

**Learning Outcomes-based Curriculum Framework (LOCF)
for Post-graduate Programme**

**NAME OF THE PROGRAMME
M.Sc. BOTANY
(SPECIALIZATION IN BIODIVERSITY
CONSERVATION)**

(Syllabus effective from 2024 Admission)



**UNIVERSITY OF KERALA
DEPARTMENT OF BOTANY**

2024

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 top-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 organized 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 and 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 was established in the year 1959 at Kariavattom, Thiruvananthapuram, Kerala with Late Prof (Dr.) A Abraham, visionary, an institution builder and a doyen in Cytogenetics and Plant Breeding, as Professor and Head of the Department. He believed that, the goal of science is to seek the simplest explanations of complex facts. His emphasis on –learning by doing!! continues to be at the heart of the Department’s educational mission. The commitment of the Department to innovations has led it to a host of scientific break-through, which includes the discovery of highest chromosome number of 1260 in *Ophioglossum reticulatum*, introduction of the most popular tapioca variety M-4 in Kerala, from Malaysia to meet the food shortage, introduction of hybrids of *Mussaenda* from Philippines as an ornamental plant and so on by Prof (Dr.) A Abraham and his research team. Fueled by optimism, ingenuity and the sense of responsibility from Professor Abraham, and a galaxy of eminent Professors like Dr. C A Ninan, Dr. P M Mathew, Dr. A. N Namboodiri, Dr Susan Abraham, Dr. P I Kuraichan and Dr. B Vijayavalli made continue to make enviable strides in research at the Department in Cytology, Genetics and Plant Breeding. Since 1980s, faculties in the Department have focused on morphogenesis, reproductive biology and genetic diversity analysis especially on crop species. Plant tissue culture laboratories and molecular biology labs were opened during this period. The modernization of facilities gained momentum due to support of the UGC in the form of COSIST and SAP programs. Infrastructure facilities were greatly augmented in the last decade under the headship of Dr. G.M Nair, Dr. Omanakumari and Dr. Ashalatha S Nair. SAP phase II, SARD programme of KSCSTE and DST-FIST were implemented during the period resulting in the addition of sophisticated equipments and facilities in the Department. The Department has been delivering research-led student education with a strong suite of two post graduate programmes (i) M Sc Genetics and Plant Breeding and (ii) M Sc Biodiversity Conservation. A dynamic research environment for plant research in the areas of Biosystematics, Biotechnology, Phytochemistry and Plant Reproductive Biology is being provided in the Department. The Department has added to its credit more than 250 doctoral degree holders, working in reputed research labs, across the country and abroad.

Vision

Our vision is to become a premier academic institution recognized internationally for its sustainable contribution to the environment and society through the pursuit of cutting edge research and academic expertise

Mission

- To produce highly competent and service oriented generations of students in Life Science that will best serve the Nation and world in the coming years
- To transform education through academic rigour, practical orientation and outcome-based teaching
- To undertake impactful research addressing local, national and global challenges in Plant Science Research

Courses Offered

M.Sc. Genetics and Plant Breeding: A unique course with superb amalgamation of classical and applied aspects of plant science.

M.Sc. Botany (specialization in Biodiversity Conservation): A unique course designed to get mastery in Biodiversity and conservation strategies.

PhD Botany: Areas of Research

- ❖ Conservation of Tropical Biodiversity and Sustainable Utilization
- ❖ Cytogenetics and Biosystematics
- ❖ Biotechnology/ Tissue culture/ Cell Culture Technology
- ❖ Phytochemical and gene prospecting
- ❖ *In vitro* secondary metabolite production & Bioreactor studies
- ❖ Bioprospecting of Microbial Resources
- ❖ Plant Reproductive Biology and Seed Biology

Admission Procedure

- ❖ PhD Admission: is scheduled in January/ July. Qualification: M.Phil/ PhD Qualifying Test/UGC-CSIR NET/KSCSTE Fellowship.
- ❖ M.Sc. Genetics and Plant Breeding, M.Sc. Botany (specialization in Biodiversity Conservation): Admission based on an Entrance Examination held in May every year.

