Core Courses (CC)		
	BOT-CC-531	Genetic Engineering	4
	BOT-CC-532	Plant Biotechnology	4
	BOT-CC- 533	Environmental Genetics	4
	BOT-CC-534	Modern Methods in Crop Breeding	4
	Discipline-Specific Elective (DE)		
	BOT-DE-535	Applied Palynology	**2**
	BOT-DE-536	Phytochemistry	**2**
IV	Core Courses (CC)		
	BOT-CC-541	Population & Evolutionary Genetics	**4**
	BOT-CC-542	Developmental Genetics	**4**

	BOT-CC-543	Biosystematics	**4**
	DISSERTATION BOT-D-444	Dissertation	**4**
Any semester (I-IV)	Generic Courses (GC)		
	BOT-GC-501	Plant Tissue Culture	**2**
	BOT-GC-502	Microbial Technology	**2**
	BOT-GC-503	Plant Cell Culture Technology	**2**
	BOT-GC-504	Principles of Gardening	**2**
	BOT-GC-505	Transgenic Plants	**2**
	BOT-GC-506	Ethnobotany	**2**
Any semester (I-IV)	Skill Enhancement Elective (SE)		
	BOT-SE-501	Plant Propagation and Nursery Management	**2**

SEMESTER I	Course Code: BOT- CC- 511	Credits: 4

NAME OF THE COURSE: MENDELIAN GENETICS

COURSE OUTCOMES (CO)

CO1 : Assess the variations in the inheritance pattern and apply this skill in the day today life.
CO2 : Analyse the data in the genetics using basic statistical methods.
CO3 : List out various types of sex determination mechanisms in different organisms and there by develop new strategy for propagation and improvement.

COURSE CONTENT

MODULE1: Mendelism: Mendel's experimental approach to study the pattern of inheritance, Monohybrid cross-the principles of dominance and segregation, Dihybrid cross-the principle of independent assortment. Applications of Mendelian Genetics, Trihybrid cross, Test Cross, Back Cross, Punnet square, Forkedline method.

MODULEII: Testing genetic hypothesis, Laws of probability, Binomial theorem, Chi-Square analysis, Pedigree analysis. Human disorders follow Mendelian patterns of inheritance, Genetic counseling,Genome imprinting, Gene amplification.

MODULEIII: Extending Mendelian Genetics-Modified Mendelian ratios,Incomplete dominance, Codominance, Multiple alleles. Lethal alleles. Epistasis, X linkage in *Drosophila*, X-linkage in humans, Sex limited and sex influenced inheritance, Hollandric genes, Penetrance and expressivity, Pleiotropy.

MODULEIV: Quantitative Genetics- Quantitative traits in Mendelian terms, frequency distribution, measures of central tendency (mean, median, mode), measures of variability (standard error, standard deviation, variance), correlation coefficient, regression. Heritability, partitioning variance, broad and narrow sense heritability, artificial selection, overview on QTL Analysis.

MODULEV: Sex determination and Sex Linkage-Mechanism of sex determination in *Drosophila*, humans and plants, XY, ZW and XO mechanism. Barr bodies, Lyon's hypothesis, dosage compensation in *Drosophila*..Chromosome theory of heredity, Experimental evidence linking inheritance to chromosomes, The chromosomal basis of Mendel's Principles of segregation and independent assortment, Coupling and repulsion theory, Non-disjunction as a proof of chromosome theory. Sex linked gens in Humans, Genes on the Human Y chromosomes. Linkage, Cytological basis of crossing over, Works of Stern in *Drosophila*, Creighton and McClintock in Maize, Chromosome mapping, two factor crosses, three factor crosses, Interference.

MODULE VI. Cytoplasmic inheritance: Introduction, characteristic features, genetic significance. Classes of cytoplasmic inheritance - Maternal effects, inheritance involving

infective particles, maternal inheritance, uniparental inheritance. Genetics of mitochondria and chloroplasts, mutations of mitochondria and human disorders

PRACTICALS

1. Problems related to Mendel's laws, Probability, Pedigree analysis
2. Problems related to codominance, multiple alleles, lethal alleles, epistasis, X linkage, sex limited and sex influenced inheritance.
3. Problems related to statistical analysis of polygenic traits, artificial selection and heritability.
4. Problems related linkage: Two-point test cross, three point mapping in *Drosophila*, Determination of gene sequences, Interference
5. Sex determination in *Drosophila*, humans and plants
6. Problems related to Maternal inheritance, Uniparental inheritance, Infectious heredity, Maternal effect

LEARNING RESOURCES

REFERNCES

- Atherly, A.G., Girton, J.R. and Mc Donald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, New York
- Benjamin A. Pierce (2020), Genetics: A Conceptual Approach Seventh Edition. Macmillan.
- Benjamin A. Pierce. (2003). Genetics: A Conceptual Approach. W.H, Freeman and Company, New York, NY.
- Daniel L. Hartl, (2019). Genetics: Analysis of Genes and Genomes, Ninth Edition. Jones & Bartlett Learning, LLC an Ascend Learning Company
- Gardner E.J., Simmons, M.J., and Snustad, D.P. (2014). Principles of Genetics, John Wiley & Sons Inc. (Reprint, student edn.,) McGraw Hill, New Delhi
- Griffith A.F. J., Wessler S.R., Connell S.B.andDobley, J. (2012). An Introduction to Genetic analysis (10th edition). W.H Freeman & Company, Palgrave Macmillan, India.
- Hartl D. L. and Jones E.W. (2001). Genetics an analysis of Genes and Genomes (5th edition). Jones & Bartlett Publishers, Boston
- Klung, W. and Cummings, M. R.(2003).Concepts of Genetics.(7thedition) Pearson Education, Singapore.
- Pierce, B. A. (2012). Genetics: A conceptual approach. New York: W.H. Freeman and Company, New York.
- Russell, P.J. (2005). Genetics A Molecular Approach (2nd edition). Pearson/Benjamin Cummings, San Francisco.
- Stanley Malloy and Kelley Hughes (2013) Brenner's Encyclopedia of Genetics (2ndedn.)

- Stansfield, W. (2002) Genetics (4rth edition, reprint edn), Schaum's outline series, McGraw Hill, New York.
- Strachnan and Read, (2011) Human Molecular Genetics. Garland Science, Taylor and Francis group
- Weaver, R.F and Hedrick P.W. (1997).Genetics (3rd edition), Wm. C Brown Publishers. Toronto.
- William Stansfield (2020), Schaum'S Easy Outline Of Genetics 1st Edition, 9389538815 · 9789389538816

Model question paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
First Semester M.Sc. (CSS1) Degree Examination
Branch: Genetics and Plant Breeding
BOT- CC- 511 MENDELIAN GENETICS

Time: Three hours Maximum marks: **40**

I. Answer all questions in one word or sentence

1. Who discovered linkage?
2. State the law of independent assortment
3. Explain the importance of Barr bodies.
4. What is the sex of *Drosophila* with AAXXY genotype?
5. To determine the homozygosity, the organism has to be crossed with which parent? What will be genotypic ratio of the progenies?
6. Give an example for sex limited trait in humans
7. Write the term for plant which produces only one type of gamete
8. What will be the genotype of progenies of a homozygous male parent with a homozygous female parent?
9. Explain the tern narrow sense heritability.
10. Explain maternal inheritance.

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Differentiate between coupling phase and repulsion phase. Predict the outcome of progenies in both cases
12. Define chromosome theory of heredity. Who proposed it?
13. With suitable example explain the phenomenon of codominance.
14. Explain penetrance
15. Rats homozygous for yellow alleles for coat colour will survive or not? Explain
16. Compare quantitative and qualitative traits. What are quasi-quantitative traits?
17. Describe the inheritance of 'poky trait' in *Neurospora*

(5X2= 10 marks)

III. Answer any ***four*** of the following Each answer not exceeding 150 words

18. Explain the experiments conducted by Calvin Bridges to discover sex determination in *Drosophila*
19. Morgan crossed red eyed female *Drosophila* with white male flies. What was the result obtained in F1 and F2 generation? What is the result of reciprocal cross? Give a genetic explanation for the results.
20. An actress with O type blood accused a producer with AB type blood of being the father of her child in a paternity suit. The child was also O type. How do you provide evidence for the case?
21. Differentiate dominance and epistasis? Explain two types of epistasis with examples of the respective altered dihybrid ratio
22. Write the distinguishing features of uniparental inheritance, maternal inheritance and maternal effect.
23. Explain the term heritability. Write the relationship of phenotypic and genotypic variance with heritability.

(4X3= 12 marks)

IV.Answer any ***one*** of the following, not exceeding 350 words

24. Singed bristles (sv), crossveinless wings (cv) and vermilion eye colour (v) are due to recessive mutant alleles of three X linked genes in *Drosophila*. When a female heterozygous for each of the three genes was test crossed with a singed, crossveinless, vermilion male the following progenies were obtained.

Singed, crossveinless, vermilion	-3
Crossveinles, vermilion	-392
Vermilion	-34
Crossveinless	-61
Singed, crossveinless	-32
Singed vermilion	-65
Singed	-410
Wild type	-3
Total	-1000

What is the correct order of these three genes on X chromosome? Construct the genetic map. What is the interference?

25. Explain the phenomenon of extra nuclear inheritance with the help of suitable examples. What are the diagnostic criteria that are used to identify extra nuclear traits?

(1X8= 8 marks)

SEMESTER I	Course Code: BOT- CC- 512	Credits: 4

NAME OF THE COURSE: BIOPHYSICS, BIOLOGICAL TECHNIQUES AND RESEARCH METHODOLOGY

COURSE OUTCOMES (CO)

CO1 : Gain knowledge about the principle and use the equipment for solving research problems
CO2 : Gain knowledge on biological techniques and develop practical skills in the area
CO3 : Take up research problems with confidence
CO4 :Design an experiment and analyze the data using suitable statistical tools

COURSE CONTENT:

MODULE I: Physical forces and chemical bonds -Ionic bond, covalent bond, electrostatic bond hydrogen bond, hydrophobic bond and Van der Waals forces. Examples of biological molecules. Principles of biophysical chemistry: pH, buffer, reaction kinetics, thermodynamics, colligative properties. Photobiological phenomena: Fluorescence, phosphorescence, Birefrinence and dichroism. Bioenergetics: Concepts of entropy, free energy, enthalpy, redox potential.

MODULE II: Principles and applications of light, phase contrast, fluorescence, polarizing, scanning and transmission electron microscopy,STEM, Scanning tunneling microscopy, Focused ion beam and scanning probe microscopy:Photomicrography, Flow cytometry. Centrifugation principles of sedimentation Preparative and Analytical centrifuges. Sedimentation equilibrium method, Sedimentation velocity method – Density Gradient Centrifugation – Isokinetic and isopycinic centrifugation – Differential centrifugation. Chromatography principles–Adsorption and Partition Chromatography–Thin layer chromatography, Gas chromatography (GC), High performance liquid chromatography (HPLC), Ion-Exchange Chromatography and Affinity Chromatography. Electrophoresis principle-agarose and polyacrylamide gel electrophoresis Isoelectric focusing, Istotachophoresis and immuno electrophoresis. Spectroscopy- principles, types of spectra and their biochemical usefulness, visible and UV spectrophotometry, Infra-red (IR), Circular Dichroism (CD), NMR, ESR and mass spectroscopy, X-ray diffraction. Detection and measurement of radiation -– Geiger-Muller counter, Liquid Scintillation Counting, ionization chamber, Pocket dosimeters-film badge. Incorporation of radioisotopes in biological tissues and cells, molecular imaging and radioactive material, safety guidelines. Application of isotopes and radioisotopes in biological research, radioisotope tracer technique and autoradiography

MODULE III: Plant Cell and Tissue processing-Killing and fixing- common fixatives-composition, preparation, e.g., Flemming's fluid, FAA, Carnoy's fluid, Chrome acetic, Nawaschins fluid, Zircle's fluid. Dehydration- Principles, important dehydrating agents. Clearing agents, mounting media used in microtechnique. Types of micro-slide preparation, temporary semi-permanent and permanent –smears and squashes-Tissue embedding in paraffin wax- Tertiary- Butyl Alcohol method (TBA), Ethyl alcohol-xylene method, Alcohol-chloroform method. Sectioning: using rotary microtome: adhesives and their preparation, Microtomes- Rotary, Sledge, Sliding microtome, Freezing microtome -Cryotome. Stains and

Staining- principles and purpose of staining, Natural Dyes: Haematoxylin, carmine, orcein; Synthetic Dyes*:* Fast green, Orange G, Safranin, Crystal Violet, Basic fuchsine, Eosin, Cotton blue. Technique of staining Preparation of whole mounts and macerations: Glycerin- xylene method for whole mounts; Techniques of smear, squash and tissue maceration

Sample Preparation for Scanning Electron Microscopy (SEM), Sample preparation for Transmission electron microscopy (TEM) Immuno-labeling of sections, Preparation of samples for X-ray microanalysis, Preparing Sample for Confocal Microscopy.

MODULE IV: Histochemical Localization of Cellular Components- Principle and methods of histochemistry, cytochemistry- Fluorimetry Histochemical localization insoluble poly saccharides -Periodic Acid–Schiff's reagent [PAS] method, Starch -Iodine –Potassium iodide method (IKI). Cellulose –IKI method, Pectin, Protein-Coomassie Brilliant Blue (CBB), Lipids-Sudan dye III method, Nucleic acids -Feulgen Reaction and toluidine blue method. Histo-enzymology- General principle and methods. Enzyme activity staining-application of histo-enzymology. Histo-enzymological localization of Acid Phosphatase, Cytochrome oxidase, Dehydrogenase, Esterase, Lipase and Pectinase.

MODULE V Research methodology- Introduction, Need for research, stages of research; Generation of a research problem, execution of work, and interpretation of results. Review of literature Books, Journals: Indexing journals, abstracting journals, research journals, review journals, e-journals. Impact factor of journals, NCBI-Pub Med, Web of Science, Scopus, J gate. Other sources of references, open access initiative, INFLIBNET, INSDOC. Bibliography management system-Mendeley, End Note, Bib Tex. Preparation of project proposals, Presentation and publication of research outcomes Preparation of a dissertation, Preparation of research paper, Preparation of review articles. Proof reading – standard abbreviations for proof correction. Presentation of research findings in seminars and workshops. Plagiarism-Plagiarism checking software.

Significance of scientific research–environmental impacts and ethical issues – ethical committees –commercialization – copy right – royalty – Intellectual property rights and patent law – Trade related aspects of intellectual property rights.

MODULE VI: Principles of Biostatistics - Methods of collection and classification of data; Frequency distribution, graphical representation, normal distribution. Measures of dispersion Mean deviation, Standard deviation, variance, standard error, co-efficient of variation. Tests of significance, testing of hypothesis - t-test, F-test, ANOVA. Correlation and Regression, correlation (simple and multiple). Data Analysis with Statistical software packages- SPSS. Design of experiments- replication and randomization. Common designs in biological experiments: Completely randomized design, randomized block design, Latin square design, and Factorial design.

PRACTICALS

Preparation of permanent double stained freehand sections of plant tissue (5 permanent preparations to be submitted).Dehydration of plant tissue using TBA method, embedding and Preparation of Paraffin blocks and preparation of serial sections. Preparation of whole mounts (1 whole mount preparation to be submitted)- Preparation of fixatives (FAA, Carnoy's fluid), Histochemical localization of starch, cellulose, protein, nucleic acid and lipids, Histo-enzymological localization of esterase and pectinase, Vital staining (e.g., Janus green B staining), Sectioning by using cryotome (demonstration only), Photo-documentation of micro-preparation by using image analyser. Colorimetric / spectrophotometric estimation of protein,

density gradient centrifugation - separation of pollen grains, DNA separation using agarose gel electrophoresis. Preparation of reference lists, drafting project proposals, conducting t test, ANOVA using provided data. Handling SPSS software.

Submission: 5 permanent slides – including 1 whole mount, 4 double stained preparations

LEARNING RESOURCES:

REFERENCES

Biophysics

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- Subramanian M.A.(2015). Biophysics: Principles and Techniques. Vikram Jain Books

Biological Techniques

- Baker, J.R. (1958). Principles of Biological Microtechnique. Methuen & Co Ltd.
- Carlo Pellicciari and Marco Biggiogera, Eds. (2017) Histochemistry of Single Molecules-Methods and Protocols, Humana Press, New York,US
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- Edward Yeung, Claudio Stasolla, Michael Sumner and Bing Huang (Eds.) (2015) Plant Microtechniques and Protocols, Springer, Publ., Berlin Heidelberg
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- William V. Dashek (2000) Methods in Plant Electron Microscopy and Cytochemistry, Humana Press, Oxford, UK.

Research Methodology

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Public Policy 13 (1990): 817–866. Reprinted in Information Ethics: Privacy, Property, and Power, A. Moore (ed.), Seattle: University of Washington Press, 2005.

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ONLINE RESOURCES:

- http://www.biomedlabs.org/introduction-to-immunohistochemistry-techniques- course-outline.html.
- https://www.jove.com/science-education/5039/histological-sample-preparation-for-light-microscopy
- https://www.sciencelearn.org.nz/resources/500-preparing-samples-for-the-electron-microscope
- http://www.biologicalelectronmicroscopy.com/biological-sample-preparation
- http://www.seas.upenn.edu/~confocal/sample_prep_l2.html
- http://www.biologydiscussion.com/microscope/microscopy-principles-and-specimen-preparations-with-diagram

UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
First Semester M.Sc (CSS1) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC- 512 BIOPHYSICS, BIOLOGICAL TECHNIQUES AND RESEARCH METHODOLOGY

Time: Three hours Maximum marks: **40**

I. Answer all questions briefly

1. What is redox couple?
2. What are vital stains?
3. What is entropy?
4. What is the source of carmine?
5. Suggest use of 'egg white' in plant microtechnique
6. What is meant by plagiarism? Name any two plagiarism checking software
7. Define measures of dispersion
8. What is chemical shift?
9. Which chromatographic separation method you will use for the separation of antibody from a mixture?
10. What is IPR?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Write notes on embedding
12. Write procedure for cytochemical localization of protein
13. Give a brief account on dehydrating agents
14. What are the features student 't' test
15. Schiff's reagent is used for the staining of insoluble polysaccharides and nucleic acid. What is the principle of this staining method?
16. Explain principle and applications of affinity chromatography
17. Give an account on the various applications of radioisotopes in biology

(5X2=10 marks)

III. Answer any ***four*** of the following. Each answers not exceeding 150 words.

18. Briefly describe the working of rotary microtome
19. Which centrifugation method you will use for the separation of heterogeneous mixture of pollen grains. Explain principle and applications of this technique
20. Derive Braggs equation and write its applications
21. Give an account on common designs in biological experiments
22. What are the components of a research paper? Explain
23. Compare correlation and regression analysis

(4X3= 12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Give an account of the classification of stains used in microtechnique with examples and applications.
25. Give an account principle, instrumentation and application of spectrophotometry

(1X8= 8 marks)

SEMESTER I	Course Code: BOT- CC- 513	Credits: 4

NAME OF THE COURSE: CYTOLOGY

COURSE OUTCOMES (CO)

CO1 : Develop a deep knowledge on the ultra structure and functions of cell organelles.
CO2 : Gain deep knowledge on the events of cell division
CO3 :Develop a skill in the cytological preparation and karyotype analysis and thereby assess the evolutionary pattern of the plant.

COURSE CONTENT:

MODULEI: Cell Organelles:Ultrastructure, chemistry, functions, interrelationships and origin**:** Cell-wall, Plasma membrane, Cytoplasm: endoplasmic reticulum, ribosomes, Golgibodies, plastids, mitochondria, centrioles, lysosomes, peroxisomes, spherosomes. Cytoskeletal structures: microtubules, microfilaments, intermediate filaments. Nucleus: nuclear envelope**,** nucleoplasm, nucleolus, chromatin reticulum.

MODULEII: Chromosomes:Morphology: size and shape. Structure: chromatid, chromonema, chromomeres, centromere and kinetochore, telomere, secondary constriction, nucleolar organizers, satellite. Material of the chromosomes: euchromatin and heterochromatin, unique and repetitive sequences. Chromosomal proteins, Molecular structure: Packaging of DNA in chromosomes- formation of nucleosome, solenoid fiber, scaffold loop, chromatid. Functions of chromosomes. Special types of chromosomes: Polytene, Lampbrush and B-chromosomes.

MODULE III: Karyotype and Pachytene analysis**:** Karyotype.- Standard parameters for karyotype analysis, Morphological classification and categorization of chromosomes, Natural karyotype, Current modifications in the system, Karyogram and Idiogram, Karyotype differentiation and evolution, Factors affecting karyotype variations such as changes in chromosome number, structural alterations, centromere position, degree and distribution of heterochromatin. Unimodal and Bimodal karyotype. Significance of chromosomal banding. Chromosome combing, chromosome painting, Digital karyotyping, Spectral karyotyping (SKY), SNP array and virtual karyotyping, electrophoretic karyotyping, DECIPHER-software. Pachytene analysis - Chromosomal parameters utilized for analysis, Idiogram, Chromosomal behaviour such as pairing and synapsis in pachytene and factors affecting the pairing.

MODULE IV: Cell division- Current concepts and molecular evidences.Interphase stages-Major events during interphase (G0, G1, S, G2). Discovery of regulatory and catalytic proteins, role of cell division proteins and checkpoints. Replication of chromosomes, structure and function of centrioles and microtubules. Genetic significance of mitosis and meiosis.

MODULE V: Mitosis - Major events during prophase, prometaphase, metaphase, anaphase and telophase - spindle structure modification, microtubule organizing centers, motor proteins, other regulatory proteins and their functions. Cytokinesis- Mechanism of cytokinesis and

proteins involved in plants, animals and bacteria. A brief review of cell division and life cycle of bacteria, fungi, algae, bryophytes and pteridophytes. Variations from the normal mitotic plan - endoreduplication and endomitosis, C-mitosis, somatic reduction and genetic consequences of the above variations.

MODULE VI: Meiosis - Major events during prophase, metaphase, anaphase and telophase of Meiosis I and Meiosis II. Role of spindle and regulatory proteins. Molecular structure of the synaptonemal complex and its functions in normal pairing and synapsis. Variations in the pairing mechanism – Asynapsis, desynapsis, exchange pairing, non-homologous pairing, secondary pairing and somatic pairing. Chiasma formation and genetic recombination. Single-strand and double-strand-break models. Proteins (cohesins, securins, separase) involved in sister chromatid separation and terminalization.

PRACTICALS

The given list of plants may be used to study the mitosis and meiosis. Observations should be recorded for all the division stages in the materials provided.

Fifteen permanent slides of the countable metaphase spreads to be prepared and submitted at the end of semester I.

Plant material	Gameticchr. number	Somatic chr. Number
Chlorophytum heynei	7	14
C. ignoratum	7	14
C. laxum	8	16
C. elatum	14	28
C. comosum	14	28
C.malabaricum	21	42
C. orchidastrum	21	42
Allium cepa	8	16
Zea mays	10	20
Aloe sp.	7	14
Capsicum annum	12	24
Trigonellafoenumgraceum	8	16
Crotalaria sp.	8	16

Endomitosis: *Cocosnucifera* endosperm to be used to study endomitosis

Karyotypic preparation and ideogram construction of somatic metaphase chromosomes of any material given in the Table.

LEARNING RESOURCES:

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Model Question Paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
First Semester M.Sc. (CSS1) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC-513 CYTOLOGY

Time: Three hours Maximum marks: **40**

I. Answer all questions in one word or sentence
1. Define idiogram
2. What is nucleoplasm?
3. What do you mean by endocytosis?
4. Explain the role of kinetochore?
5. Write the features of peroxysomes.
6. Distinguish between bimodal and unimodal karyotype
7. Write the importance of blepharoplast.
8. Define endomitosis
9. What are cohesins?
10. What do you mean by synapsis?

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answer *not* exceeding 50 words
11. Distinguish between euchromatin and heterochromatin
12. Give the functions of Golgibodies
13. Compare the major events in different phases of interphase stage
14. Analyse the role of different proteins in chromatid separation and terminalization
15. Deduce the basic chromosome number by citing an example
16. Write the significance of pachytene analysis.
17. Give an account on membrane lipids

(5X2= 10 marks)

III. Answer any ***four*** of the following Each answer *not* exceeding 150 words
18. 'The chromosome number remains constant in a species by meiosis, through successive generations of progenies' substantiate it using the life cycle of bryophytes
19. Describe the molecular structure of centromere
20. Describe the ultra-structure of chloroplast
21. Compare Levan *et al.* system of chromosome classification with that of Stebbins
22. Write about the development and structure of polytene chromosomes.
23. What is C mitosis? Describe its genetic consequences

(4X3= 12 marks)

IV. Answer any ***one*** of the following, *not*exceeding 350 words
24. Write the importance of chiasma. Briefly explain the molecular mechanisms of genetic recombination
25. Karyotype is a tool to assess interrelationships of organisms. Justify

(1X8= 8 marks)

SEMESTER I	Course Code: BOT- DE- 514	Credits: 2

NAME OF THE COURSE: DIVERSITY IN CRYPTOGAMAE AND GYMNOSPERMAE

COURSE OUTCOMES (CO)

CO1 : Exemplify the structure and classification of Algae, Fungi, Lichen, Bryophyta, Pteridophyta and Gymnospermae
CO2 : Get knowledge in process of evolution, life cycle pattern, reproduction of Cryptogamae and Gymnospermae
CO3 : Compare life cycles, morphological and anatomical variations in different Groups
CO4 : Assess the economic, ecological and evolutionary significance of non flowering plants

COURSE CONTENT

MODULE I: Algae- Principles and modern trends in taxonomy of algae; Classification of Algae (Fritsch F. E. 1935). Salient features of major groups, economic importance of Algae, Structure, reproduction and life cycle of the following types: *Ulva, Nitella, Padina, Gracilaria,*

MODULE II: Fungi- Principles and modern trends of classification of Fungi- (Alexopoulos*etal.*1996); salient features of major groups, economic importance of Fungi. Thallus structure, reproduction and life cycle of the following types: *Phytophthora, Polyporus, Colletotrichum.*

MODULE III Lichens -Classification, thallus structure, reproduction, ecological significance and economic importance of Lichens. Type study:Parmelia

MODULE IV: Bryophyta- General characters and recent systems of classification (Shofield, 1985); salient features of major groups, economic importance of Bryophya. Life cycle study of the following types: *Cyathodium, Anthoceros, Polytrichum.*

MODULE V: Pteridophyta- General characters, Telome theory, classification (Bierhost, 1971) salient features of major groups, economic importance of Pteridophytes; Structure, reproduction and life cycle of the following types: *Angiopteris*, *Lygodium, Salvinia,*

MODULE VI: Gymnosperms-General characters and classification (Sporne, 1965); salient features of major groups, economic importance of Gymnosperms. Structure, reproduction and life cycle of the following types: *Araucaria, Podocarpus Ephedra*

LEARNING RESOURCES:

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ONLINE RESOURCES

- https://epgp.inflibnet.ac.in/

Model question paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
First Semester M.Sc (CSS1) Degree Examination
Branch: Genetics and Plant Breeding
BOT-DE-514 Diversity in Cryptogamae and Gymnospermae

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. Point out identifying features of Ascomycetes
2. What is epimatium?
3. Differentiate mycelium and Pseudomycelium
4. Write about male flower in Ephedra
5. What is a sporocarp?
6. Mention ecological significance of Salvinia
7. Lichens are ecologically significant. Explain how?
8. Whatis protonema ?
9. How can youidentifyPadinafrom a group of algae ?
10. Whatis alternation of génération ?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words

11. Explain how Cyathodium is reproduced
12. Explain the economic importance of Gracilaria
13. Give an account on pathological significance of Phytophthora.
14. What is the function of heterocyst?
15. " Gymnosperms are economically important" substantiate
16. Explain heterospory and its significance
17. Briefly explain asexual reproduction in Lygodium

(5X3= 15marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Explain telome theory
19. Derive salient features of major groups of Bryophyta
20. Briefly explain the structure and reproduction in Polyporus
21. Give an account on reproduction in polytrichum
22. Explain the life cycle of Anthoceros
23. Explain how Gymnosperms are classified?
24. ' Salvinia can spread in a water body very fastly' True of False? Give reasons for your answer

(5X5= 25marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

25. Give an account on classification of algae
26. Briefly explain anatomical structure, reproduction and life cycle of Ephedra. Mention economic importance

(1X10= 10marks)

SEMESTER II	Course Code:BOT- CC- 521	Credits: 4

NAME OF THE COURSE: MOLECULAR GENETICS

COURSE OUTCOMES (CO)

- **CO1 : Gain knowledge on organization of nucleic acids and mechanism of DNA replication in prokaryotes and eukaryotes**
- **CO2 :Identify the location of genes in the genomes of bacteria, viruses, fungi and yeast by recombination mapping techniques.**
- **CO3 :Predict the expression and regulation of genes in prokaryotes and eukaryotes**
- **CO4 :Get a conceptual knowledge of the genome sequencing projects, transcriptome, proteome and metabolomes of different organisms**
- **CO5 :Translate this knowledge for improvement of human health.**

COURSE CONTENT

MODULE I: Genetic organization-DNA structure, Chemistry of nucleotides, organization of the poly nucleotide strand, Importance of double helical structure of DNA, Watson-Crick model- Conformational changes in DNA structure, Types of DNA, Organization of the Eukaryotic DNA, Repetitive DNA, DNA variation in organisms- DNA replication, Semi-conservative replication in prokaryotic and eukaryotic organisms- enzymes in replication, DNA polymerase I, II, III, DNAgyrases, topoisomerases, ligases, RNA polymerase (primase) and replisome complex- current concept of DNA replication in prokaryotes and eukaryotes.

MODULE II: Gene mapping, Introduction to bacterial culture, serial dilution, identification and classification of microorganisms-Recombination and mapping in Bacteria, Viruses and Fungi- Bacteria -Mechanism of genetic recombination, Transformation, Transduction and Conjugation, Mapping the bacterial chromosome, Interrupted and uninterrupted conjugation, recombination mapping, complementation and deletion mapping- Viruses, Types, genetic fine structure, inter- and intra-genic recombination and mapping, role of rII locus of phage in mapping, complementation and deletion mapping- Fungi,Ascomycetes - *Neurosporacrassa*: ordered tetrads, tetrad-analysis, recombination mapping-*Saccharomyces cereviscea* - unordered tetrads, parental and non-parental di-types, recombination mapping.

MODULE III: Gene expression**:**Evolution of the Gene Concept, Functional definition, One gene-one metabolic block, one gene-one enzyme, one gene-one polypeptide- Structural and operational definition of gene- Molecular Biology of gene expression,Brief overview of the Central Dogma and Teminism- Transcription in prokaryotes and eukaryotes- Types and structure of RNA polymerase- Different types of RNA- mRNA, tRNA, rRNA, snRNA, snoRNA, miRNA, Xist, RNA, siRNA, shRNA, antisense RNA- Regulatory sequences and transcription factors involved- Mechanism- Initiation, elongation and termination- Post transcriptional modification of RNA, Split genes and RNA splicing in eukaryotes, RNA editing, Ribozymes- Translation in prokaryotes and eukaryotes- Basic structure of proteins, ribosomes, tRNA-Genetic code Experiments conducted to decipher the genetic code, salient features, exceptions, wobble-hypothesis, genetic code in mitochondria and ciliate protozoans, Mechanism of translation- Chain initiation, elongation and termination, proteins involved, factors affecting translation accuracy.

MODULE IV: Molecular mechanism of Gene Regulation in Prokaryotes- Constitutive, Inducible and Repressible expression, positive and negative control- Induction and catabolite repression in *lac* operon, repression and attenuation in *trp*operon, lysogenic and lytic switches in lambda phage, Translational and post translational regulation**.**

MODULE V: Molecular mechanism of Gene Regulation in Eukaryotes- Controlled transcription of DNA, Alternate splicing of RNA, Cytoplasmic control of mRNA stability, Induction of transcriptional activity by environmental and biological factors- Temperature-Heat shock proteins, Genes that respond to hormones- Proteins involved in control of transcription, transcriptional factors, activator proteins, enhancers, silencers, eukaryotic transcription complex, chromatin remodeling during gene expression, alternative promoter-Post transcriptional regulation, RNA interference, siRNAs, miRNAs, untranslated regions (UTRs), nonsense mediated decay, chromatin remodeling, DNA methylation, Imprinting.

MODULE VI: Genomics: Structural genomics-Sequence analysis, next generation sequencing technologies, history of genome projects, gene families, genome assembly and annotation, human genome sequencing project; Functional genomics- transcriptome, proteome and metabolome. Microarrays and gene expression studies, Comparative genomics - basis of molecular evolution, nucleotide substitutions (synonymous and non-synonymous), functional and evolutionary relationships between prokaryotes and eukaryotes, orthologues and paralogues, phylogenetic tree; Pharmacogenomics-Genomic basis of rare diseases

PRACTICALS

(i) Aseptic transfer of micro-organisms for subculturing
(ii) Isolation of discrete colonies from mixed cultures
(iii) Identifying and classifying the given micro-organisms
(iv) Serial dilution agar plate method to quantitative viable cells
(v) Isolation of plasmid DNA from *E. coli* using alkaline lysis method.
(vi) Production of enzymes using microorganisms
(vii) Antimicrobial screening and assays
(viii) Problems relevant to themodules

LEARNING RESOURCES

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- Ramadas P (2015) Animal Biotechnology. Recent concepts and developments, MCJ Publishers, Chennai, India
- Russell, P.J. (2005) Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
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- Stewart NC (2016) Plant Biotechnology and Genetics, Principles, techniques and applications, 2nd Edition. John Wiley & Sons Inc. New Jersey
- Watson RR, Preedy VR (Editors) (2016) Genetically Modified Organism in Food-Production, Safety, Regulation and Public Health. Academic Press, New York

ONLINE RESOURCES

- Human Genome Project; http:// www.ornl.gov.
- Hugo: http:// ash. gene. ncl. ac .nk..
- DNA learning center: http://tor. cshl. org.
- Genome Databases: http:www. gdb. org.
- National Centre for Genome Resources. http://www. neg r. org.
- Washington Univ. Dept. of Genetics. http://www. genetics. wustl. edu.
- Genome Sequencing Center. http://genome. imb-jena. dc.
- https://swayam.gov.in/course/1391-human-molecular-genetics

Model question paper

UNIVERSITY OF KERALA

DEPARTMENT OF BOTANY

Second Semester M.Sc (CSS2) Degree Examination

Branch: Genetics and Plant Breeding

BOT-CC-521 MOLECULAR GENETICS

Time: **3**hrs Maximum marks: 4**0**

I. Answer all the questions in one word or sentence.

1. Write function of repressible type of effector molecule?
2. What is the function of ribosomal A and P site?
3. Define Enhancers.
4. Whatis Nuclear splicing?
5. What is Pribnow box?
6. What is a transcriptome?
7. What is gene annotation?
8. What are SnRNPs?
9. An RNA is generated from the DNA. Name the phenomenon and who reported this phenomenon for the first time?
10. During the course of prokaryotic transcription, free core assembly of RNA polymerase were present. In this system, What will be the regulating factor to occur transcription in its maximum capacity?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 50 words

11. What are the two mechanisms which control the rate of transcription of *trp* operon?
12. Elucidate the physiology and genetic defect associated with phenylketonuria
13. Explain central dogma of molecular biology.
14. What are Kozak sequences and Shine-Dalgarno sequences?
15. What is the difference between first division and second division segregation pattern in the tetrads of *Neurospora*?
16. Give an account on the various subunits of prokaryotic RNA polymerase enzyme
17. Name the three nucleotide databases and their geographical locations? What is gene annotation?

(5X2= 10 marks)

III. Answer any *four* of the following. Each answer not exceeding 150 words

18. Describe Beadle and Tatum's experiment from which the 'one-gene-one-enzyme concept' evolved. Why was the concept further modified to the 'one-gene-one-polypeptide' concept?
19. Explain the different mechanisms of genetic recombination in bacteria.
20. Describe various mode of mRNA splicing.
21. Describe the mechanism of transcription attenuation in the *trp* operon.
22. What are transcription factors? How do the transcription factors help in the process of transcription regulation?
23. What is phylogeny? Describe the different approaches in the preparation of a phylogenetic tree.