Faculty

1. Prof (Dr.) E.A. Siril (Head of the Department)
2. Prof (Dr.) T.S. Swapna
3. Prof (Dr.) Shiburaj S
4. Prof (Dr.) Bindu R. Nair
5. Prof (Dr.) Rajalakshmi R.
6. Prof (Dr.) Suhara Beevy S, Emeritus Professor
7. Prof (Dr.) A. Gangaprasad, Emeritus Professor
8. Prof (Dr.) P.M. Radhamany, Emeritus Professor

Research Activities

- Conservation of Tropical Plant Diversity, Evaluation and Genetic characterization
- Biosystematics and Evolution
- Chemical / Gene prospecting
- Crop Genomics
- Plant Tissue culture and Molecular Biology of Medicinal and Crop Plant relatives
- Cytogenesis, Cytotoxicity and Cytotaxonomy
- Plant Reproductive Biology, Breeding and Palynology
- Plants and Microbes for bioactive molecules.

Facilities available

1. **Botanic Garden:** A well-maintained, fully organized garden was established in the Department which support researchers and students. The garden is recognized by Botanic Garden Conservation International (BGCI). The garden includes medicinal plantconservatory, nurseries, green houses, water plant conservatories, fernery, Dr. M. Kamarudheen Memorial Biosystematics Garden, green houses, water plant conservatories, healing garden, butterfly garden, sensory garden, Miyawaki forest, horticulture and topiary garden.
2. **Herbarium:** Department herbarium has a collection of 11000 Angiosperms, 21 Gymnosperms and 2000 Pteridophytes.
3. **Seed bank:** Established through a joint project by University of Kerala and Kerala State Biodiversity Board. Seed bank aimed to conserve wild relatives of crop plants, underutilized crops plants and medicinal plants.
4. **Library and Information Services:** The Department Library has over 15,000 books and 15 subscribed National and International journals. The library provides INFLIBNET and science@direct facility.
5. **Molecular Biology Laboratory Facility:** A centralized lab facility established through KSCSTE-SARD, DST-FIST, and UGC Plan fund with modern sophisticated instruments. Some of the important instruments are; PCR, RT-PCR, Gel documentation, Gel electrophoresis vertical and horizontal, Nanophotometer, Biophotometer, Biofermentor, UV-VIS spectrophotometers, Nitrogen analyzer, Protein purification system, Cryostat, ELISA reader, Fluorescence microscope, Phase contrast microscope, Image analyzers, Stereomicroscope, Gas chromatography unit, HPLC unit, High speed centrifuges, Lyophilizer, Homogenizers etc.
6. **Microbiology Laboratory with BSL I & II facility:** Biosafety levels I and II were established at the Microbiology laboratory. This facility enables to testing of antimicrobial and anti-biofilm properties of biomolecules from plant and microbial origin.
7. **Computer lab facility:** Established through DST-FIST Programme. Computers with high speed broadband internet connection and LAN facility. INFLIBNET facility is provided for deep literature search.
8. **Department Auditorium:** Department has an auditorium (A/C) with modern Audio-Visual Facility.

The Kerala University Botany Alumni Association (KUBAA)

The Botany Department of the University of Kerala is located in the Kariavattom Campus, about 14kms from the Thiruvananthapuram city. It was established in 1959 by the late Prof. (Dr.) A. Abraham. Since its inception, the Department has been focusing its attention mainly on PhD programmes and other research activities. The main activity of the Department is to undertake research projects and guide researchers for PhD and M. Phil degrees. Alumni Association was established in the year 2003 with Prof. (Dr.) C.A. Ninan & Prof. P.M. Mathew (Former Head of the Department) as Patrons. Dr. E.A. Siril Professor & Head, Department of Botany is the present chairman of the Association and Dr. Bindu R. Nair is the Secretary. The Association has around 350 members who actively participate and generously contribute to all its activities. The Alumni Association proposes to conduct annual seminars with a view to encourage and enhance the interactions between its many members. It may thus serve as a platform for the exchange of ideas, both academic and social, by its members, thus effectively reduce the generation gap between the older acclaimed scientist and today's young researchers. The Alumni Association is proud to announce that many of the members of the Association are working in reputed research labs, across the country and abroad. Some of them frequently visit the Department, hold discussions with the students and even provide numerous valuable insights. Furthermore, the Alumni Association encourages their members to exchange their expertise and ideas among themselves and to the students of the Department, thereby providing scope for the generation of new ideas which may act as an impetus to research as whole.