(4X 3 = 12marks)

IV. Answer any *one* of the following not exceeding 350 words

24. What is genome sequencing? Write a historical account of the human genome sequencing project
25. What is the genetic code? Enlist the important features of the genetic code. Explain the steps involved in gene translation in prokaryotes

(1X 8=8marks)

SEMESTER II	Course Code: BOT- CC- 522	Credits: 4

NAME OF THE COURSE: CYTOGENETICS

COURSE OUTCOMES (CO)

CO1 :Analyze the different types, origin and cytogenetic consequences of structural and numerical chromosomal variations in organisms.
CO2 :Interpret the chromosomal variations through chromosome banding techniques
CO3 :Comprehend the molecular features, types, genetic and evolutionary consequences of transposons in different organisms and their specific applicationsin crop breeding programmes.
CO4 :Create awareness about human syndromes and remedy them through genetic counseling

COURSE CONTENT

MODULE I: Haploidy*:* Terminology and classification: Euhaploids- monohaploids- polyhaploids- aneuhaploids- disomic haploids- addition haploids- substitution haploid--nullisomic haploid and misdivision haploid. Spontaneous occurrence-twin seedlings-androgenetic and gynogenetic haploids- induction of haploids. Morphology and cytology of haploids and practical value in plant breeding. Polyploidy: Types of euploids- autopolyploids-allopolyploids- segmental allopolyploid-, autoallopolyploids and agmatoploids – origin and cytogenetic basis of different types of polyploids – meiosis in polyploids (triploids and tetraploids), morphological- physiological and genetical characters of polyploids. Induction of polyploids-cytological effects of colchicines. Role of polyploids in plant breeding. Allopolyploids – genetic regulation of chromosome pairing- allopolyploidization of autopolyploids- genome analysis – genetic consequences – deviation segregation- aneuploids in allo-polyploids-identification of homologous chromosomes. Segmental allopolyploids-fertility – Higher polyploids- diplodization- agmatoploids

MODULE II: Aneuploidy: Hyperploids – trisomics- tetrasomics- double tetrasomics – Trisomics- types of trisomics- primary trisomics- secondary trisomics- tertiary trisomic-acrocentric trisomics- fragment trisomics- compensating trisomics – meiosis in trisomics-morphology-physiology and biochemistry of trisomics. Transmission of extra chromosome in trisomics. Elimination of extra chromosome during meiosis. Hypoploids: monosomic-nullisomics. Meiosis in aneuploids, Role of aneuploids in the evolution. Transmission and genetic consequences – transmission of the extra chromosome through the female and male – morphology- physiology- anatomy and biochemistry of trisomics, Hypoploids. Aneuploidy of sex chromosome.

MODULEIII: Structural aberrations: Deficiency – origin- cytological behavior- genetic effects, pseudo dominance; Duplication – origin- types of duplications: tandem- reverse tandem- displaced, cytological behavior- position effect. Inversion – origin- types of inversion (paracentric and pericentric)- meiotic behavior. Translocations- origin- types of translocations-meiotic behavior- Translocation complex in *Rhoeo, Oenothera*- Renner effect. Identification of chromosome segments and their alterations.

MODULEIV: Quinacrine banding- Giesma banding (G-banding)- Reverse fluorescent banding- C- banding- Fuelgen banding- Silver banding (AG- NOR banding)- N- banding- Orcein banding. Nucleic acid hybridization: Fluorescence *in Situ* Hybridization (FISH)- *Genomic in Situ* Hybridization (GISH)- *Multic*olor Genomic *in Situ* Hybridization (Mc GISH*).*

MODULE V: Transposable elements - Historical background- General features,- Types- Transposons in bacteria (IS elements, Composite elements)- Maize (Ac/ Ds elements, Spm / En elements)- *Drosophila* (P elements)- Mechanism of transposition- Genetic and evolutionary significance. Retro transposons - Mechanism of reverse transcription- Types - Retro viruses- Retroposons in yeast (Ty elements)- *Drosophila* (Copia elements)- mammals (LINES, SINES)- Retro elements and C-value paradox. Transposon mediated molecular techniques: S-SAP (Sequence Specific – Amplified Polymorphism- IRAP (Inter-retrotransposon – Amplified polymorphism)- REMAP (Retrotransposon – Microsatellite Amplification)- RBIP (Retrotransposon – Based insertional polymorphism)- Evolutionary implications of Transposable Elements- Applications of transposons and retroposons in breeding programmes.

MODULE VI: Cytogenetics of sex (a) Sex chromosomes; types of sex chromosomes – undifferentiated, structurally heteromorphic and multiple sex chromosomes, sex chromosomes in plants and animals- Evolution of sex chromosomes- origin of the sex chromosome mechanisms; (b) Sex chromatin: chromosomal and genetic mechanisms- sex determination in dioecious plants and animals- role of 'sry' genes in mammalian sex determination- inter sexes- gynandromorphic,- sex reversal- environmental influence in sexual dimorphism- evolution of dioecism. Human Cytogenetics: Human chromosome culture technique- Normal karyotype in man- chromosome aberrations associated with congenital defects in man. Turner's syndrome- Klinefelter's syndrome- triple X syndrome- hermaphroditism- Down's syndrome- trisomy D1 and trisomy 18 syndromes

PRACTICALS

1. Polyploid :Cytology of polyploid series of *Chlorophytum*
2. Colchiploid production - *Capsicum*
3. Aneuploidy -*Datura*
4. Structural aberrations : Inversion – *Eleuthrinebulbosa,*
   Translocation - *Rhoeo*
5. Sex chromosomes in plants -Demonstration
6. Human cytogenetics - Demonstration
   (a) Human chromosome culture technique
   (b) Normal human karyotype
   (c) Chromosomal aberrations

LEARNING RESOURSES:

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Model question paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Second Semester M.Sc (CSS2) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC-522 CYTOGENETICS

Time: **3** hrs

Maximum **40** marks

I. Answer all questions in one word or sentence

1. What is autopolyploid?
2. What is meant by parthenogenesis?
3. Define Lyon's hypothesis?
4. Which stain is used for G banding?
5. Which chromosomal aberration does cause pseudo dominance?
6. Name a congenital defect in man which is associated with aberration in sex chromosome?
7. What are nullisomics?
8. Name any four transposon-mediated molecular techniques
9. What is apogamy?
10. What do you mean by non-disjunction?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answer not exceeding 50 words

11. What are acrocentric trisomics?
12. What is Turner's syndrome?
13. What is segmental alloploids?
14. What do you mean by translocation?
15. Give a short account on *'sry'* gene
16. How do the IS elements differ from the composite transposons?
17. Describe the causes and symptoms of triple X syndrome

(5X2=10 marks)

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. Describe the structure of human karyotype
19. Write down the meiotic behavior of polyploids
20. Give an account on prenatal diagnosis of genetic disorders
21. Explain the phenomenon of sex reversal in mammals
22. Explain the experiment which led to the discovery of transposons in Maize. What were the other types of transposons detected in Maize subsequently?
23. Explain C- value paradox

(4X3=12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. What are inversions? Explain the meiotic behaviour of paracentric and pericentric inversion
25. Explain the role of allopolyploidy in crop evolution

(1X8=8 marks)

SEMESTER II	Course Code:BOT- CC- 523	Credits: 4

NAME OF THE COURSE: PLANT BREEDING

COURSE OUTCOMES (CO)

CO1 : Gain knowledge about the types of crops
CO2 :Collect, conserve, evaluate and utilize crop germplasm
CO3 :Get the skill in vegetative propagation methods and hybridizationtechniques
CO4 :Evaluate the types, genetics, biochemical and molecular basis of incompatability and sterility between genotypes and devise methods to overcome them
CO5 :Analyze the types of seeds and identify methods of seed processing and seed certification

COURSE CONTENT

MODULE I: Introduction-History of plant breeding, Green Revolution, nature of plant breeding, the disciplines to be known by a breeder, activities in plant breeding, some important achievements, undesirable consequences. Centres of origin: Different centres and their significance. Types of crops: Cereals, Millets, pulses,oil yielding plants. Fibre crops, narcotics, beverages(botanical names and economic part). Plant introduction, procedure, quarantine period, Phytosanitary certificate, Role of plant genetic resources in plant breeding, PG database management, PBR, Intellectual property rights.

MODULE II: Domestication: selection under domestication, changes in plant species under domestication. Germplasm: different types of germplasm, gene pool concept, genetic erosion, germplasm collections-requisites for a gene bank, genetic erosion in gene banks, constraints of gene bank. . Germplasm conservation : - *in situ* and *ex-situ* conservation- seed banks, plant gene banks, shoot tip gene banks, cell and organ gene banks, DNA banks, germplasm evaluation- cataloguing- multiplication and distribution, germplasm utilization.

MODULE III: Modes of reproduction**:**Vegetative and sexual reproduction. Different methods- budding, grafting, layering, apomixis- classification with examples. Sexual reproduction- mechanism promoting self-pollination and cross pollination, genetic consequences of self and cross pollination. Relevance of mode of pollination.Breeding methods in self and cross pollinated crops : Selection: History of selection, pureline selection, mass selection, pedigree selection, bulk method of selection, backcross method of selection procedure, applications, merits, demerits and achievements of each type. Transfer of recessive and dominant gene through back cross. Modifications of back cross method.

MODULE IV: Hybridization: Types of hybridization, procedure, emasculation – different methods, consequences of hybridization. Distant hybridization: History, barriers in production of distant hybrids-failure of zygote formation-failure of zygote development- lethal genes-phenotypic disharmony between two parental genomes- chromosome elimination-incompatible cytoplasm- endosperm abortion-failure of hybrid seedling development. Application of distant hybridization in crop improvement alien chromosome addition and substitution lines–transfer of small chromosome segment–achievements and limitations.

MODULE V: Incompatibility: Different types, self-incompatibility- homomorphic and heteromorphic, gametophytic and sporophytic incompatibility, mechanism of self-incompatibility, pollen- stigma interaction, pollen tube -style interaction, pollen tube -ovary interaction–Genetic, biochemical and molecular basis of incompatibility, significance of self-incompatibility in plant breeding, methods to overcome self-incompatibility. Male sterility: types of male sterility, Cytoplasmic male sterility, genetic male sterility –origin of male ms alleles, site of action of ms alleles, molecular mechanism of ms action, Phenotypic expression of male sterility, cytoplasmic genetic male sterility, development of new male sterile and restorer lines, photoperiod sensitive cytoplasmic-genetic male sterility, utilization in plant breeding, origin of male sterile line, limitations of cytoplasmic genetic male sterility system, approach to minimize the undesirable consequences of male sterile cytoplasms, chemically induced sterility, features of chemical hybridizing agents(CHA), some important CHAs, hybrid seed production based on CHAs,advantages and limitations of CHAs.

MODULE VI: Classes of seed- Basic nucleus seed, breeder seed,foundation seed, certified seed. Seedprocessing- Drying, grading, testing, treating, bagging and labeling. Seed certification – genetic purity, physical purity, germination, moisture content, freedom from weeds and diseases. National Seed Corporation, State Seed Certification Agencies, Activities of seed industry, Seed multiplication.

PRACTICALS

I Germplasm collection

1. Cereals - Paddy
2. Vegetables - *Capsicum*
3. Pulses - Green gram, Black gram, Red gram

II Plant propagation

1.Vegetative

a. Layering: (1). Air layering (2). Mound layering

b. Grafting

c. Budding – T – budding (wild rose and H*ibiscus*)

2.Apomixis

a. Polyembryony: Mango seedlings
b. Vivipary - *Alpinia* and grass

III Hybridization

a. Notes on types of hybridization
b. Floral biology in self and cross pollinated species
c. selfing and crossing techniques
d. Emasculation in Solitary flower

1.'V' cut method 2. Slit method

3. Round cut method

IV Incompatibility – Pollen viability test

In vitro a. Brewbaker's medium preparation

b. Staining test in acetocarmine

In vivo – Pollen Germination on stigma

Pollen germination through style

Pollen germination through ovule

LEARNING RESOURCES

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Model question paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Second Semester M.Sc (CSS2) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC- 523 PLANT BREEDING

Time: Three hours Maximum marks: **40**

I. Answer ***all*** questions in one word or sentence

1. Define emasculation.
2. Name any two cereals with botanical nomenclature.
3. What do you mean by combination breeding?
4. Write down the contribution of Thomas Fairchild?
5. What is introgression?
6. What is introduction?
7. What is gene bank?
8. Define theterm'androgenic haploid'.
9. Explain gametophytic incompatibility
10. Differentiate between grafting and layering

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Describe the selection procedure to produce a homozygous population in a crop?
12. What are the genetic consequences of crosspollination?
13. Give the features of a good chemical hybridizing agent.
14. Describe the propagation technique adopted to produce more plantlets from a mother plant
15. Explain the genetics of distyly and tristyly in plants
16. Distinguish between single cross and double cross.
17. Briefly explain the features of gametophytic incompatibility

(5X2= 10 marks)

III. Answer any ***four*** of the following Each answer not exceeding 150 words

18. Explain the procedure of approach grafting
19. Explain the procedure of transferring recessive genes by backcross method
20. Homozygous rice plants can produce heterozygous progenies. Substantiate your answer
21. Describe the various steps involved in plant introduction
22. Briefly explain the different types of genetic male sterility
23. Give an account on the various centers of origin of plants

(4X3= 12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Give an account on various plant conservation methods
25. Describe the method for the production of interspecific hybrids**(1X8= 8 marks)**

SEMESTER II	Course Code: BOT- CC- 524	Credits: 4

NAME OF THE COURSE: PLANT PHYSIOLOGY AND BIOCHEMISTRY

COURSE OUTCOMES (CO)

CO1 : Gain knowledge on the chemical constitution, synthesis, storage, function and degradation of carbohydrates, proteins, enzymes, lipids, vitamins and hormones in plants.
CO2 : Analyze the physiological and biochemical mechanisms of photosynthesis, respiration and nitrogen metabolism
CO3 : Classify the plant secondary metabolites and decipher their application in pharmaceutical industries to manage human health

COURSE CONTENT

MODULEI: Photosynthesis and Respiration- Plant pigments-Chemistry of photosynthesis and plant product, chemistry, structure and role of chlorophyll, carotenoids and anthocyanin, light absorption and energy transfer, light and dark reaction, Hill reaction O_2 evolution, photosynthetic unit and reaction centre, Emerson enhancement effect, photosystems, electron transport system, mechanism of photophosphorylation, quantum requirements of quantum yield, CO_2 fixation, Calvin cycle, Hatch and Slack pathway, CAM pathway, Bacterial photosynthesis, photorespiration. Biochemical oxidation: Substrate of respiration, respiratory quotient, difference between respiratory quotient and photosynthetic quotient, Aerobic oxidation of pyruvic acid, Electron Transport System, terminal oxidation of reduced coenzymes, Oxidative phosphorylation. ATP Synthetase structure and chemistry, Structure and function of electron carriers in ETC. Mechanism of oxidative phosphorylation- various theories to explain ATP synthesis. Cynanide resistant respiration. Stress physiology – Responses of plants to biotic (pathogen and insects) andabiotic (water, temperature and salt) stresses

MODULEII: Nitrogen Metabolism-General aspects of nitrogen economy; Nitrogen cycle, nitrate and nitrite reduction, denitrification, Non symbiotic and symbiotic N_2 fixation, Biological N_2 fixation, Structure of nodules, nod genes, *nif* genes; Structure, function and regulation of nitrogenase; Leghaemoglobin; Nodulins; Regulation and enhancement of nitrogen fixation. Biochemistry of nitrogen fixation. Chemoautrotrophy in rhizobia and nitrifying bacteria, Pathways of ammonia assimilation, biosynthesis of amino acids, reductive amination, transamination, GDH and GS/ GOGAT pathways.

MODULEIII: Carbohydrates - General composition and properties- solubility, reducing and non-reducing optical isomerism, stereoisomerisms, mutarotation, Classification- Monosaccharides, their structure, occurrence, role, their derivatives by oxidation, reduction and substitution, Oligosaccharides- Disaccharides, tetrasaccharides their structure, occurrence and role in glycosidic bond formation, Polysaccharides- Homo and heterosaccharides, structural and storage polysaccharides – starch, glycogen, cellulose, hemicellulose, pectic substances, chitin, agar, gum -synthesis and breakdown of glycosidic bonds, Amylase, invertase and phosphorylase action, Synthesis and degradation of Carbohydrates – Starch and

Sucrose synthesis, Metabolism of Carbohydrates: Glycolysis, Fermentation, inter conversions of monosaccarides, pentose phosphate pathway and gluconeogenesis.

MODULEIV: Proteins and Enzymes-Classification of Amino acids, structure of common amino acids, physio-chemical properties of amino acids, Synthesis and breakdown of peptide bonds, oxidation, reductive amination, transamination, and deamination. Proteins-Classification, General accounts, Functions of protein, Classification of protein according to solubility characteristics and chemical nature. Structure – primary, secondary, quarternary structure, Ramachandran plot, Protein sequencing, proteotype enzymes. Enzymes- General account: Importance of enzymes in biological sciences, the classification and nomenclature of enzymes with examples, key to numbering classification of enzymes, Mode of enzyme action, derivation of Michaeli's constant, models for explaining enzyme action, energy of activation, various factors affecting the enzyme activity, Properties of enzymes, Competitive and non-competitive enzyme inhibition and types. Coenzymes- Introduction, structure and classification. Brief account on important coenzymes- NAD, NADP, ATP, Cytochromes, Coenzyme –A, lipoic acid, thiamine pyrophosphate.

MODULEV: Lipids, Vitamins and Hormones-Classification of lipids: triacylglycerols, waxes, phospholipids (membrane lipids), glycerolipids, glycolipids, sphingolipids, isoprenoids, carotenoids, steroids. Chemistry and structure of terpenes, (eg. hemi, mono, sesqui, di and poly-terpenes), Fatty acids- classification and systematic naming system, essential fatty acids, non-essential fatty acids, omega 3 and omega 6 fatty acids, Lipid metabolism- Synthesis of fatty acids, oxidation of fatty acids- α and β oxidation, Vitamins: Water soluble and lipid soluble vitamins, structure and role of vitamin A, D, tocopherol , thiamin, riboflavin, nicotinic acid, panthothenic acid, folic acid, ascorbic acid, lipoic acid, PABA, Plant hormones- Chemical structure and synthesis of hormones in plants, transport, mode of action and physiological effects of Auxin, Gibberellin, Cytokinins, Abscisic acid and Ethylene in plants.