For membership and other details please Contact:-

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UNIVERSITY OF KERALA

DEPARTMENT OF BOTANY

**Syllabus for M.Sc. Programme in Botany
(Specialization in Biodiversity Conservation)**

Programme Code 850

**Programme Specific Outcomes (PSO) for
MSc Botany Specialization in Biodiversity Conservation**

- | | |
|--------------|---|
| PSO 1 | Mastery in biodiversity and its conservation strategies. |
| PSO 2 | Experience and identify the diversity of plant and animal kingdom, from lower to higher level |
| PSO 3 | Recognize the need to conserve the wealth of Biodiversity |
| PSO 4 | Address environmental issues related to biodiversity |
| PSO 5 | Create social awareness in biodiversity conservation and sustainable utilization of bioresources |

**Programme Structure of M.Sc Botany
(Specialization in Biodiversity Conservation)
Programme Code 850**

Semester	Course Code	Name of the course	Credits
I	Core Courses (CC)		
	BBC-CC- 511	Biodiversity and Conservation of Natural Resources	3
	BBC-CC- 512	Diversity in Algae, Fungi and Lichens	3
	BBC-CC- 513	Biophysics, Bioinstrumentation and Techniques	3
	BBC-CC- 514	Practical I	3
	Discipline-Specific Elective (DE)		
	BBC-DE- 515	Research Methodology and Biostatistics	2
	BBC-DE- 516	Pharmacognosy, Phytochemistry and Phytomedicine	2
II	Core Courses (CC)		
	BBC-CC-521	Cytology, Molecular Biology and Immunology	3
	BBC -CC-522	Animal Diversity	3
	BBC-CC-523	Diversity in Bryophytes, Pteridophytes and Gymnosperms	3
	BBC-CC-524	Plant Physiology and Biochemistry	3
	BBC-CC-525	Practical II	4
	Discipline-Specific Elective (DE)		
	BBC-DE-526	Climate Change and Crop Adaptations	2
	BBC-DE-527	Wildlife Ecology and Management	2

III	Core Courses (CC)		
	BBC-CC-531	Angiosperm Taxonomy, Economic Botany and Ethnobotany	3
	BBC-CC-532	Genetics, Plant Breeding and Evolution	3
	BBC-CC-533	Histology and Plant Reproductive Biology	3
	BBC-CC-534	Genetic Engineering and Plant Biotechnology	3
	BBC-CC-535	Practical III	4
	Discipline-Specific Elective (DE)		
	BBC-DE-536	Bioinformatics	2
	BBC-DE-537	Remote Sensing Applications and GIS	2
IV	Core Courses (CC)		
	BBC-CC-541	Environmental Biology, Forest Botany and Phytogeography	3
	BBC-CC-542	Microbiology and Plant Pathology	3
	BBC-CC-543	Coastal, Marine and Wetland Diversity and Conservation	3
	BBC-CC-544	Practical IV	3
	DISSERTATION BBC-D-545	Dissertation	6
Any semester (I-IV)	Generic Courses (GC)		
	BBC-GC-501	Germplasm Conservation	2
	BBC-GC-502	Principles and Practice of Sustainable Development	2

SEMESTER I	Course Code: BBC- CC- 511	Credits: 3
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NAME OF THE COURSE: BIODIVERSITY AND CONSERVATION OF NATURAL RESOURCES

COURSE OUTCOMES (CO)

- CO1: Get a deep knowledge on biodiversity richness in global scale and biogeography of India.**
- CO2: Assess the value of biodiversity wealth of our Nation.**
- CO3: Discuss the basic concepts of global frame work, acts and policies in natural resource management.**
- CO4: Familiarize with major activities of different committees and Biodiversity Board / BMC, NGO's with special reference to Biodiversity conservation in Kerala state.**
- CO5: Acquainted with National and International organizations and NGOS with special reference to UN and specialized agencies, institutional regulatory bodies and authorities.**

COURSE CONTENT

MODULE I: Biodiversity fundamentals: Biodiversity concepts (Species diversity, Genetic diversity and Ecosystem biodiversity), India as a Mega Diversity Nation. Bio-geographic classification of India. Biodiversity hot spots, Criteria for determining hot spots. biodiversity of the Western Ghats of India, biodiversity of the Eastern Ghats of India, biodiversity of the Northeast, biodiversity of the Himalayan region, Value of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information. Biodiversity and ecosystem functioning.

MODULE II: Threats to Biodiversity- Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Man- wildlife conflicts. Endangered and endemic species of India.

MODULE III: Conservation of Biodiversity: Strategies for conservation: In-situ and ex-situ conservation- protected areas-biosphere reserves, national parks, Wildlife sanctuaries, Conservation Reserves, Community reserves, Sacred Groves. Single species / single habitat-based conservation programmes (e.g. Project tiger, Valley of flowers). Ex situ conservation- Managed ecosystems, biological resources and gene banks, botanical gardens, bio-parks, simulated ex situ conservation strategies, ecotourism. Top-down and bottom- up protocols for conservation. Strategies for ex situ conservation – Botanical Gardens, Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation. Conservation Practices in India and World- Important international conventions & treaties on nature & conservation. Ecosystem Restoration and Management. Biodiversity register.

MODULE IV: Conservation of Natural resources Introduction: Legal and political environments in resource management. Global and local governance, challenges of good

governance. Ostrom design principles and basic frameworks, organizational structure and stakeholders in NRM and livelihood. Natural Resource Governance in rapidly changing world. Local utilization and institutions: Joint Forest Management Committees (JFMCs), watershed committees, irrigation committees, Forest Rights Act (FRA) committees, NBA, State Biodiversity Boards, Biodiversity Management Committees (BMCs).

MODULE V: Overview of legal policy instruments in Natural Resource Management: National Forest Policy of 1988, National Environment Policy of 2004, National Conservation Policy, National Action Plan on Climate Change of 2008, and Coastal Protection Act. Wildlife Protection Act of 1972, Forest Protection Act of 1980, Environment Protection Act of 1986, ICZM-Indian Coastal zone management, Water Act, 1981. Gadgil report and Kasturi Rangan Report. Biological Diversity Act of 2002 and Rule 2004, Forest Rights Act of 2006. Green Tribunal Act, 2009. Non-Timber Forest Products (NTFP) related policies and other acts: (PESA 1996, FRA 2006), sustainable harvesting rules of MP, Nistar Rights in MP and Chhattisgarh, product specific policies, taxation, Institutional/Organizational Arrangements. NTFP Deregulation, Policy of Odisha.

MODULE VI: Conflicts in resource management: Protecting traditional knowledge, Significance of PBR, customary laws and practice related to traditional knowledge, implications for access benefit sharing. International and National efforts by Non-Governmental organizations on resource management: CITES and other international treaties and conventions, roles of international organizations and NGOS with special reference to UN and specialized agencies, institutional regulatory bodies and authorities: direct intervention by the state, green business and green ethics. Resource management- understanding and managing governance issue, governance tactics and tools, CSR (Corporate Social Responsibility) as a tool for sustainable NRM based business. Case studies about corporate social responsibility. Corporate social responsibility (CSR)-NRM based CSR action -E-governance - Climate change and corporate responses.

LEARNING RESOURCES:

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Online Resources

Rseources	Link and Description
National Mission on Education through ICT(NME-ICT)	https://youtu.be/fu4ArzcOyto Current Status of Biodiversity in India
	https://youtu.be/hT0ptJNXW1w Strategies for Biodiversity Conservation
	https://youtu.be/972dj-vO038 Wildlife Conservation Projects in India
	https://youtu.be/aP_GDVr_9xA?si=VEuqdfCuXY-ykAZr How a forest cooperative is reversing desertification in Tamil Nadu

You Tube	https://youtu.be/BiDBAU2d7oE?si=XscCNmw9FGVfV_G0 transforming monoculture plantations into real forests, using an unusual reforestation technique.
	https://youtu.be/PhrT0Av8D4A?si=KGBtYlkxILoIaOiu How conservation efforts are making the fires of the sacred Arunachala Hills go away
	https://youtu.be/rx5Tmq3o2r4?si=5n9pxrTDdkzLjqUD Why native plant species are more reliable to regenerate forests
	https://youtu.be/6AzG9EZ20tY?si=Of9hmOaInfNF515w The Global Seed Vault is protecting the world's agricultural genetic diversity and protecting our future food supply in case of catastrophe.
	https://youtu.be/rTV-56QagQM?si=mYPliJ2LEOi5gJ3l Wounded Hills: A documentary on the environmental issues of the Western Ghats
	https://youtu.be/1TBrEVM1fXw?si=UYILDf_QarcjRwxI Silent Valley is one of the last remaining Rainforest in South India. Part of the Nilgiri Biosphere Reserve, this unmatched beauty is a true wonder of nature.
	https://youtu.be/94S88t0sqDc?si=NRZXd5MXtmyFlZms Enchanting journey through the wilderness of Western Ghats and the National Parks of Kerala
	https://youtu.be/4wle7YlEqiA?si=IFDd7glqTk2uuH_y Shola - Grasslands Nature's Water Towers
	https://youtu.be/C08FAa-Vlj0?si=vIGK6b0qapecyS5ws How a farmer turned 90 acres of wasteland into a lush green forest in Odisha