MODULEVI: Secondary metabolites - Interrelationship of basic metabolic pathways with secondary metabolite biosynthesis, major pathways of secondary-metabolite biosynthesis, Major types– terpenes, phenols, flavonoids- anthocyanins, flavones, flavonols, isoflavones, lignins, tannins and nitrogen-containing compounds- alkaloids, cyanogenic glycosides, glucosinolates, and nonprotein amino acids, Roles for secondary metabolites in plants. Applications of Plant Secondary Metabolites in pharmaceutical industry.

PRACTICALS

I. Quantitative tests for Carbohydrates

1. Molisch's Test
2. Benedict's Test
3. Fehling's Test
4. Seliwanoff's Test
5. Iodine Test for starch

II. Acid hydrolysis of starch

III. Qualitative and quantitative tests for proteins

1. Million's Reaction
2. Xanthoproteic Reaction
3. Ninhydrin Test

4. Biuret Test
5. Precipitation Test
6. Estimation of protein using Lowry's method.

IV. Qualitative Test for fats

1. Sudan IV Test
2. Formation of Acrolein from fat

V. Qualitative Tests for Biological Compounds

1. Test for biological compounds in plant tissues
2. Tests for the chemical nature of milk.

VI. Calorimetric estimation of carbohydrates and proteins.

VII. Enzymes

1. Demonstration of polyphenoloxidase in plant tissue.
2. Action of invertase on sucrose.
3. Effect of temperature on enzyme activity.
4. Action of salivary enzyme on starch.

VIII. Photosynthesis Pigments

1. Separation of the green and yellow pigments

LEARNING RESOURCES

REFERENCES

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- http://biology.jbpub.com/botany/4e/
- http://plantfacts.osu.edu/
- http://study.com/directory/category/Biological and Biomedical Sciences/Botany/PlantPhysiology.html
- http://www.tau.ac.il/~ibs/teaching.html
- https://ocw.mit.edu/courses/biology
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Model question paper

UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Second SemesterM.Sc (CSS2) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC- 524 PLANT PHYSIOLOGY AND BIOCHEMISTRY

Time: Three hours Maximum marks: **40**

I. Answer ***all*** questions in one word or sentence

1. What are waxes?
2. What is the structural formula of DHA?
3. Write specific function of leghaemoglobin in root nodules of leguminous plants
4. What are homo polysaccharides with an example?
5. What is a peptide bond? How it is formed?
6. Define enzyme inhibitors
7. Define energy of activation and allosteric modulation
8. What is meant by substrate level phosphorylation?
9. What is NAD? Give its structural constituents
10. Name major anaerobic pathways occurring in organisms

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words

11. 'Keeping a ripe mango in a box of unripe mangoes can enhance the ripening rate of fruits' Comment
12. Write a note on different respiratory substrates
13. What are auxins? Describe important plant response that are influenced by auxins
14. Explain the concept of Km
15. Define inorganic cofactor, prosthetic group, apoenzyme and coenzyme and conjugated proteins
16. What is Hill reaction?
17. Compare C3 and C4 plants

(5X2= 10 marks)

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. Write an account on synthesis of glycerol
19. Explain the role of nitrogenase enzyme in biological nitrogen fixation
20. Indicate some of the major features of EMP pathway in terms of reactants, products and type of reactions
21. Briefly describe the secondary structure of protein
22. With the help of suitable illustrations, explain chemiosmotic theory
23. Briefly explain the steps involved in the oxidation of fats

. **(3X4= 12 marks)**

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Briefly explain the classification of amino acids. Illustrate with the structure of one amino acid in each group.
25. What is the function of ETS? How does it work and from what source does it derive the reducing power for operation

(1X8= 8 marks)

SEMESTER II	Course Code: BOT- DE- 525	Credits: 4

NAME OF THE COURSE: BIOINFORMATICS

COURSE OUTCOMES (CO)

CO1 : Develop technical skills to retrieve and submit nucleic acid sequence data, align them and identify sequence similarities
CO2 : Analyze the bioinformatic resources in the public domain for deriving phylogenetic relationships
CO3 : Predict gene and protein structure and study drug interactions.

COURSE CONTENT

MODULEI: Introduction to Bioinformatics, Definition, Terminology, Applications: Biotechnology and Pharmaceutical industry, Business, Employment opportunities,Journals in Bioinformatics

MODULEII: Bioinformatics resources –NCBI, NCBI data model, File formats-FASTA, Biological databases- Organism, Sequence (Primary and Secondary, Nucleotide and Protein), Structure and Mapping databases; Biolgical data-mining, Information retrieval-Entrez; Submitting sequences-Sequin; Biomark up languages-HTML,XML, Bio-Programming languages

MODULEIII: Genome annotation and Gene prediction:Predictive methods - DNA sequences and proteins: Gene finding strategies - Detecting open reading frames, Gene prediction programs: Hidden Markov model based gene discovery softwares-GENSCAN, GLIMMER,Artificial neural network based gene discovery softwares- GRAIL, GENE PARSER.

MODULEIV: Secondary databases of functional domains - Structure analysis tools-RASMOL, PYMOL, Tools at Ex Pasy–Motifs and patterns PROSITE, Pfam, Protein sequence analysis tools- PEPTOOL, Predictive methods –PSIPRED, SOPMA.

MODULEV: Phylogenetic analysis-Sequence similarity searches - Comparing nucleotide and amino acid sequences - Distance metrics. Similarity and homology. Scoring matrices. Methods of sequence alignment- Nucleotide BLAST, Protein BLAST, PSI-BLAST, Pairwise and Multiple sequence alignments, Methods of phylogenetic analysis: UPGMA, WPGMA, Neighbour joining method, Fitch/Margoliash method, Character Based Methods Molecular phylogenetic programmes. CLUSTAL, MEGA, PHYLIP, PAUP, PHASE, TREEVIEW.

MODULEVI: Pharmacogenomics and drug designing, drug designing tools- ARGUSLAB. Molecular docking software- ArgusLab.

LEARNING RESOURCES:

REFERENCES

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Model question paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc (CSS2) Degree Examination
Branch: Genetics and Plant Breeding
BOT –DE-525 BIOINFORMATICS

Time: Three hours Maximum marks: 6**0**

I. Answer ***all*** questions in one word or sentence

1. Expand the term 'PHYLIP'
2. Name one gene prediction program.
3. Give the website address of NCBI
4. What is PAM?
5. Name one biomarkup language
6. What is HMM?
7. What are ligands?
8. Mention the utility of SWISS-PROT database
9. What is a FASTA format?
10. Name the different versions of CLUSTAL. **(10X1 =10 marks)**

II. Answer any ***five*** of the following. Each answer not exceeding 150 words

11. Compare 'orthologues' and 'paralogues'.
12. What is the difference between local and global alignment?
13. What is a database? Describe the different types of databases.
14. Describe the process of querying the database with ENTREZ
15. What is the utility of gene prediction programmes?
16. Describe homology modeling.
17. Mention at least five journals in the field of bioinformatics

(5X3 =15 marks)

III. Answer any ***five*** of the following. (Each answer not exceeding 250 words

18. What is data-mining? Discuss the role of internet in data-mining and knowledge discovery
19. Give a short account on the bio-programming languages
20. Explain the gene finding strategies. Give examples of softwares that are used to predict genes in DNA sequences
21. Name the different types of protein databases
22. Explain the role of the molecular visualization tools in structure analysis.
23. What is the utility of BLAST in sequence analysis?

(5X5 = 25 marks)

IV. Answer any *one* of the following (Each answer not exceeding 500 words)

24. Highlight the importance of sequence analysis in biological research. Add a note on molecular phylogeny. Describe the operation of CLUSTAL in phylogenetic analysis
25. Describe the process of computer aided drug-designing and molecular docking Explain the role of ARGUS Lab in drug-designing

(1X10=10 marks)

SEMESTER III	Course Code: BOT- CC- 531	Credits: 4

NAME OF THE COURSE: GENETIC ENGINEERING

COURSE OUTCOMES (CO)

CO1 : Identify the characteristics of vectors and their significance in the production of transgenic plants/animals
CO2 : Outline the process in gene transfer technology
CO3 : Analyse the process involved in animaland microbial biotechnology
CO4 : Discuss the production of industrially and pharmaceutically important compounds usingrecombinant DNA technology.
CO5 : Get practical skills in Plasmid DNA isolation,plant DNA isolation, protein isolation and separation
CO6 : Get the knowledge on the tools and techniques for molecular analysis
CO7 : Evaluate the ethical, legal and biosafety issues in genetic engineering

COURSE CONTENT

MODULEI: Gene Cloning - Nucleic acid sample preparation for downstream analysis: Purification and extraction of nucleic acids, Techniques for the isolation of plasmid DNA, plant genomic DNA and total cellular RNA, mRNA preparation, C-DNA synthesis. Nucleic acid cleanup, quality and purity considerations, downstream applications.Vectors-Plasmids, phages, cosmids, phasmids, cornybacterial plasmids, BAC vectors. *Agrobacterium*Ti and Ri plasmids, plant viruses and animal viruses; Special vectors such as shuttle vectors, expression vectors, dominant selectable vectors, amplifiable vectors, integrating vectors, artificial mini chromosomes, broad host range vectors.

MODULE II: Recombinant DNA technology- Cutting and Joining DNA - Restriction enzymes, nomenclature, types, specificity; Ligation- Enzymes involved and optimization conditions; Modification of restriction fragments - Linkers, Adaptors. Gene transfer technology- Introducing genes into prokaryotes and eukaryotes, Agrobacterium mediated gene transfer in plants,Recombinant viral technique, DNA mediated gene transfer method, protoplast fusion, microcell fusion technique, metaphase chromosome transfer, liposomes, microinjection technique, electroporation and Biolistics.

MODULEIII: Identification of the right clone, Recombinant selection-Insertional inactivation of the antibiotic resistance gene marker genes, *lac*Z gene, λcI gene and on the basis of λ genome size, Spi phenotype and growth on minimal medium. Identification of the clones from a gene library - Immunochemical methods, Hybrid-arrested translation, Hybrid-selected translation, Marker rescue techniques, nucleic acid hybridization and blotting techniques- colony, plaque and dot-blot hybridization. Probes and Tests- DNA, RNA, antigen and antibody probes, methods for the preparation of probes, homologous and heterologous probes. Radioactive and non-radioactive labeling methods.

MODULE IV: Molecular Analysis: Tools & Techniques- Construction of DNA libraries: Genomic and cDNA libraries: Objectives of constructing genomic library, determination of size of DNA library, steps and enzymes involved, method of screening libraries, screening expression libraries, preparation of BAC/YAC library, Polymerase Chain Reaction (PCR):

Concept of PCR, Various kinds of PCR, Real Time PCR. Blotting techniques: Southern, Northern and Western blotting techniques, Ligation Chain Reaction, Applications of PCR. Mapping of DNA: restriction mapping, DNA foot-printing, gel retardation analysis, chromosome walking and jumping, DNA fingerprinting, RAPD, RFLP, AFLP, SSR, ISSR, SCoT, Single nucleotide polymorphisms (SNPs)- DNA sequencing-Maxam-Gilbert method, Sanger-Caulson method, Messey's shot gun method. Next generation sequencing-pyrosequencing, second generation DNA sequencing methods, third generation sequencing methods- single molecule sequencing (SMS) methods, Automated sequencing, DNA sequencer. RNA sequencing - Genotype by sequencing (GBS), DNA barcoding, RNAi, non-coding RNAs, transcriptome analysis. Protein engineering and proteome analysis- Objectives of protein engineering, Techniques of protein engineering, chemical modifications, applications of protein engineering, Site-directed mutagenesis & Error-prone PCR, Proteome analysis, 1D-2D electrophoresis, Maldi-TOF, LC-MS, Protein arrays and their applications.

MODULE V: Animal Biotechnology-Objectives of gene transfer in animals Gene constructs. Transfection methods- calcium phosphate precipitation, DEAE-Dextran mediated transfection, microinjection, stem cell mediated gene transfer- Embryonic stem cell transfer, targeted gene transfer, trans gene integration, recovery of genes transferred into animals cell, expression of cloned proteins in animal cells, detection of transgene function. Current status of transgenic animal production-Applications in the pharmaceutical industry, targeted production of pharmaceutical proteins, drug production, specific proteins- insulin, somatotropin, vaccines, genetically engineered hormones, to increase milk yield, meat production; genetic engineering of livestock and developing animals specially created for use in xenografting. Bioethics: Animal welfare and ethics.

MODULE VI: Microbial biotechnology- Major products of industrial microbiology, Fermentation technology for production of industrially important compounds -antibiotics, amino acids, organic acids, enzymes. Types of Fermentation, SSF, SmF. Applications in microbiology: biopolymers, biosurfactants and biopesticides. Probiotics, Prebiotics, Synbiotis& Problems of Antimicrobial resistance. Bioconversion processes-Biosafety considerations, Biological risks, ethical issues, economic issues, legal issues associated with microbes, Experiments with microorganisms, biosafety levels- general (standard) laboratory practices, special laboratory practices, laboratory facilities and requirements for ensuring biosafety-GMO regulatory procedures in India, Biotechnology regulatory authority of India.

PRACTICALS

1. Genomic DNA isolation from plant tissues by CTAB method.
2. Isolation of proteins from plant tissue samples
3. ISSR PCR
4. Electrophoresis: Separation of DNA
5. SDS PAGE for proteins.
6. Primer design and PCR
7. Cloning and Expression in *E.coli*
8. Protein analysis: Protein quantification, SDS-PAGE, Coomassie & Silver staining
9. Problems related to above topics

LEARNING RESOURCES:

REFERENCES

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http://www.bch.cbd.int/database
http://www.ncbi.nlm.nih.gov
http://www.csu.edu.au
http://www2.le.ac.uk
https://swayam.gov.in
http://www.protocol-online.org
http://www.bioethics.net/
https://www.microbes.info/
https://epgp.inflibnet.ac.in/

Model question paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Third SemesterM.Sc (CSS3) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC-531 GENETIC ENGINEERING

Time: Three hrs. Maximum marks: **40**marks

I. Answer all the questions in one word or sentence

1. What is the role of *cI* gene in the lysogenic pathway of lambda bacteriophage?
2. How are plasmids different from cosmids?
3. Name any two artificial chromosomes
4. What is the use of ddNTPs?
5. What is bioleaching?
6. How will you calculate minimum number of clones required to construct genomic library of an organism?
7. Suggest a method to precisely induce mutation in a particular site of the genome
8. What is the utility of lyophilization?
9. What is micro-injection?
10. Give the expansion of the term AFLP

(10X1=10 marks)

II. Answer any ***five*** questions. Each answer not exceeding 50 words

11. What is the difference between Hybrid selected translation and Hybrid arrested translation?
12. Describe the process of 'insertional inactivation' using the blue white screening method
13. You are provided a collection different clones bearing 20 kb fragments of genomic DNA. To sequentially arrange these clones which method you will use. Write principle with the help of suitable schematic diagram
14. Explain the CTAB method for the isolation of plant genomic DNA
15. What is PCR? Explain major steps involved in PCR process
16. Give a short description of restriction enzymes and their nomenclature.
17. What is ELISA? How is this analytical technique used in identification of the recombinant clone?**(5X2=10 marks)**

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. Give an account on any three vectors used for gene cloning experiments
19. Explain the steps involved in the construction of a genomic DNA library. How does it differ from a cDNA library?
20. Define chromosome jumping. Explain process involved in chromosome jumping
21. Give a short note on the bioconversion processes using microbial transformation
22. Enlist objectives of protein engineering
23. Discuss the utility of microarrays in gene expression studies

(4X3=12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Give an overview of the procedures involved in the production of transgenic organisms
25. Discuss the advances made in genetic engineering studies in the past decade

(1X8= 8 marks)

SEMESTER III	Course Code: BOT- CC- 532	Credits: 4

NAME OF THE COURSE: PLANT BIOTECHNOLOGY

COURSE OUTCOMES (CO)

CO1 : Describe the techniques and types of plant tissue culture
CO2 : Analyse the application of tissue culture in secondary metabolite production
CO3 : Gain practical skills in the preparation of tissue culture and *invitro* culture technique
CO4 :Apply cryopreservation technique as a strategy for the conservation of rare, endangered and threatened plants

COURSE CONTENT

MODULEI: Plant Tissue Culture Techniques -Historical aspects and significance: Introduction, history, and scope. Development of organ, tissue and cell culture, exploitation of totipotency. Laboratory requirements for plant tissue culture: Designing of plant tissue culture laboratory. Lab maintenance and fumigation. Culture vessels and their washing, Basic aspects of plant tissue culture: Sterilization techniques, different culture media components, growth regulators, undefined supplements, surface sterilization of explants, inoculation, subculturing etc. Types of Cultures: Cyto differentiation, organogenic differentiation, callus culture, callus mediated organogenesis, cell suspension culture- different types, measurements of growth pattern of cells in suspension, isolation of single cells, culture methods of single cells, testing viability of cells. Application of cell suspension and callus culture with special reference to medicinal and aromatic plants, *in vitro* techniques for micropropagation: Axillary bud proliferation approach, meristem and shoot tip culture. Production of virus free plants, shoot meristem culture, thermotherapy and meristem culture, cryotherapy, chemotherapy, virus indexing, maintenance of virus free stocks, applications and limitations, phases of micropropagation, micropropagation of tree species, medicinal and aromatic plants. Organogenesis via callus formation.

MODULEII: Applications of plant tissue culture - Cell Suspension Culture: Types of suspension culture, batch culture, continuous culture, open continuous, closed continuous, semi continuous, growth measurements, techniques for single cell culture, production of secondary metabolites, secondary products found in plants, method of production – factors affecting yield. Immobilized cell systems, bioreactors. Secondary metabolites detected in plant tissue culture. Root and hairy root culture. Methods of enhancement of secondary metabolite production in culture. Problem associated with secondary metabolite production. Meristem culture: explant, culture medium, environment during culture, browning of medium, rooting of shoots, deflasking and transfer of plantlets into soil. Somatic embryogenesis: Principle and concept, ontogeny and development of somatic embryos. Factors affecting embryo formation. Application of somatic embryogenesis. Artificial- synthetic Seeds: Introduction to synseed, production of synthetic seed encapsulation, steps of commercial artificial seed production, artificial seed propagation, applications. *In vitro* production of Haploids: *In vitro* production of haploids and uses of haploids, androgenic methods, anther culture, microspore (pollen) culture, pathways of development, factors governing the success of androgenesis, explant genotype, culture medium, growth regulators, physiological status of the donor plants, stages of pollen,

pretreatment of anthers, other factors, Process of androgenesis. The ploidy level and chromosome doubling, diplodisation, Uses of haploids in plant breeding, gynogenic haploids, Factors affecting gynogenesis. Embryo rescue techniques recovery of interspecific hybrids, ovary, ovule, endosperm and embryo culture. *In vitro* pollination and test tube fertilization, methodology, factors affecting seed set application. Green pod culture of orchids, applications.