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
First Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-511 BIODIVERSITY AND CONSERVATION OF NATURAL RESOURCES

Time: 3 Hours

Maximum Marks: 60

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

1. Specify the National Park in Kerala, known for the conservation of lion-tailed macaque.
2. Will microhabitats encourage biodiversity? Give your views and reasons.
3. Name any two endangered plants of Kerala
4. Concentration and potency of reserpine in *Rauwolfia vomitoria* growing in different regions of the Himalayas vary. Which type of diversity does this variation represent?
5. Give one example for the potential resource.
6. Specify the law passed by the Parliament of India to prevent and control the harmful effects of air pollution in India.
7. Do PBRs help in the conservation of Biodiversity?
8. Give examples for non-timber forest products
9. What is the purpose of the establishment of ICZM?
10. Expand WWF. Which animal is the symbol of WWF?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Are amphibians more vulnerable to extinction than other animal groups? If so, review the characteristics that contribute to their higher susceptibility to extinction.
12. Recently, amid the pandemic, a plant called forked fanwort, *Cabomba furcata* caused what local people mentioned as 'pink phenomenon' in the waterbodies of a remote village of Avalpandi in Kozhikode district of Kerala. What is common to forked fanwort, *Lantana*, and African catfish? Comment.
13. Reveal the importance of biodiversity for ecosystem functioning.
14. 'Tropical regions have greater biological diversity than the temperate ones'. Give reasons to justify the statement.
15. Discuss the role of 'State Biodiversity Boards' in protecting biodiversity.
16. Enlist any three non-governmental organizations in India involved in resource management. Add a note of its activities
17. In the wake of the Bhopal gas Tragedy or Bhopal Disaster, the Indian parliament enacted an umbrella legislation that authorizes the central government to protect and improve environmental quality, control and reduce pollution. Name it and list out its main objectives.

(5X3= 15 marks)

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

18. Elaborate your view of conservation biology as a profession.

19. Discuss the potential of Joint Forest Management in improving the livelihood of the forest dwellers and fringe forest communities.
20. Whenever there is a natural disaster in Kerala, Madhav Gadgil's Western Ghats Ecology Expert Panel report of 2011 is recalled. Briefly describe the significance of the report.
21. Substantiate one case study on Corporate Social Responsibility.
22. Explore why sacred groves are often the last refuge for endemic and endangered plant and animal species.
23. Biodiversity hotspots are home to thousands of irreplaceable species that are facing multiple, urgent threats. Analyze the significance of Western Ghats as a biodiversity hotspot
24. Enumerate the different biogeographic zones of India. Why is it important to divide India into different biogeographical zones?

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. Though the conflict between humans and wildlife started with the evolution of man, the intensity of the conflict has increased in recent years. Investigate the activities of modern man that contributed to the escalation of this conflict and propose suitable measures for promoting the coexistence between humans and wildlife.
26. In the present world, customers, employees, and other stakeholders judge a company by how its activity impacts the community, economy, environment, and society at large. In this context, express your views regarding corporate social responsibility.

(1X10= 10 marks)

SEMESTER I	Course Code: BBC- CC- 512	Credits: 3
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NAME OF THE COURSE: DIVERSITY IN ALGAE, FUNGI AND LICHENS

Course Outcomes (CO)

CO1: Get knowledge to identify and classify algae and fungi

CO2: Analyze process of evolution, life cycle pattern, reproduction and economic importance of algae and fungal groups and its associations.

CO3: Relate to the structural organizations of algae, fungi, lichens

COURSE CONTENT

MODULE I: Algae- Principles and modern trends in taxonomy of algae; Contributions of Indian Algologists Classification of Algae (Fritsch F. E. 1935; Lee R. E. 2018). Characteristic features of major Divisions, Thallus organization and its morphological variations; Evolutionary trends. Unusual habitats of algae. Ecological role of algae. Fossil algae - Brief account only. Cell structure - Prokaryotic, mesokaryotic and eukaryotic organizations.

MODULE II: Modes of perrenation. Asexual reproduction in algae. Sexual reproduction and life cycles in algae. Economic Importance of Algae – Algae as biofuel. Algae as biofertilisers, as food, their uses in industry, water blooms and their ecological role.

MODULE III: Structure, reproduction and life cycle of the following types: *Hydrodictyon*, *Ulva*, *Pithophora*, *Draparnaldiopsis*, *Cephaleuros*, *Halimeda*, *Acetabularia*, *Nitella*, *Padina*, *Turbinaria*, *Amphiroa*, *Gracilaria*, *Ceramium*, *Spirulina*, *Scytonema*

MODULE IV: Fungi- Principles and modern trends of classification of Fungi- (Alexopoulos *etal.* 1996; Kirk *et al.* 2001, 2008); Contributions of Indian Mycologists. Structure, reproduction and phylogeny of: Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

MODULE V: Thallus structure, reproduction and life cycle of the following types: *Phytophthora*, *Pilobolus*, *Aspergillus*, *Uromyces*, *Polyporus*, *Lycoperdon*, *Geaster*, *Ganoderma*, *Nidularia*, *Schizophyllum* *Colletotrichum*, *Fusarium* and *Helminthosporium*. Economic importance of fungi with special reference to secondary metabolites; Fungi as biocontrol agent.

MODULE VI: Lichens -Classification, Origin and Evolution of Lichens. Occurrence and Inter-relationship of Phycobionts and Mycobionts - Structure and Reproduction in Ascolichens, Basidiolichens and Deuterolichens – Thallus structure, reproduction and life cycle of the following types: *Parmelia*, *Graphis*. Lichens as indicators of Pollution – Ecology of lichens, Economic importance of lichens.

LEARNING RESOURCES:

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Online Resources

Resource	Link and Description
You Tube	https://youtu.be/DVhoPrywEwM?si=4LE9w9yHj6mAClar Can algae save the world? Investigating the potential uses of microalgae. (make bio-cement biologically-based plastic substitute. edible dyes)
	https://youtu.be/3ZKbyXCrTG8?si=jx0A7dGSY2WxHCvM Algae - nature's answer to fossil fuels and plastics!!algae as a secret weapon to combat climate change
	https://youtu.be/Hq7kjC3jzyE?si=ba6LBLmqI6jl6W0y Turn harmful algae into plastic foam, which could help clean up waterways and reduce demand for plastic
	https://youtu.be/qYnGAAU-05Y?si=7TCb94CgxVboy3VT Why Demand For Seaweed Is About To Boom
	https://youtu.be/fvYyYNixXuo?si=V51ABYWWVgBL0Jwr Cultivation of this algae which has become a mainstay for thousands of fishers in Tamilnadu.
	https://youtu.be/7IZ-Fek2kzE?si=valxVkg6sMgR1x-W importance of fungi for the functioning of the forest – the most mysterious group of organisms in this forest puzzle.
	https://youtu.be/IiK-Wlh0eyY?si=soSsvqWg8TjQF_IB The Carnivorous Fungi That Devour Nematodes
	https://youtu.be/SsJSzABM-K0?si=BXe5w-5teueLs6dW How Fungi Made All Life on Land Possible
	https://youtu.be/BlcKBKJ8uro?si=RbCnGrf_SbWnnjF- Mushrooms are being tested in innovative and imaginative ways to

	help society. Engineers, medical researchers, and designers are utilizing the natural abilities of various fungi for antibiotics, building materials, water filtration, toxic waste cleanup, pest abatement, textiles, and other purposes.
	https://youtu.be/0GOgiJIHkcY?si=1QR30sr7dM24h7B9
	Lichen: The Mysterious Love Child of Fungi and Algae
	https://youtu.be/Z2haTr0j4hk?si=ZejUKzcyBsnpszo3
	How to recognize different types of lichens Lichen growth forms, structures and reproduction
	https://youtu.be/HX9TpjMsDOY?si=z-S32dFGWg-0A-t1
	Intro to Crustose Lichen Identification

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
First Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-512 DIVERSITY IN ALGAE, FUNGI AND LICHENS