MODULEIII: Protoplast Isolation and Culture- Protoplast isolation- different methods-mechanical method, enzymatic method, production of protoplasts, osmoticum, protoplast viability and density, protoplast purification. Culture of Protoplast: Culture techniques, culture medium and environmental factors, protoplast culture, cell wall formation, growth, division and regeneration of plants, protoplast fusion, somatic hybridization, different types, fusion methods, spontaneous fusion, induced fusion, different types of fusagen, mechanism of fusion, identification and selection of hybrid cells, verification and characterization of somatic hybrids, chromosome status of fused protoplasts, cybrids, achievements and limitations, significance of protoplast culture and somatic hybridization, somatic hybridization for crop improvement, problems and limitations of somatic hybridization, genetic modification of protoplasts, direct genetic transformation of DNA into protoplasts, particle bombardment, transformation of protoplast by electroporation, microinjection and microprojectiles.

MODULEIV: Somaclonal and gametoclonal variations and importance. Origin and causes-regeneration system, type of tissue, explant source, media components, duration and number of culture cycles; Technique for detection and isolation of somaclonal variants; Characterization of variants, molecular basis of somaclonal variation; Factors controlling somoclonal variation and its applications and achievements in plant breeding, limitations.

MODULEV: Transgenic Plants-Introduction, brief account of vector mediated and vectorless mediated gene transfer, application of transgenic plants, transgenic plants for crop improvement (dicots and monocots), Insect resistance, resistance to virus, resistance to other diseases, recombinant DNA techniques for the production of transgenic plants, procedure and protocols of producing transgenic plants. Transgenics for quality, improved storage, flower color and shape, terminator seed, Commercial transgenics crops, Uses and applications of transgenic plants, new products, pharmaceuticals. Bioremediation, edible vaccines, antiviral proteins, Current status of transgenics, biosafty norms and controlled field trials and release of transgenics**.**

MODULEVI: Germplasm Storage and Cryopreservation - Conservation Biotechnology - Eco-restoration Conservation of germplasm, *In vitro* strategies, short, medium and long term (cryopreservation) preservation application, techniques of cryopreservation, choice of material, preculture, cryprotection, freezing, thawing, reculture, vitrification, encapsulation dehydration, determination of survival and viability, plant growth and regeneration, applications of cryopreservation, Cryopreservation of vegetative propagated and recalcitrant seed species, Large-scale utilization of cryopreservation for germplasm conservation, cryopreservation-progress and prospects.

PRACTICALS

1. Preparation of stock solutions of MS and Mitra media
2. Preparation of solid and liquid media
3. Sterilization of culture media
4. Techniques of isolation, surface sterilization and inoculation of different explants.
5. Direct and indirect organogenesis (Medicinal plant)
6. Introduction of callus and organogenesis

7. Preparation of artificial seeds
8. Green pod (embryo culture) culture of orchid (*Spathoglotisplicata*).
9. Protoplast isolation by enzymatic method
10. Anther culture

LEARNING RESOURCES:

REFERENCES

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ONLINE RESOURCES: VIDEO LINK

https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-biotechnology/v/introduction-to-genetic-engineering

https://swayam.gov.in/nd1_noc19_bt15/...(https://www.youtube.com/watch?v=Yh9w_fyvpUk)

Model question paper

UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Third Semester M.Sc (CSS3) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC- 532 PLANT BIOTECHNOLOGY

Time: Three hours Maximum marks: **40**

I. Answer ***all*** questions in one word or sentence
1. What is bioreactor?
2. Expand PEG
3. Define callus
4. What are secondary metabolites?
5. Explain diploidization
6. What is fusogen?
7. Define totipotency
8. Define cytodifferentiation
9. Mention advantages and disadvantages of clonal propagation
10. What is the significance of embryo rescue technique?

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answer not exceeding 50 words
11. Give an account on plant growth regulators
12. Explain the application of micropropagation
13. List out two organic compounds present in MS medium and mention the role
14. Discuss the significance of ovule culture
15. What are synseeds? Add a note on their applications
16. 'Hairy root culture can be used to produce valuable metabolites' Substantiate
17. Differentiate plant growth regulators and plant growth inhibitors

(5X2= 10 marks)

III. Answer any *four* of the following. Each answer not exceeding 150 words
18. Discuss the application of tissue culture in the conservation of RET plants
19. What are the major constituents in a tissue culture medium?
20. Explain somaclonal variation and its applications?
21. Discuss the steps involved in cryopreservation
22. How is plant secondary metabolites obtained through tissue culture? Mention how they can be elicited
23. Discuss the procedure of different kinds of suspension culture

(4X3= 12 marks)

IV. Answer any *one* of the following, not exceeding 350 words
24. Briefly explain the production of *Bt* cotton and its application in crop improvement
25. Explain the methods of cell fusion and add a note on their importance in crop improvement

(8X1= 8 marks)

SEMESTER III	Course Code: BOT- CC- 533	Credits: 4

NAME OF THE COURSE: ENVIRONMENTAL GENETICS

COURSE OUTCOMES (CO)

CO1 : List out the environmental factors andtheir effect in gene expression
CO2 : Correlate chromosomeabnormalities with mutations
CO3 : Identify the causes of various genetic disorders, syndromes
CO4 : Discuss molecular basis of mutation
CO5 : Compare the methods for mutation detection and the molecular tools for disease diagnosis

COURSE CONTENT

MODULE I: Environmental factors affecting genes and their expression-Heritable changes*:* Spontaneous and induced mutations Luria Delbruck fluctuation Test, Somatic mutation and germinal mutation, genetic mosaics, Environmental Mutagens: Physical- Corpuscular radiations-Alpha particles, Beta particles, and Neutrons. Electromagnetic radiations - Gamma rays, X rays and ultra violet radiations, Properties of radio nucleotides, Radiation units. Chemical- Alkylating agents, Base analogues, Acridines, deaminating agents-

MODULE II: Chromosomal mutations - Variation in chromosome number – Gamete formation in autotetraploids, aneuploid segregation in plants, Monosomy, Cri-du-Chat syndrome Trisomy, Down syndrome, Patau Syndrome, Edward syndrome, Chromosome structure mutations- Deletion, Duplication- Bar eye in *Dropsophila*, Inversion-Consequences of inversions, Translocation- Familial Down syndrome, Fragile sites in Humans

MODULEIII: Molecular basis of mutations-Molecular Mutations: Tautomeric shifts, transitions and transversions, back mutations, suppression mutations, Silent mutations, Neutral mutation, Missense mutations, Nonsense mutations and Frame shift mutations.

MODULEIV: Mutation detection systems: Specific locus test, Ames test, *ClB* method, Muller-5 method, Attached X-Chromosomes, mutation detection in humans, mutation frequency, Mutational hot spots, DNA repair mechanisms: Photoreactivation, Excision repair, Post replication recombination, Mismatch repair, SOS repair.Gene and environmental interactions, Environmental influences in gene expression.

MODULEV: Human mutations- Understanding of mutations in Humans, ABO blood types, Muscular Dystrophy, Fragile X syndrome, Huntington's disease, Xeroderma pigmentosum. Site-directed Mutagenesis, Knock out mutations and transgenes, *cre*/*lox* system for targeted deletion of gene. Chromosomes in malignant diseases in man. Environmental genomics, Epigenetics and Environment

MODULE VI: Molecular Tools for screening and diagnosis of human diseases – Prenatal Diagnosis of Genetic Disorders and Congenital Defects, Somatic Chromosome mutation, environmental carcinogenesis.

PRACTICALS

1. Problems related to radiation dose and mutation frequency.
2. Problems related to chromosome variations in number and structure.
3. Problems related to variation in genetic code and protein synthesis
4. Problems related with point mutations and frame shift mutations
5. Problems with mutation detection systems in plants, Drosophila and humans.
6. Problems related with DNA repair mechanisms.
7. Problems with mutations in humans
8. Chromosomal aberrations due to the effects of mutagens e.g. EMS, 2,4-D or acridine orange in *Allium cepa* or *Viciafaba*

LEARNING RESORUCES:

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ONLINE RESOURCES

- Hugo: http://ash.gene.ncl.ac.nk
- DNA learning center: http://tor.cshl.org
- Genome Databases: http://www.gdb.org
- National Centre for Genome Resources. http://www.neg r.org
- Washington Univ. Dept. of Genetics. http://www.genetics.wustl.edu
- Genome Sequencing Center. http://genome.imb-jena.dc
- https://swayam.gov.in/course/1391-human-molecular-genetics
- https://epgp.inflibnet.ac.in/

Model question paper

UNIVERSITY OF KERALA

DEPARTMENT OF BOTANY

Third Semester M.Sc (CSS) Degree Examination

Branch: Genetics and Plant Breeding

BOT-CC- 533 ENVIRONMENTAL GENETICS

Time: Three hours Maximum marks**40**

I. Answer all questions in one word or sentence

1. Name a non-ionizing radiation which causes mutation.
2. What is RAD?
3. Name a radioisotope
4. Name the base analog for adenine
5. Name a human disorder caused by trisomy in chromosome 21
6. How many gametes can be formed from autotetraploid?
7. What is the phenotype effect produced by translocation between chromosome 8 and 9 in maize?
8. Define photoreactivation
9. Write about Cytogenetic position of FMR1
10. Define slippage mutation

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Explain Muller 5 *Drosophila* flies. How it can be used to detect mutation?
12. Explain how acridine dyes cause frame shift mutations.
13. What is suppressor mutate stations?
14. Explain molecular genetic aspect of Huntington's disease
15. Write gene locus and molecular genetic aspects of Duchenne muscular dystrophy
16. Define site directed mutagenesis. Write steps involved in oligonucleotide directed mutagenesis
17. Write functional features offucosyltransferase

(5X2= 10 marks)

III. Answer any ***four*** of the following Each answer not exceeding 150 words

18. Explain transition and transversion mutation
19. Explain the molecular basis of bar eye formation in *Drosophila*
20. Why nitrous acid is known as a potent mutagen?
21. With the help of schematic representation explain nuclear excision repair mechanism
22. Suggest a method to produce an organism with specific gene is 'inoperative'. Explain the principle
23. Give an account of environmental carcinogens

(4X3= 12 marks)

IV. Answer any ***one*** of the following Each answer not exceeding 350 words

24. The antisense (non coding) strand of DNA is
    5' ATGGATAAAGTTTTAAACAGAGAGGAATCT 3'
    What is the **a.** Sense strand **b.** mRNA transcribed **c.** Polypeptide that is transcribed **d.** If a base "C' deleted on 4^{th} position in the sense strand, what happens to the polypeptide?
25. Explain types, disease syndrome, cytogenetics and molecular genetics of xeroderma pigmentosum

(1X8= 8 marks)

SEMESTER III	Course Code: BOT- CC- 534	Credits: 4

NAME OF THE COURSE: MODERN METHODS IN CROP BREEDING

COURSE OUTCOMES (CO)

CO1 : List out various breeding methods and their applications in the improvement ofcrops
CO2 : Suggest the breeding methods to be adopted to produce biotic and abioticstress resistant varieties
CO3 : Compare the method of production of hybrids and synthetic varieties
CO4 : Discuss the applications of mutation breeding polyploidy breeding and ideotype breeding in crop improvement
CO5 : Identify various types of plant diseases, their pathogen and mode of production of resistant varieties
CO6 : Analyse the evolution of selected crops on the basis of cytogenetics

COURSE CONTENT

MODULE I: Heterosis and Inbreeding: Definitions. Inbreeding depression – effect of inbreeding – degree of inbreeding depression – homozygous and heterozygous balance.Heterosis and luxuriance – manifestation of heterosis.Genetic basis – dominance hypothesis- over dominance hypothesis – similarities and differences.Physiological basis of heterosis- mitochondrial complementation – fixation of heterosis. Recurrent selection- types- simple- recurrent selection for general combining ability – for specific combining ability – reciprocal recurrent selection.

MODULEII: Hybrids and synthetic varieties: Procedure – development of inbreds – methods for evaluation of inbreds–production of hybrid seeds- double cross and polycross hybrids. Role of cytoplasmic genetic male sterility and self-incompatibility in hybrid seed production.Improvement of inbred lines- pedigree selection- backcross method – convergent improvement – gametic selection- somatic hybridization, somaclonal variation, Genetic engineering- merits and demerits – achievements.Methods for the production of synthetic varieties – Merits and demerits of synthetic varieties.

MODULEIII: Mutation Breeding: Introduction –effects of mutation, Procedure for mutation breeding,-objectives, selection of material for the treatment, Factors affecting radiation effects- biological, environmental , water content, temperature and chemical factors, part of the plant to be treated, dose of the mutagen, mutagen treatment, handling of mutagen treated population, procedure for breeding of oligogenic and polygenic traits , precautions, applications of mutation breeding, limitations and achievements. Polyploidy breeding: Auto and allopolyploids. Aneuploidy- Origin and production, morphological and cytological features, aneuploid analysis for locating genes on particular chromosomes-nullisomic analysis, monosomic analysis, trisomic analysis-limitations of aneuploid analysis.Monosomic and haploids and its relevance in plant breeding.Autopolyploidy -origin and production of doubled chromosome numbers, Colchicine treatment-morphological features of autopolyploids. Application of autopolyploidy in crop improvement—Triploids and tetraploids- limitations of autopolyploidy, Allopolyploidy- origin and production of allopolyploids, morphological and

cytological features of allopolyploids, role of allopolyploidy in evolution.Applications of allopolyploidy in plant breeding.Limitations of allopolyploidy.

MODULEIV: Quality breeding: Introduction. Quality traits – morphological- nutritional – biological – organoleptic- other qualities. Quality traits of crops like rice, wheat, cotton and tomato. Breeding for nutritional quality, elimination of toxic substances-lathyrism- protein and mineral content and quality. Breeding approaches for the improvement of quality- evaluation of germ plasm, mutagenesis, hybridization, somaclonal variation and genetic engineering - problems and prospects of quality breeding.Marker assisted selection- Marker system selection, Mapping strategies-Recombinant Inbred Lines (RILs), Bulked Segregant Analysis (BSA), Near –Isogenic Lines (NILs), Mapping disease resistance genes, Mapping Quantitative trait Loci (QTLs) Application of molecular markers. Molecular breeding.Advantages and limitations of molecular markers.

MODULEV: Ideotype breeding: Ideotype concepts, types, development of ideotypes, Characters of a crop ideotype, Steps in development–identification of traits for analysis-determination value of traits, choice of traits for evaluation- ideotype breeding method-limitations. Resistance breeding: Historical account, loss due to disease, variability in pathogen. Physiological races and pathotypes.Genetics of pathogenicity- disease development-disease escape-disease resistance, susceptible reaction- immune reaction, resistance-tolerance.Vertical and Horizontal resistance- Mechanism of disease resistance–mechanical, hypersensitivity and nutritional.Genetics of disease resistance – oligogenic inheritance, gene for gene relationship–molecular basis for gene for gene relationship – polygenic inheritance.Methods of breeding for disease resistance: Testing for disease resistance – Disease epidemics, Insect resistance, mechanism of resistance, breeding methods, screening techniques, problems in insect, resistance breeding. Breeding for stress resistance: Drought resistance; introduction – types of abiotic stresses – minimizing drought resistance – breeding methods – Genetics of drought resistance –Problems. Mineral stresses: Salt affected soil- alkali soil, breeding for salinity resistance – effect of salinity stress, water stress, salt toxicity – salinity resistance, sources of salinity resistance breeding approach- Problems.

MODULE VI: Breeding of Crop plants:

Origin, taxonomy, cytogenetics and evolution of the following crops

1. Cereals	-Rice, Wheat, Maize
2. Tuber Crops	-Tapioca, Potato
3. Fiber yielding	-Cotton
4. Plantation Crops	-Rubber
5. Sugar yielding	-Sugar cane
6. Narcotics	-*Nicotiana*
7. Vegetables	-*Allium*, Tomato
8. Oil yielding	-*Brassica, Arachis*
9. Pulses	-V*igna*
10. Beverages	-Coffee, Tea

PRACTICALS

1. Heterosis Breeding

i). Pepper

Uthirankotta X Cheriakaniakkaden

↓

Panniyur

ii). Maize cob

iii). Sorghum

2. Mutation breeding

i. *Capsicum* seed treated with chemicals. Drawings of control & treated seedlings showing morphological variations

ii. Demonstration for mutation breeding– sunflower, tapioca

3. Polyploidy breeding

a. Autopolyploids- colchicines treatment –i.*Capsicum*seed and seedling

b. Polyploids

c. Evolutionary chart of the following crops

i). Wheat – *Triticumaestivum*

ii) Triticale

iii). Cotton

iv) *Nicotiana, Brassica*

4. **Ideotype:**-Rice

5. **Disease resistance:** Identification of plant diseases and their pathogen– viral, bacterial and fungal diseases

6. **Crops:** Description on taxonomy, cytogenetics and evolution of all the above mentioned crops.

LEARNING RESOURCES:

REFERENCES

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Model Question Paper

UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Third Semester M.Sc (CSS3) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC-534 MODERN METHODS IN CROP BREEDING

Time: Three hours Maximum marks: **40**

I. Answer all questions in one word or sentence

1. What is nullisomic?
2. What do you mean by spontaneous mutation?
3. Define ideotype
4. What is luxuriance?
5. Define vertical resistance
6. What are autopolyploids?
7. What is meant by double cross hybrid?
8. What is lathyrism?
9. What do you mean by directed mutagenesis?
10. Define trait analysis

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answer not exceeding 50 words

11. What are the sources used in salinity resistance breeding approach?
12. Describe the characteristics of crop ideotype
13. Write short note on hypersensitivity
14. What is mitochondrial complementation?
15. Describe the method of bulked segregant analysis?
16. Briefly describe the origin of rice
17. Distinguish between hybrid and synthetic varieties

(5X2= 10 marks)

III. Answer any ***four*** of the following Each answer not exceeding 150 words

18. Describe the breeding method to be adopted to produce disease resistant variety
19. Discuss the role of self incompatibility in hybrid seed production
20. Distinguish between dominance and over dominance hypothesis
21. What are the steps involved in the production of an ideotype?
22. Write short note on genetics of pathogenicity.
23. Briefly describe the morphological and cytological changes observed in polyploids

(4X3= 12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. What are mutagens? Briefly explain the procedure of mutation breeding. Discuss its application in crop improvement
25. Discuss the significance of cytogenetics in the evolution of wheat.

(1X8= 8 marks)

SEMESTER III	Course Code: BOT- DE- 535	Credits: 2

NAME OF THE COURSE: APPLIED PALYNOLOGY

COURSE OUTCOMES (CO)

CO1 : Analyse general characters of Pollen, their structure and function
CO2 :Evaluate the palynological characters in solving taxonomic problems
CO3 :Analyse the evolutionary trend in pollen characters
CO4 :Get the knowledge on application of pollen in different fields

COURSE CONTENT

MODULEI: Anther and pollen-Pollen mother cell, Pollen wall ontogeny. Pollen wall development-exine growth phase -primexine model,undulation model-intine growth phase,production and deposition of sporopollinin-distribution,chemistry and function of sporopillinin Surface coatings on pollen and spore-pollenkit, Tryphine, Perine, Glycocalyx, Viscin Threads, Elaters.

MODULEII: Pollen units: Monad, dyad, tetrad, polyad, pseudomonad, pollinium and massula. Polarity: Apolar, isopolar, hetropolar. Symmetry: Symmetric -Radially symmetric or Bilaterally symmetrical- Asymmetric; Shape: Pollen shape (tertiary): Radio symmetrical, bilateral, shape index in radio symmetrical grains (P/E X100). Shape types- oblate, suboblate, oblate-spheriod, spherical, prolate-spheriodal, subprolate, prolate, perprolate. Major evolutionary trends in shape of pollen. Size: Based on Walker and Doyle (1975). Apertures: Various types of apertures, NPC system of aperture classification-subdivision of pollen surface, Evolutionary trends in aperture.

MODULE III: Exine surface ornamentation (secondary): projection types- spinate, spinulate, verrucate, gemmate, bacculate, tuberculate. Depression types- reticulate, lophate, fossulate, scrobiculate, punctate, pilate, psilate. Evolutionary trends in exine ornamentation, Exine strata: intine, exine with endo exine (base layer), mid exine (columella layer) and extoexine (the tetum, tegillum and supra tegillum).

MODULEIV: Systematic palynology-role of palynology in taxonomy, Evolution of aperture and exine ornamentation in general and evolutionary trends amoung pollen grains with special reference to Compositae,Acanthaceae,Verbenaceae.

MODULE V: Palynological Techniques-Laboratory equipments. Processing of pollen-Acetolysis,chlorination and mounting-staining,microscopy and measurements,Palynograms and illustrations,Photomicrography,LO-analysis,Collection and analysis of fossil pollen and spores,Trapping aerospora and processing of honey.

MODULEVI: Applied Palynology -Geo or Palaeopalynology-Pollen spectrum, Climatic chronology, Exploration of coal and oil- aeropalynology, Melittopalynology, iatropalynology, pharmacopalynology, copropalynology and forensic palynology.

LEARNING RESOURCES:

REFERENCES

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Model question paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc (CSS3) Degree Examination
Branch: Genetics and Plant Breeding
BOT- DE - 535 APPLIED PALYNOLOGY

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. What is sporopollinin?
2. Explain prime exine
3. Explain columella
4. What is annulus?
5. What is margo?
6. Explain the term polytreme
7. What is colporate pollen?
8. What is apocollpium?
9. What is confervoid pollen?
10. Explain the features of gemmate ornamentation

(10X1=10 marks)

II. Answer any ***five*** of the following. Each answer not exceeding 150 words

11. Explain the features of various types of amb
12. Explain various types of aperture characters
13. What is polarity of pollen grain?
14. Give a short account on Forensic palynology
15. Write the functions of various wall layers of pollen
16. Write the importance of mellisso- palynology
17. Write the procedure of acetolysis method

(5X3 =15marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Give an account on the various types of surface coatings on pollen and spore
19. Explain the NPC system of aperture classification
20. Give an account on Iatropalynology
21. Explain the various shape and size classes of pollen
22. Briefly explain the ontogeny of pollen wall development and structure of mature pollen wall
23. Explain various types pollen units
24. Give an account on the Pharmacopalynology

(5X5=25marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

25. Write an account on various applications of geo-palynology
26. Briefly explain the features of any ten types of pollen ornamentations

(1X10=10marks)

SEMESTER III	Course Code: BOT- DE- 536	Credits: 2

NAME OF THE COURSE: PHYTOCHEMISTRY

COURSE OUTCOMES (CO)

CO1 : Identify and classify the various phytochemicals
CO2 : Discuss the methods of phytochemical extraction
CO3 : Compile the applications of phytochemicals in pharmacology, neturaceutical and cosmetic development
CO4 : Analyse phytochemical data bases

COURSE CONTENT

MODULE I: Major classes of plant chemicals-terpenoids, alkaloids and other nitrogen containing metabolites, phenolic compounds.

MODULEII: Extraction techniques. Separation and Purification techniques-chromatography TLC, HPLC and GC.Detection techniques-UV-Vis spectroscopy, Infrared spectroscopy (IR) and Mass spectroscopy (MS), NMR spectroscopy.
MODULEIII: Phytochemicals in disease prevention: Utility in treatment of cancer, diabetes, cardiovascular diseases. Mode of action-antioxidants, hormonal action, stimulation of enzymes, interference with DNA replication, antibacterial and antifungal effects, blocking and suppressing agents, phytoestrogens, isoflavanoids and lignans. Toxins such as glycoalkaloids, fucocoumarins, miscellaneous toxicants.Drug discovery and development.
MODULEIV: Nutraceuticals and cosmetics: With special reference to vegetables and fruits from plant families such as Lilieaceae, Cruciferae, Solanaceae, Umbelliferae, Compositae and Rutaceae. Brief description of properties and constituents of plants and plant parts used as Cosmetics and in Aromatherapy.
MODULE V: Biotechnology and Phytochemical production:Engineering the plant metabolism. Methods of expression of foreign proteins in plants, production of pharmaceuticals and industrial enzymes, expression of whole proteins and pharmaceutically active peptides.Isolation and purification from plants.

MODULE VI: Phytochemical databases: Dr. Duke's Phytochemical and ethnobotanical databases, NAPRALERT, MEDFLOR.

LEARNING RESOURCES:

REFERENCES

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- Tiwari, B.K, Nigel D. Brunton, Charles S. Brunton, Charles S. Brannan. (2013). Hand Book of Plant Food Phytochemicals: Sources, Stability & Extraction. Wiley- Black Well, A John Wiley & Sons Ltd Publication.
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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc (CSS3) Degree Examination
Branch: Genetics and Plant Breeding
BOT- DE- 536 PHYTOCHEMISTRY

Time: Three hours Maximum marks **60**

I. Answer ***all*** the questions in one word or sentence.

1. What are phytoestrogens?
2. What is Charakasamhita?
3. What are glycoalkaloids?
4. Expand the term 'HPLC'
5. What is aromatherapy?
6. Name a hydrosol
7. What is an antioxidant?
8. Name a Phytochemical database
9. What are sesquiterpenes?
10. Give an example for tannin

(10X1=10 marks)

II. Answer any ***five*** of the following. Each answer not exceeding 150 words

11. How do the secondary metabolites help in plant defence? Describe the role of phytoalexins during plant infections
12. Discuss the application of bioinformatics in drug designing
13. Explain the utility of metabolic engineering in secondary metabolite production
14. Give a short note on biosynthesis of terpenoids
15. What is curcumin? Discuss the role of curcumin in cancer cure
16. Briefly describe the classification of secondary metabolites
17. What is green tea? The consumption of green tea is considered beneficial. Justify

(5X3=15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Describe the application of spectroscopic techniques in the characterization of plant secondary metabolites
19. Enlist the chromatographic techniques used for the isolation of phytochemicals
20. Name the different types of nitrogen compounds in plants along with a short description on each
21. Discuss the utility of new generation hyphenated techniques in the area of natural product chemistry.
22. What are nutraceuticals? Discuss their role in disease prevention
23. Give an account on at least five different plants which are used in cosmetics
24. What are essential oils? Explain the process of essential oil extraction.

(5X5=25 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

25. What is ethnobotany? How is ethnobotanical information utilized in the drug discovery process?
26. Discuss the role of herbal medicines in disease prevention and cure

(1X10=10 marks)

SEMESTER IV	Course Code: BOT- CC- 541	Credits: 4

NAME OF THE COURSE: POPULATION & EVOLUTIONARY GENETICS

COURSE OUTCOMES (CO)

CO1 : Gain knowledge on the gene frequency, changes in gene frequency and their consequences in the genetics of populations using Hardy Weinberg law.
CO2 : Analyze the factors affecting the gene frequencies in populations and their impacts
CO3 : Explain the process of species evolution and molecular concepts
CO4 : Identify factors affecting gene frequencies
CO5 : Analyze the importance of population gene frequencies in driving the process of evolution.
CO6 : Explain the increased incidence of lethal hereditary diseases in consanguineous populations.

COURSE CONTENT

MODULE I: Genetic Composition of Mendelian Population**:** Basic concepts - History and origin of Population Genetics, Gene and Genotype frequencies, Gene pool.

MODULE II: Hardy-Weinberg equilibrium**:** Random mating and Hardy-Weinberg Law, Assumptions, predictions and derivation of Hardy-Weinberg Law, Calculating gene and genotype frequencies for – codominant alleles, dominant-recessive alleles, autosomal loci with multiple alleles and blood types, sex-linked alleles – codominant and dominant-recessive alleles.

MODULE III: Applications of Hardy-Weinberg Law - Test for Random mating (chi-square analysis), Test for sex-linked genes, Test for carrier gene frequency, Test for mode of inheritance, Test for multiple genes. Non – random mating - Positive and Negative non-random mating.

MODULE IV: Factors affecting gene frequencies in natural populations -Factors affecting random mating population: Migration, Mutation – non-recurrent and recurrent mutations, Selection - Fitness, gametic selection, zygotic selection, Selection against dominant genotype, Selection against recessive genotype, Selection in favour of heterozygote, Mutation-selection balance, Random drift, Genetic Load, Founder effect, Bottleneck effect.

MODULE V: Consanguinity in natural populations: Inbreeding/consanguinity- Overview, Types of inbreeding, pedigrees of inbreeding and calculation of inbreeding co-efficient, Harmful genetic effects of inbreeding.

MODULE VI: Evolutionary Genetics - Synthetic theory of evolution, Adaptive radiation; Isolating mechanisms - Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution, evolution of multi-gene family.Molecular evolution: Concept of neutral evolution, molecular divergence and molecular clocks, Human evolution.

PRACTICALS

Problems to prove the Hardy-Weinberg Law

Problems that test the various applications of Hardy-Weinberg Law.
Problems that test the factors affecting Hardy-Weinberg Law
Problems related to consanguinity in populations

LEARNING RESOURCES:

REFERENCES

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Model question paper
UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY
Fourth Semester M.Sc. (CSS 4) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC – 541 POPULATION & EVOLUTIONARY GENETICS

Time: **3** hrs

Maximum **40** marks

I. Answer ***all*** questions in one word or sentence

1. What is gene pool?
2. What is chi- square test?
3. What is effective population?
4. What is non – recurrent mutation?
5. How is 'degrees of freedom' calculated?
6. Define the term species
7. What is positive nonrandom mating?
8. What is the formula for calculating genotype frequency?
9. What is linkage disequilibrium?
10. What is consanguinity?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words

11. Explain mutation selection balance
12. Give a short account on 'molecular clock'
13. What are sex-influenced traits?
14. Explain negative non-random mating and its consequences in evolution
15. Explain genetic load. Describe mutational and segregational load in populations
16. What is gene frequency? How is the gene frequency calculated for codominant and dominant recessive autosomal loci
17. How does recurrent mutation affect gene frequency in a random mating population?

(5X2=10 marks)

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. How does migration change gene frequency in a random mating population, if the migration is recurrent? What will be the difference in gene frequency between a donor and a recipient population after sixth generation of migration when compared to first generation?
19. Describe the different modes of speciation
20. Describe the consequence of gene erosion and its remedies
21. What is meant by the term 'founder effect'?
22. Define inbreeding coefficient. What are the major genetic effects of inbreeding?
23. Write an account on origin and evolution of humans

(4X3=12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. State the Hardy-Weinberg equilibrium and its applications
25. Describe gametic selection and zygotic selection and their effects in populations

(1X8=8 marks)

SEMESTER IV	Course Code: BOT- CC- 542	Credits: 4

NAME OF THE COURSE: DEVELOPMENTAL GENETICS

COURSE OUTCOMES (CO)

CO1 : Gain knowledge on genetic and molecular basis of cell differentiation and development in model organisms.
CO2 : Recognize significance of cell signalingmechanism and its importance in immunological response
CO3 : Analyze various theories of ageing and identification of factors accelerating ageing
CO4 : List out the reasons, and discuss molecular and genetic factors in tumour development and progression
CO5 : Identify various types of carcinogens and its action

COURSE CONTENT

MODULEI: Cell differentiation, growth and development- Basic concepts of development- Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients, cell fate and cell lineages, stem cells, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenics in analysis of development- General characteristics of cell differentiation, effects of mutations in developmental processes, antennapaedia complex, the bithorax complex, segmental genes, Gap genes and pair rule genes in *Drosophila*, Effects of nuclear and cytoplasmic factors in development, environmental effects, maternal effects, nuclear cytoplasmic interactions with particular reference to *Acetabularia*.

MODULEII: Growth and Development in Plants- Patterns of growth and differentiation- Gene expression and mutations regulating meristem function, embryogenesis, seedling, root, leaf and flower development. Homeotic genes, ABCD model in *Arabidopsis* flower, hormonal control of plant tissue development, effect of auxins on root and root formation, gibberellin promoted growth of plants, ethylene and triple response mutants, brassinosteroids and photomorphogenesis.

MODULEIII: Cell signaling & communications-Types of signals and signaling molecules, Types of Cell surface receptors, G protein coupled receptors, Signal transduction pathways- ras/map kinase pathway, phosphoinositide pathway, receptor serine kinases, secondary signal molecules, second messengers, calcium signaling, two component regulatory systems, bacterial chemotaxis, quorum sensingand quarum sensing disruptors. Immunology- Structure and function of different classes of immuno-globulins, Monoclonal antibodies, lymphoid system, B cells and T-cells, natural immunity and acquired immunity, vaccine development and immunization, immune disorders, super antigenicity and diseases associated with superantigen production.

MODULE IV: Developmental mechanisms-Biological Rhythms-Spectrum of biological rhythms, Circadian rhythms, factors affecting rhythmic responses, molecular mechanism of

rhythmic responses in model organisms – *Synecchococcus, Neurospora, Drosophila*, mammals. Sex differentiation- Sex as a developmental phenotype, factors influencing sex differentiations, environmental effects, hormonal effects, effects of ploidy, monoecious and dioecious plants. Ageing-Cellular and molecular changes in ageing, Theories of ageing – Genetic, Neuroendocrine, Free-radical, Membrane, HayFlick-limit, Mitochondrial decline, Cross-linking, Telomease, Wear and tear theories. Difference between necrosis and apoptosis- Processes, pathways and proteins involved in apoptosis regulation- Factors and signals inducing cell death.

MODULEV: Regulation of Cancer-Tumourogenesis in plants- Characteristics of Crown Gall Tumour(CGT) cells, crown gall and plant transformation, Interaction between wound cell and bacteria, plasmids as tumour inducing principle.Viruses that cause cell transformation-DNA tumour virus -papova virus, adenoviruses, RNA tumour virus, oncogenic retrovirus, Characteristics of cancer cells, cytological changes, Theories of carcinogenesis - Multiple Mutations in Cancer, Oncogenes and cancer,Oncogene families, Functional classes of oncogenes, cell division signals and oncogenes, Characteristics of individual oncogenes-*src*, *myc*, *ras*, *erb* A &*erb* B, *sis* and *fms.* Tumour suppressor genes- Properties of Tumor Suppressor Genes- rb, p53, Wilms' tumor suppressor gene (wt-1), Adenomatous polyposis coli (*apc*) gene, BRCA 1 & 2. Identification of tumor suppressor genes.

MODULEVI: Carcinogens - Chemical carcinogens- Metabolic activation of chemical carcinogens, Donors of simple alkyl groups, Cytochrome p-450–mediated activation, 2-acetylaminofluorene, Other aromatic amines, Polycyclic aromatic hydrocarbons, Interaction of chemical carcinogens with oncogenes and tumor suppressor genes, Central dogma of tumor progression. Radiation as carcinogens- Ionizing radiation and UV radiation. Teratomas, teratocarcinomas, teratogenesis.

PRACTICALS

1. Study of various developmental stages and polytene chromosomes of *Drosophila*
2. *Drosophila* various developmental stages
3. Preparation of sex chromatin from cheek cells
4. Angiosperm embryo development using bean/ *Tridax*/ *Vinca* seeds
5. Early plant development – Pollen tube formation
6. Study of plant tumours – galls
7. Study of human cancers using permanent slides
8. ABC model flower development
7. Problems: nuclear cytoplasmic interactions with particular reference to *Acetabularia*

LEARNING RESOURCES:

REFERENCES

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- Avery A. S. (1980). Chromosomes in Human Cancer and Leukemia, Elsevier, New York.
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- Twyman RM (2010) Instant Notes- Developmental Biology, BIOS Scientific Publishers, UK
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ONLINE RESOURCES:

- http://evolution.berkeley.edu
- www.benbest.com
- http://labs.biology.ucsd.edu
- www.mdpi.com
- http://advances.sciencemag.org
- http://mcb.asm.org
- www.dnalc.org
- https://swayam.gov.in
- https://epgp.inflibnet.ac.in/

Model question paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
FOURTH SEMESTER M.Sc (CSS4) DEGREE EXAMINATION
Branch: Genetics and Plant Breeding
BOT-CC-542 DEVELOPMENTAL GENETICS

Time: Three hours Maximum marks: **40**

I. Answer ***all*** questions in one word or sentence

1. What is white-collar complex?
2. What is senescence?
3. What is *Zeitgeber*?
4. Explain the term 'free-running period'
5. What are Biological Rhythms?
6. Define E-box
7. What are NIH3T3 and He La cell lines?
8. What are growth factors and growth factor receptors?
9. What is MHC?
10. Give the role of SOD in aging

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words

11. Define tumour suppressor gene. What are the important activities if p53? Explain
12. Give an example of DNA tumour virus. Describe its structure, genomic organization and involvement in tumour formation
13. Give an account on G-protein
14. Explain two theories concerning the ageing
15. Write role of g*ap* gene in development
16. Give the relation between the rhythmic bioluminescence in *Gonyaulax* to light signals
17. What are the effects of maternal genes in the development of *Drosophila*?