Time: 3 Hours

Maximum Marks: 60

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

1. Under what conditions would you expect a zygomycete to produce zygosporangia rather than haploid spores?
2. Identify the fungus that grows on rotting wood with the fruiting bodies resembling tiny egg-filled bird nests.
3. Can endophytic fungi protect their host from herbivory? If yes, how?
4. A farmer noticed many red-coloured longitudinal lines in the stem of Sugarcane. Can you help him to identify the disease and causative organism?
5. Unlike other algae, dead diatoms do not readily decompose. Why?
6. The crustose lichen, which is commonly called script lichen is
7. Who is the 'father of Modern Algology of India'.
8. Some algae produce an ethereal glow in the dark. Specify the phenomenon.
9. Point out two similarities between algae and fungi.
10. What protects hyphae from being digested by the fungus's own secreted enzymes?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. If algae produce oxygen in a pond, how does having too much algae cause oxygen depletion?
12. Which algal group is known as stoneworts? Why they are considered the closest living relatives to land plants? Name two genera belonging to this group.
13. Differentiate between crustose and fruticose lichen.
14. Brown algae are a very large group of species that predominantly include marine multicellular algae common in cold waters along continental coasts. Schematically represent the life cycle of any one member of this algal group.
15. Discuss the structure of the fungal mycelium, which causes late blight and early blight diseases in potatoes.
16. The importance of fungi in the evolution of terrestrial life is typically understated. Evaluate the importance of fungi in the colonization of land.
17. Give the illustrated life cycle of the fungal group in which mushrooms are included.

(5X3= 15 marks)

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

18. On what characters is the classification of algae by F. E. Fritsch based? Give an outline of his classification.
19. A nonsexual mechanism for transferring genetic material without meiosis or the development of sexual structures is seen in certain fungi. In which fungal type is this phenomenon seen, and discuss the various steps involved in this mechanism.

20. Examine the role of lichen as a bioindicator tool for the assessment of climate and air pollution vulnerability.
21. 'Cyanobacteria is considered as a precious bio-resource in Agriculture, Ecosystem, and Environmental Sustainability'. Analyse the statement.
22. Citing examples, enumerate the different modes of perennation of algae.
23. With the help of diagrams, discuss the structure of vegetative mycelium and basidiocarp of *Polyporus*.
24. 'Commercial cultivation of agarophytes is yet to increase in spite of growing pressure on wild stocks.' What are agarophytic algae? Mention the cause for its overexploitation. Explain the reproduction and life cycle of one agarophytic alga.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. Compiling information about the commercial uses of fungi, predict the role of mycology for the global development of the bioeconomy.
26. 'There is great variation in thallus structure in green algae, which ranges from simple, but primitive motile unicells, to complex, but highly evolved large multicellular forms'. Validate the statement by citing suitable examples.

(1X10= 10 marks)

SEMESTER I	Course Code: BBC- CC- 513	Credits: 3
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NAME OF THE COURSE: BIOPHYSICS, BIOINSTRUMENTATION AND TECHNIQUES

COURSE OUTCOMES (CO)

- CO1 : Demonstrate an understanding of the fundamental principles of biophysics**
CO2 : Gain knowledge about the principle and use the equipment for solving research problems
CO3 : Acquire knowledge on biological techniques
CO4 : Develop practical skills in the area

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, Birefringence and dichroism. Bioenergetics: Concepts of entropy, free energy, enthalpy, redox potential.

MODULE II: Instrumentation in biology-Principles and applications of light, phase contrast, fluorescence, polarizing, scanning and transmission electron microscopy, STEM, Scanning tunneling microscopy, Confocal microscopy-Principle and application, Focused ion beam and scanning probe microscopy: Photomicrography, Flow cytometry. Sample Preparation for Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM), Immuno-labeling of sections, Preparation of samples for X- ray microanalysis, Preparing Sample for Confocal Microscopy. 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: Analytical techniques in biology-Centrifugation principles of sedimentation Preparative and Analytical centrifuges. Sedimentation equilibrium method, Sedimentation velocity method – Density Gradient Centrifugation – Isokinetic and isopycnic 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, Isoelectric focusing, Isoelectric focusing and immuno electrophoresis.

MODULE IV: 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.

MODULE V: Stains and Staining- principles and purpose of staining, Natural Dyes: Haematoxylin, carmine, orcein; Synthetic Dyes: Fast green, Orange G, Safranin, Crystal Violet, Basic fuchsin, 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.

MODULE VI: Histochemical Localization of Cellular Components- Principle and methods of histochemistry, cytochemistry- Fluorimetry Histochemical localization insoluble polysaccharides -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.