(5X2= 10 marks)

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. Enumerate important characters of cancer cells
19. Why *Sxl* gene considered to be the master-switch in the sex determination of *Drosophila mealnogaster*
20. Discuss the genetic impact in *Caenorrhabditis elegans* sex determination
21. Explain the genetics of circadian clock mechanism in insects
22. Describe ABC model of flower development
23. The immune system is considered to be most appropriate model system for studying the cellular and molecular mechanism of aging. Explain

(4X3= 12 marks)

IV. Answer any ***one*** of the following. Each answer not exceeding 350 words

24. Briefly describe the organization of Ti plasmid with special reference to its T-DNA and *vir*regulon. Explain the mechanism of T-DNA transfer into plant genome
25. Write an account on signal transduction pathway

(8X1= 8 marks)

SEMESTER IV	Course Code: BOT- CC- 543	Credits: 4

NAME OF THE COURSE: **BIOSYSTEMATICS**

COURSE OUTCOMES (CO)

CO1 : Analyze systems of plant nomenclature and plant classification
CO2 : Familiar with common botanic garden and herbarium
CO3 : Apply various tools – morphological, anatomical, phytochemical and molecular characters for solving taxonomic problems.
CO4 : Assess various tools that can be used for more accurate systematization of plant kingdom.
CO5 : Get familiarized with common plants in the adjacent localities, use suitable tools in the plant identification and preservation through herbarium
CO6 : Develop skill in identification of plants

COURSE CONTENT

MODULEI: History and development of Plant classification in India- Brief study of Artificial (Linnaeus)-Natural (Bentham and Hooker) and Modern systems of Classification (APG)- Plant nomenclature- ICBN- author citation- type concept- publication of names- rule of priority- definition of nomenclatural terms- autonym- homonym- basionym- tautonym and numen nudum. Classification of taxonomic literature- floras- icons- monographs- reviews and journals.

MODULEII: Botanic gardens-definition- role in taxonomic studies- National and International Botanic Gardens- special reference to Royal Botanic Garden, Kew- Indian Botanic Garden, Calcutta- JNTBG &RI, Trivandrum. Herbarium-definition- importance-history and development of herbarium-kinds of herbarium-steps in herbarium techniques-important herbarium in India and World.

MODULEIII: Macroscopic vegetative and floral identifying features-: Brief account on roots-types-modifications, stem-modifications, leaves-types-venation-phyllotaxy-modifications, inflorescence-racemose-cymose-special types, flowers-symmetry-floral whorls-arrangements-variations, fruits-simple-aggregate-multiple types, Seeds- structure-shapes, microscopic or ultra-structural morphological characters- trichomes- stomata- types of stomata- pollen wall ornamentation- seed surface pattern.

MODULEIV: Anatomy in relation to taxonomy: Applications of anatomical features-vegetative and floral anatomy in relation to taxonomy and phylogeny-e.g.,- Apocynaceae, Caesalpiniaceae -Papilonaceae, Ranunculaceae- Leaf anatomy in relation to taxonomy e.g.,Myrtaceae. Embryology in relation to taxonomy: Basic embryological characters of taxonomic significance- e.g.,.-Loranthaceae. Cyperaceae.*Trapa.-Paeonia*. Cytology in relation to taxonomy: Chromosome number - morphology and relative size-heterochromatin-chromosome behaviour at meiosis- Importance of genomic characters for biosystematics-cytological data for the identification of following angiosperm families - Zingiberaceae, Liliaceae, Malvaceae. Cucurbitaceae, Araceae, Rubiaceae and Araliaceae. Palynology in relation to taxonomy--evolution of pollen morphological characters-role of palynology in

relation to taxonomy. e.g.- Acanthaceae, Rubiaceace, Scrophulariaceae, Rutaceae and Malvaceae.

MODULEV: Chemotaxonomy- definition- importance- role of secondary metabolites in systematics of plants- plant to plant variation- chemistry and plant identification - chemosystematics of Apiaceae- essential oils of Asteraceae and Lamiaceae, pigments of Gesneriaceae. Serotaxonomy- definition- history- methods-.role of serology in taxonomy. Numerical taxonomy- definition- OTU's- principles of numerical taxonomy- merits and demerits of numerical taxonomy- applications of numerical taxonomy.

MODULEVI: Molecular systematics: Molecules and genomes in plant systematics- Techniques used in molecular taxonomy- Chloroplast DNA and plant phylogeny- present status and future prospects- Use of chloroplast DNA rearrangements in reconstructing plant phylogeny- Mitochondrial DNA in plant systematics- Applications and limitations- Ribosomal RNA as a phylogenetic tool in plant systematics. E.g. Asteraceae, Onagraceae, *Brassica*, Nymphaceae- Molecular approaches to plant evolution- Intraspecific cpDNA variation in systematic and phylogenetic implications. Molecular evidence and plant introgression- molecular data and polyploid evolution in plants. Molecular systematics and crop evolution- rice, wheat, maize, potato, *Brassica, Nicotiana*.

Cytogeography and biosystematics: Cytogeography and structure of a group of related taxa. E.g., *Ranunculus plantagieus*, *Polycarponpolycarpoides*, *Erysimum grandiflorum*. Cytogeography and historical botanical geography, occurrence of other biosystematic methods on cytogeography.

PRACTICALS

Preparation of herbarium and identification of plants belonging to the following families (Minimum 15 families and 25 herbarium sheets)

Ranunculaceae, Magnoliaceae, Annonaceae, Cruciferae, Caryophyllaceae, Tiliaceae, Sterculiaceae, Clusiaceae, Rutaceae, Meliaceae, Menispermaceae, Anacardiaceae, Bixaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Combretaceae, Myrtaceae, Lythraceae, Cucurbitaceae, Umbelliferae, Rubiaceae, Asteraceae, Sapotaceae, Apocyanaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Verbenaceae, Amaranthaceae, Euphorbiaceae, Zingiberaceae, Heliconaceae, Poaceae, Arecaceae, Orchidaceae

Taxonomic key preparation

LEARNING RESOURCES:

REFERENCES

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ADDITIONAL REFERENCES

- Journal - Taxon
- Journal- Plant Systematics and Evolution
- Journal- Rheedia

Model question paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Fourth Semester M.Sc (CSS4) Degree Examination
Branch: Genetics and Plant Breeding
BOT-CC-543 BIOSYSTEMATICS

Time: **3**hrs Maximum **40** marks

I. Answer ***all*** questions in one word or sentence

1. What is genome?
2. Expand ELISA
3. What is cryptic structural polyploidy?
4. What is nexine?
5. What do you mean by stenopalynous?
6. What is amphimixis?
7. What is phenetics?
8. Define molecular systematics
9. What is a cytotype?
10. What are semantides?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answer should not exceed 50 words

11. What is the application of serotaxonomy?
12. What is cluster analysis?
13. Distinguish between orthotropous and amphitropous ovule
14. Describe the structure of ITS
15. List out the applications of molecular systematics
16. What does the author citation indicates in the binomial Ipomoea purpurea *(L.) Roth.*
17. Differentiate between reticulate and psilate type of ornamentation

(5X2=10 marks)

III. Answer any ***four*** of the following. Each answer not exceeding 150 words

18. Describe the role of chemotaxonomy in biosystematics
19. What is apomixis? Describe the different types of apomixis with examples
20. Describe the functions of herbarium
21. Chloroplast genomes are widely used for phylogenetic studies. Why?
22. Analyse the major embryological characters used in plant taxonomy?
23. What are taxonomic keys? How will you prepare key for taxa based on morphological characters giving emphasis to trichomes?

(4X3=12 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Discuss the applications of numerical taxonomy, its principles, merits and demerits
25. Evaluate the methods available for the generation and interpretation of molecular data in plant taxonomy?

(1X8=8 marks)

SEMESTER IV	Course Code: BOT-D- 544	Credits: 4

NAME OF THE COURSE: DISSERTATION

COURSE OUTCOMES (CO)

CO1 : Develop the skill for identification of research problems and design suitable experiments

CO2 : Gain the capability to observe, analyze and interpret the results obtained and conclude.

CO3 : Discuss the methodologies to be adopted for scientific research and publication

SEMESTER I-IV	Course Code: BOT- GC- 501	Credits: 2

NAME OF THE COURSE: PLANT TISSUE CULTURE

COURSE OUTCOMES (CO)

CO1 :To develop deep knowledge on the technique of plant tissue culture and its application.
CO2 : Develop skill in various tissue culture techniques
CO3 : Apply tissue culture techniques for crop improvement
CO4 : Gain knowledge in the production of artificial seeds,conservation of germplasam

COURSE CONTENT

MODULEI: Introduction- Historical aspects and significance: Introduction, history, and scope. Development of organ, tissue and cell culture, exploitation of totipotency

MODULEII: Basic techniques and principle, General laboratory requirements for plant tissue culture: Designing of plant tissue culture laboratory. Lab maintenance and fumigation. Culture vessels and their washing, Basic aspects of plant tissue culture: Sterilization techniques, different culture media media components, growth regulators, undefined supplements, surface sterilization of explants, inoculation, subculturing etc.

MODULE III: Different types of cultures**, c**allus culture- characteristic features,Cytodifferentiation, significance. Suspension culture -different types, growth patterns, significance, Secondary metabolites detected in plant tissue culture. Root and hairy root culture. Methods of enhancement of secondary metabolite production in culture. Problem associated with secondary metabolite production.

MODULEIV: Application of culture technologies to plant improvement, Micropropagation protocol and application, production of pathogen free plants-meristem culture and its applications, Anther culture protocol and applications, protoplast culture and somatic hybridization protocols and applications. Somaclonal and gametoclonal variations and importance. Origin and causes- regeneration system, type of tissue, explant source, media components, duration and number of culture cycles; Factors controlling somoclonal variation and its applications.

MODULEV: Somatic embryogenesis, Embryo culture and artificial seed, Ovary, ovule, endosperm and embryo culture, application of embryo culture, embryo rescue technique, Green pod culture of orchid, embryogenesis. Chemical and physical factors, pathway of development, Artificial seeds- applications

MODULEVI: Germplasm Storage and Cryopreservation,Conservation of germplasm, *In vitro* strategies, short, medium and long term (cryopreservation) preservation application, techniques

of cryopreservation, choice of material, preculture, cryprotection, freezing, thawing, reculture, vitrification, encapsulation dehydration, determination of survival and viability, plant growth and regeneration, applications of cryopreservation, Large-scale utilization of cryopreservation for germplasm conservation, cryopreservation-progress and prospects.

LEARNING RESOURCES:

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Model question paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc (CSS) Degree Examination
BOT-GC-501 PLANT TISSUE CULTURE

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. Define an explant
2. Expand PEG
3. What are cryoprotectants?
4. Define cellular totipotency
5. What is embryo rescue technique?
6. What is dedifferentiation?
7. Differentiate cybrid and hybrid
8. Expand DMSO
9. Name two surface sterilizing agents
10. Define gynogenic haploid

(10X1= 10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Write short notes on shoot tip culture
12. Give an account of plant growth regulators
13. Enlist steps for synthetic seed preparation
14. List out the application of cryopreservation. Point out the disadvantages
15. Describe different types of sterilization techniques.
16. What is somaclonal variation? Mention the significance
17. What are different sterilization methods used in plant tissue culture?

(5X3= 15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. How are protoplast induced to regenerate into whole plant?
19. What is a callus? What is its application?
20. Explain procedure for micropropagation
21. What are the advantages of protoplast culture? Mention the difficulties in culturing the protoplast
22. Explain the scope of plant tissue culture.
23. What are the constituents of a tissue culture medium? Mention the role of each
24. How do you set a tissue culture laboratory?

(5X5= 25 marks)

III. Answer any ***one*** of the following, not exceeding 350 words

25. Discus the *in vitro* production of haploids through anther and pollen culture and its application.
26. What are the applications and types of cell suspension culture?

(1X10= 10 marks)

SEMESTER I-IV	Course Code: BOT- GC- 502	Credits: 2

NAME OF THE COURSE: MICROBIAL TECHNOLOGY

COURSE OUTCOMES (CO)

CO1 : Get deep knowledge on the microbial techniques and its application.
CO2 : Develop skill in microbiology practices, andapply bioprocess technology.
CO3 : Analyze phylogeny of microbial isolates.

COURSE CONTENT

MODULE I: Introduction**,** Historical development and significance: History of development of Microbiology; Development of fields of Microbiology in 20th century, Ecological, clinical and industrial importance.

MODULE II: Basic techniques and principles of Microbiology, General laboratory requirements for Microbiology:Laboratory rules and safety regulations, first aid, Preparation of glassware - washing - sterilization techniques, laminar flow chamber types, safety levels. Microscopy: Types of microscope, slide preparation. Preparation of culture media, nutritional needs of microbes, pure culture techniques, preparation of slants, sub-culturing, Microbial growth measurements, cell count, turbidity measurement, Optical Density, serial dilution, standard plate count, types of dyes, staining techniques - simple – Grams staining.

MODULE III: Different groups of Microorganisms: Viruses, Bacteria, Fungi, Actinomycetes; Classification, Isolation and cultivation**.** Structure of common bacteria (*E. coli, Bacillus*), actinomycetes(*Streptomyces)* and fungi (*Aspergillus, Penicillium, Trichoderma, Agaricus*), Phylogenetics – morphological, biochemical and molecular phylogenetics.

MODULE-IV: Analysis of cultivable and non cultivable microorganisms, Long term and short term preservation of Microbes, Culture collections and Mycological herbarium - Importance, Examples of Indian and International culture collections.

Module V: Microbial Genetics: Prokaryotes and Eukaryotes, Isolation of genomic DNA, Plasmid isolation, agarose gel electrophoresis, PCR amplification, Restriction digestion, Competent cell preparation and transformation, Cloning and expression.

Module VI: Microbes as cell factories: Production of antibiotics & enzymes, Antimicrobial screening, MIC and MBC, antibiotic sensitivity testing, Submerged and solid state fermentation, Optimization, Production of industrial enzymes using microbes (alpha amylase and protease).

MODULE VI: Plant-Microbe interactions - mutualism, symbiosis, commensalisms, predation, parasitism, competition, biofilms. Phylloplane, endophytic and rhizosphere microbes, Lichens, Mycorrhiza: ecto-, endo-, ectendo-, VAM. Use of microbes in agriculture, Nitrogen fixation (symbiotic and asymbiotic associations), Phosphate solubilization, antagonism, plant growth promoting rhizobacteria (PGPR).

LEARNING RESOURCES:

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Model question paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc (CSS) Degree Examination
BOT-GC-502 MICROBIAL TECHNOLOGY

Time: Three hours Maximum marks: **60**

1. Answer ***all*** questions in one word or sentence
    1. Define an VAM
    2. Expand MTCC
    3. What are Ray-fungi?
    4. Define MIC
    5. What is probiotic? Name a probiotic drink.
    6. What is actinorrizha?
    7. Give an example of Phosphate solubilizing bacterium
    8. What is bioleaching ?
    9. Name two symbiotic Nitrogen fixing organisms
    10. Define contamination

(10X1= 10 marks)

2. Answer any ***five*** questions. Each answers not exceeding 50 words.
    11. Write a note on the different microbial groups producing antibiotics.
    12. Discuss PGPR and its applications.
    13. Give a brief account of slime molds.
    14. Give general characters of bacteriophages
    15. What is bacterial growth curve?
    16. Explain the steps in bacterial biofilm formation.
    17. Differentiate phylloplane and rhizosphere fungi.

(5X3= 15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words
    18. Write about the microbial groups producing antibiotics with example.
    19. Write the contributions of Louie Pasteur and SA Waksman
    20. Write a commonly used method for isolation of pure culture of bacterium.
    21. Explain briefly the structure and functions of bacterial cell wall
    22. Briefly explain the morphological features of Aspergillus
    23. What are the constituents of a microbial culture medium?Point out the role of each.
    24. 'Microbial growth can be measured by many methods' Explain different methods.

(5X5= 25 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words
    25. Give five examples of microbial products and write short notes on the processes relating to modern biotechnology
    26. Explain the importance microbial culture collections and types of culture collections.

(1X10= 10 marks)

SEMESTER I-IV	Course Code: BOT- GC- 503	Credits: 2

NAME OF THE COURSE: PLANT CELL CULTURE TECHNOLOGY

COURSE OUTCOMES (CO)

CO1 : Gain knowledge in new advances in the field of cell culture technologies
CO2 : Apply this knowledge for the enhanced production of useful and novel compounds for the benefit of mankind.

COURSE CONTENT

MODULEI: Introduction- plant metabolites and their importance, Cell culture techniques- basic procedure, Different types of *in vitro* cultures, callus culture, suspension culture- growth& maintenance, factors influencing cell suspension. Production of secondary metabolites through cell culture technique.Measurement of growth- and productivity. Enhancement of metabolite production- optimization of medium and culture conditions, development of high yielding cell lines, cell line selection- Bergmann's technique of cell plating, Fluorescence Assisted Cell Sorting (FACS),Elicitors- mechanism of action, selection of elicitors.

MODULEII: Large scale culture of plant cells- Bioreactros (Stirred tank reactors), principle, types, working, need of bioreactors in cell cultures, Cell immobilization, immobilized bioreactors.

MODULEIII: Specialized techniques for the production of metabolites - Use of organ culture and two-phase systems.*In vitro* mutagenesis and induction of polyploids-protoplast fusion, somatic cell hybridization-Addition of Precursorsand Biotransformation, Genetic engineering of secondary metabolites, Metabolic engineering - advantages and limitations.

MODULEIV: Hairy root culture- *Agrobacterium rhizogenes* and *Ri* plasmid – culture method-development of hairy root lines- production of metabolites- advantages and limitations.

MODULE V: Secondary metabolite classes & groups-Alkaloids- morphines, codeine, quinine, nicotine, cocaine, hyoscyamine, lysergicacid, taxol, Terpenoids-menthol, camphor, caroteniod, pigments, Polyterpenes- rubber, Phenyl propanoids-anthocyanin, coumarins, flavanoids, isoflavniods, stilbenes, tannins, Quinones-anthraquinones, benzoquinones, naphthoquinones, Steroids-diosgenin, sterols, ferruginol.

MODULEVI: Large scale exploitation of secondary metabolites- model systems-Commercial production of shikokonin, berberine, diosegnin, taxol, vincristine, vinblastine, scopolamine ajmaline and anthraquinones.

LEARNING RESOURCES:

REFERENCES

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ONLINE RESOURCES:

- http://vlab.amrita.edu
- http://www.nature.com/nbt/journal/v22/n11/full/nbt1027.html?foxtrotcallback=true
- https://www.acsedu.co.uk/Courses/General-Horticulture/TISSUE-CULTURE-BHT306-118.aspx
- https://www.wiziq.com/tutorials/plant-tissue-culture
- www.ncbiotech.org/educational-resources
- www.nptel.ac.in/courses/102103016 (National Programme on Technology Enhanced Learning (NPTEL) - Phase II- Course Name: Plant Biotechnology, Indian Institute of Technology Guwahati, Guwahati)

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M Sc (CSS) Degree Examination
BOT-GC- 503**- PLANT CELL CULTURE TECHNOLOGY**

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. Define cell line
2. What is axenic culture?
3. Define secondary metabolites
4. Name important macronutrients present in cell culture medium
5. What is an explant?
6. Define aseptic condition
7. What is meant by surface sterilization?
8. Define plant cell immobilization
9. Which instrument you will suggest to large scale cultivation of plant cells
10. Write expansion and use of EMS

(10X1=10 marks)

II. Answer any ***five*** questions. Each answer not exceeding 50 words

11. What are the major problems encountered in large-scale cultivation of plant cells?
12. What is biotransformation? Give examples
13. Define metabolic engineering. What are the major steps involved in metabolic engineering?
14. Describe the process of shikonin production
15. Enlist two major antitumour drugs extracted from plants. Name the source plants
16. What are steroids? Give examples for plant derived steroids
17. Explain the process of berberine production

(5X3=15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Enlist major requirements of a cell culture laboratory
19. Explain the design of an immobilized bioreactor. Enumerate major advantages of immobilized bioreactor
20. What is meant by two phase culture system? Write its advantages
21. What are hairy root cultures? How they are developed? Enlist its major advantages
22. What are alkaloids? Explain important classes of alkaloids
23. Discuss major advantages and limitations of biochemical production from cultured plant cells
24. Explain sterilization techniques used in cell culture laboratory

(5X5=25 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

25. Define cell culture technology. What are important strategies to improve metabolite production in a cell culture system?
26. What is bioreactor? What are important types of bioreactors used in plant cell culture technology

(1X10=10 marks)

SEMESTER I-IV	Course Code: BOT- GC- 504	Credits: 2

NAME OF THE COURSE: PRINCIPLES OF GARDENING

COURSE OUTCOMES (CO)

CO1 : Recognise the scope and significance of horticulture and floriculture

CO2 : Gain knowledge on the various types of plants and propagation techniques

CO3 : Design and lay out a vegetable/ ornamental/ home garden

COURSE CONTENT

MODULE I: Introduction**.** Scope and importance of horticulture. Divisions- pomology, olericulture,ornamental horticulture, floricultue, arboriculture, silviculture. Classification of ornamental plants - annual, biennial and perennial, herbs, shrubs and trees, succulents, palms, ferns and conifers, hanging plants, climbers and creepers.

MODULE II: Commercial flowers- examples**,** Common cut flowers. Scope of cut flowers in Indian scenario. Allied horticultural industry, National and Regional agencies involved in promotion of horticultural industry in India.

MODULE III: Common plant management techniques for horticultural crops - Soil structure,Macro and micro nutrients. Fertilizers- organic, inorganic and chemical,bio fertilizers, vermi composting, diseases and pests of ornamentals, methods of disease and pest control, weed control. manuring – organic and inorganic manures. Methods of irrigation, fertigation.

MODULE IV: Propagation-definitions, types. Seed propagation- merits and demerits-Ornamentals propagated through seeds. Vegetative propagation- merits and demerits-cutting, layering, grafting and budding- stock/scion relationship. Specialized parts of propagation -(bulbs, tubers, offsets, runners, suckers, slip, corms).Specialized structures for propagation-mist chamber, net house, hardening chamber- Micro propagation – Applications.

MODULE V: Special types of garden- vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, and temple garden, sacred groves

MODULE VI: Characteristics of home garden**.** Benefits of home garden. General principles ofvegetable gardening – Choosing a site, designing, garden tools, growing popular garden crops, Applying management techniques, extending harvest

LEARING RESOURCES:

REFERENCES

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Model Question Paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M Sc (CSS) Degree Examination
BOT-GC-504- PRINCIPLES OF GARDENING

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. Define parthenocarpy
2. What are biofertilizers?
3. What is polyembryony?
4. Give an example of a hanging plant
5. What do you mean by de-shooting?
6. Write down the advantage of mist chamber for growing plants
7. What is grafting?
8. What is leaf bud propagation?
9. Name the process in which breaching of natural seed coat occurs by mechanical method
10. What do you mean by monoecious plant?

(10X1=10 marks)

II. Answer any ***five*** questions. Each answer should not exceed 50 words

11. Distinguish between runners and offset
12. Write down the merits and demerits of seed propagation
13. Describe the scope of horticulture
14. Briefly classify the horticultural crops based on the nature of flowers
15. Write short note on presowing treatment
16. Describe the procedure of layering
17. Suggest any three measures to prevent the spread of viral disease in ornamentals

(5X3=15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Briefly describe the role of national agencies involved in the promotion of horticultural industry in Kerala
19. Describe the methods adopted for pest management in garden plants
20. Write a note on common cut flowers
21. Give an account on nutritive value of horticultural crops
22. Micropropagation is a means to produce large number of plants. Discuss the statement based on its applications
23. Briefly explain the types of specialized structures used for the propagation of plants

(5X5=25 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

24. Evaluate the merits and demerits of artificial vegetative propagation in comparison with sexual reproduction
25. Explain the various management practices used for the cultivation of horticultural crops

(1X10=10 marks)

SEMESTERI- IV	Course Code: BOT- GC- 505	Credits: 2

NAME OF THE COURSE: TRANSGENIC PLANTS

COURSE OUTCOMES (CO)

CO1 : Understand the basic concepts of genetic engineering in plants
CO2 : Acquainted with genetic transformation techniques in plants
CO3 : Understand the applications of transgenic plants and Biosafety regulations

COURSE CONTENT

MODULEI: Basic concept of genetic engineering -Genetic transformation of plants, Transgenic techniques, Steps for developing new crop varieties

MODULEII: Gene transfer methods-DNA Vectors for Plant Transformation Components for Efficient Gene Expression in Plants Vector mediated gene transfer, creating recombinant DNA- Site-Specific DNA Recombination- Vector Design- Targeted Transgene Insertions- Targeted Transgene Insertions- Marker Genes and Promoters-

MODULE III:*Agrobacterium* mediated gene transfer -Tumor inducing principle and the *Ti* plasmid-*Agrobacterium* mediated - agro infection, Genetic engineering through disarmed *Ti* plasmids- T-DNA integration into chromosomal, DNA-Viral Vectors.

MODULE IV: Vector less or direct DNA transfer - Physical gene transfer methods, Particle bombardment/ microprojectile/ biolistic, Macroinjection, Microinjection, Protoplasts, Whole-Tissue Electroporation, Silicon Carbide Whiskers, Laser Micropuncture, Nanofiber Arrays

MODULE V: Application of transgenic plants, transgenic plants for crop improvement (dicots and monocots), Insect resistance, resistance to virus, resistance to other diseases, recombinant DNA techniques for the production of transgenic plants, procedure and protocols of producing transgenic plants. Transgenics for quality, improved storage, flower color and shape, terminator seed, Commercial transgenics crops, Uses and applications of transgenic plants, new products, pharmaceuticals,bioremediation, edible vaccines, antiviral proteins.Prospects of transgenic plants- zinc-finger nucleases- the future of food fuel, and pharmaceuticals.

MODULE VI: Regulations and Biosafety-Introduction -Regulation of GE USDA FDA Genetic Engineering Appraisal Committee (GEAC) of MoEF, Govt. of India. Controversy of Transgenic plants-debates- Process versus product -health concerns -environmental concerns -consumer choice- Field testing of transgenic plants-Environmental Risk Assessment (ERA) Process- Proof of safety versus Proof of Hazard –Proof of benefits: agronomic performance

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- www.ncbiotech.org/educational-resources
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- www.nrcpb.res.in
- www.plant-biotech.net

Model question paper

DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc (CSS) Degree Examination
BOT-GC-505 : TRANSGENIC PLANTS

Time: Three hours Maximum marks: **60**

I. Answer ***all*** questions in one word or sentence

1. What is gene cloning?
2. Mention uses of zinc finger nucleases
3. Expand MoEF
4. What are promoters?
5. Write about *npt II* gene
6. Define transgenesis
7. Explain disarmed Ti plasmids
8. Write about golden rice
9. Explain pharming
10. Definebiolistics

(10X1=10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words

11. Write a note on a transgenic crop with improved pest resistance
12. Write about targeted transgene insertions
13. Give an account on edible vaccines
14. Write about green fluorescent protein
15. Explain how flower colour can be changed by transgenesis
16. Write about nanofiber arrays
17. Write about terminator seeds

(5X3= 15marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words

18.Give an account on controversies of transgenic plants
19.Write about Genetic Engineering Appraisal committee
20.Explain how a crop variety with increased pesticide resistance can be produced.
21. Explain agrobacterium mediated gene transfer
22.Explain importance of transgenic plants for bioremediation and pharmaceutical production
23.'Marker genes are important in production of transgenic plants' Discuss.
24. Explain how a recombinant DNA can be constructed.

(5X5= 25marks)

IV. Answer any ***one*** of the following, not exceeding 350 words

25.Give an account on application of transgenesis for crop improvement.
26.Describe vector less DNA transfer

(1X10= 10marks)

SEMESTER I-IV	Course Code: BOT- GC- 506	Credits: 2

NAME OF THE COURSE: ETHNOBOTANY

COURSE OUTCOMES (CO)

CO1 :Get knowledge about indian ethnobotanists and ethnic communities of kerala
CO2 : Identify and classify ethnobotanical plant resources for documentation
CO3 : Apply uses of ethnomedicinal plants in day today life

COURSE CONTENT

MODULE I: Definition, history and scope of ethno botanical studies. Selected national, regional works inEthnobotany. Contributions of major Indian Ethnobotanists- Janaki Ammal, S.K. Jain Dr.P.Pushpangadan.

MODULEII: Ethnic Societies in Kerala - Major tribes in Kerala Kani- Mannan- Kurichya- Paniya- Malaarayar- Chola naikar- Malampandaram. Role of tribals in conservation of ecosystem.

MODULEIII: Centres of Ethno botanical studies in India AICRPE-All India Coordinated Research Project on Ethno biology, FRLHT- Foundation for the Revitalisation of Local Health Traditions. Contribution of AICRPE and FRLHT to ethno biology of India.

MODULEIV: Classification of ethno botanical uses: utilization of plant resources for food-shelter-furniture- antidote- fibre- agricultural implements- natural dyes- manure- wild edibles andvegetables- medicine- minor forest produce.

MODULEV: Method of documentation of ethnobotanical studies- Ethnobotanical studies in Kerala- Relevance of ethnobotany in modern context- Role of ethno medicine and its scope in modern times.

MODULEVI: Plant used in ethno medicine- e.g.: *Trichopuszeylanicus- Ocimum sanctum- Aegle marmelos- Janakiaarayalpatra- Phyllanthus niruri- Cissampelospareira-* preparation and uses

LEARNING RESOURCES:

REFERENCES

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Model question paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc (CSS) Degree Examination
BOT-GC-506 ETHNOBOTANY

Time: Three hours Maximum marks: **60**

I. Answer ***all***questions in one word or sentence
1. Define ethnobotany
2. Expand FRLHT
3. What are NWFP?
4. Define Herbal medicine
5. What is Folk medicine?
6. What is herbal technology?
7. Explain CBD
8. Name a tribal community in Kerala
9. Give the ethnobotanical significance of *Trichopuszeylanicus*
10. Write ethnobotanical use of *Emblica officinalis*

(10X1=10 marks)

II. Answer any ***five*** questions. Each answers not exceeding 50 words.
11. Explain the role of ethnomedicine and its scope in modern time
12. Write short notes on natural dyes
13. Give an account on Indigenous knowledge
14. Give an account of wild edibles used by the tribal people of Kerala
15. What is herbal technology
16. Describe the major contribution of S.K. Jain in the field of Ethnobotany
17. Write short notes on two wild edible plants

(5X3=15 marks)

III. Answer any ***five*** of the following. Each answer not exceeding 150 words
18. Explain the methodology of ethnobotanical studies
19. Give a brief account of the wild fruit yielding plants
20. Briefly describe the minor forest produce
21. What are the major tribes in Kerala?
22. Explain the role of FRLHT in revitalizing the local health traditions
23. Evaluate ethnobotany as an interdisciplinary science
24. Describe the role of pharmacology with ethnomedicine

(5X5=25 marks)

IV. Answer any ***one*** of the following, not exceeding 350 words
25. Briefly describe the role of tribal in conservation of the ecosystem
26. Write a brief account on the ethnobotanical studies done in Kerala

(1X10=10 marks)

SEMESTER I-IV	Course Code: BOT- SE- 501	Credits: 2

NAME OF THE COURSE: PLANT PROPAGATION AND NURSERY MANAGEMENT

COURSE OUTCOMES (CO)

CO1: Gain knowledge on various aspects of nursery development, management and marketing of products

CO2: Demonstrate the propagation, growth, and maintenance of plants in nursery conditions.

CO3: Utilize the plant tissue culture techniques in the propagation of crops, medicinal plants and ornamentals.

CO4: Apply plant propagation and nursery operation skills and knowledge to explore career opportunities in horticulture industry

MODULE 1: Development of Nursery: nursery site, potting and transplanting, selecting and managing nursery stock, introduction to plant breeding, pest and disease management, growing media, specialized structures for propagation and maintenance -mist chamber, agro-net shade-house, glass house, hardening chamber; nursery materials and equipment, irrigation, nursery management and marketing.

MODULE 2: Composting, organic fertilizers, green manures-*Azolla* cultivation, vermicompost**,** production of biofertilizers, biofungicides, biopesticides, integrated pest management. Soil-less production of horticultural crops–hydroponics, sand culture, gravel culture, aquaponics, terrarium. Modern devices in nursery operations and automations.

MODULE 3: Plant propagation- conventional tools: Seed propagation techniques- dormancy breaking treatments; vegetative propagation- cutting- softwood and hardwood cuttings, layering, grafting and budding. Specialized parts of propagation - (bulbs, tubers, offsets, runners, suckers, slip, corms). Development of clonal plantations. Clonal propagation technology of important crops and commercial trees (rubber, *Eucalyptus*, *Casuarina* etc...).

MODULE 4: Plant propagation –Biotechnological tools: Plant tissue culture- Basic techniques and principle, General laboratory requirements for plant tissue culture, designing of plant tissue culture laboratory. Lab maintenance and fumigation. Culture vessels and their washing, basics of aseptic techniques, sterilization techniques, preparation of stock solutions and culture media, inoculation, tissue culture stages, multiplication by shoot tip, nodal culture and callus culture subculture, rooting – *in vitro* and *ex vitro* rooting and hardening. Micropropagation technology of crops, medicinal plants and ornamentals

MODULE 6: Skill acquisition in conventional propagation- production of 2 week old, ready to transplant seedlings of any three of the following vegetable crops through seed germination; brinjal, tomato, okra (bhindi), cow pea, bitter gourd, snake gourd, ash gourd.

Propagation through cuttings any one of the following: rose, henna, croton,

Air layering: any one of the following; croton, *Callinadra* sp.

Development of grafted plants: any one of the following; croton, rose, *Solanum*

MODULE 6: Skill acquisition in plant tissue culture: Preparation of stock solutions and media, autoclaving, surface sterilization, inoculation.

Establishment of *in vitro* culture for any of the following; Dianthus, *Oldenlandia*, *Bacopa*, *Plumbago* sp. etc...

Potting and maintenance of micropropagated plants in the hardening chamber

LEARNING RESOURCES

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Model question paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc (CSS) Degree Examination
BOT-SE-501 PLANT PROPAGATION AND NURSERY MANAGEMENT

Time: Three hours Maximum marks: **60**

V. Answer ***all*** questions in one word or sentence

1. Write a note on importance of shade net in a nursery
2. Name two plants which can be propagated with air layering
3. What is Fumigation?
4. Mention importance of hardening of plants
5. Write about a biopesticide
6. Explain the importance of autoclaving
7. What is the use of agar agar in a medium
8. Name an organic insecticide
9. Mention the need for transplantation of seedlings in tomato
10. Write about a propagation technique of rose

(10X1=10 marks)

Answer any ***five*** questions. Each answers not exceeding 50 words.

11. Write about conventional propagation technique of brinjal
12. Enlist specialized parts for propagation
13. Write about importance organic farming
14. Differentiate *In vitro* and *ex vitro* rooting
15. Write about aquaponics
16. Differntiate callus culture and shoot culture
17. How an explant can be inoculated in a culture tube

(5X3=15 marks)

Answer any ***five*** of the following. Each answer not exceeding 150 words

18. Explain how a microporpagated plants can be established in field
19. Write about modern devices for nursery automation
20. Write about mist chamber and glass house
21. Write an account on surface sterilization techniques
22. Illustrate and explain grafting and budding
23. Explain basic technique for *in vitro* propagation
24. If you want to develop a nursery, explain how you can do it?

(5X5=25 marks)

Answer any ***one*** of the following, not exceeding 350 words

25. Briefly describe how *in vitro* culture can be established for Dianthus
26. Write about techniques for soil less propagation and maintenance of plants

(1X10=10 marks)