LEARNING RESOURCES

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Online Resources

Resource	Link	Description
Biophysical Society	https://www.biophysics.org/education-careers/education-resources/selected-topics-in-biophysics/biophysical-techniques	Lessons, videos
National Mission on Education through ICT(NME-ICT) e-PG Pathshala	https://epgp.inflibnet.ac.in/Home https://youtu.be/aawDYbpWZC4	Scattering of X-rays, diffraction of X-rays from one-, two- and three dimensional array of atoms, X-ray sources and detectors
	https://epgp.inflibnet.ac.in/Home https://youtu.be/l-uELw3mQvs	Working Principles of HPLC and its application
	https://epgp.inflibnet.ac.in/Home https://youtu.be/fr0qt0D7bQE	Introductions, Principles & types of centrifugation
	https://epgp.inflibnet.ac.in/Home https://youtu.be/tc7bkZXRaz8	Differential Centrifugation and Density Gradient Centrifugation
	https://epgp.inflibnet.ac.in/Home https://youtu.be/86OrpD1nZqg	Ultracentrifugation
	https://epgp.inflibnet.ac.in/Home https://youtu.be/VjxNgkCi7Nc	Preparative Ultracentrifugation
	https://epgp.inflibnet.ac.in/Home https://youtu.be/VdjHZfC7Us4	Analytical Ultracentrifugation
	https://epgp.inflibnet.ac.in/Home https://youtu.be/-FJJ4LL5nbQ	Introductions & Types of Chromatography
	https://epgp.inflibnet.ac.in/Home https://youtu.be/hANish35GkE	Gas chromatography: principles and application

	https://epgp.inflibnet.ac.in/Home https://youtu.be/JYbSJwvGFZk	Ion-exchange chromatography: Principle, Methodology & applications
	https://epgp.inflibnet.ac.in/Home https://youtu.be/fydYLuEl9vE	Affinity Chromatography: Principle, Methodology & Applications
	https://epgp.inflibnet.ac.in/Home https://youtu.be/LMaPg8BaXKo	Recent Advances in Chromatography

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
First Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-513 BIOPHYSICS, BIOINSTRUMENTATION AND TECHNIQUES

Time: 3 Hours

Maximum Marks: 60

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

1. Suggest the use of egg white in plant microtechnique.
2. Mention the principle of the Periodic Acid–Schiff's reagent (PAS) method?
3. Define measures of dispersion
4. What is chemical shift?
5. Which chromatographic separation method you will use for the separation of antibody from a mixture?
6. What is IPR?
7. How would you define a redox couple in the context of redox reactions?
8. As a part of the research project, you are planning to determine the percentage of pollen viability of the flower you are working with. What type of staining method you are expected to adopt? Can you suggest any of the commonly used stains for the purpose?
9. Can you explain the concept of entropy in thermodynamics?
10. Nitrogen molecule (N₂) is a highly stable molecule. In nitrogen how many electrons are shared to achieve this stability? Which type of bond is constituted by electron sharing in this case?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Write notes on embedding
12. Write procedure for cytochemical localization of protein
13. Give a brief account on dehydrating agents
14. How is the Coomassie Brilliant Blue (CBB) method used for the histochemical localization of proteins?
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

(5X3= 15 marks)

III. Answer any *five* of the following. Each answer not exceeding 250 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. What is histo-enzymology? Explain its principle with an example.
21. Explain the Feulgen Reaction method for the histochemical localization of nucleic acids. Discuss its principle and staining procedure.

22. Explain the principle of agarose gel electrophoresis. Discuss its applications and advantages.
23. Describe the principle and applications of immuno-electrophoresis.
24. Describe a scenario in which high performance liquid chromatography (HPLC) would be preferred over gas chromatography (GC) for the separation of constituents in a phytoextract.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

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

(1X10= 10 marks)

SEMESTER I	Course Code: BBC- CC- 514	Credits: 3
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NAME OF THE COURSE: PRACTICAL I

COURSE OUTCOMES (CO)

CO1: Identify algae, fungi and lichens through its structural organizations

CO2: Formulate techniques to isolate and culture fungi

CO3: Develop practical skills in different biological techniques

CO4: Understand the use the various laboratory equipments for solving research problems

COURSE CONTENT

MODULE I

- Field Survey in Kariyavattom campus for studying plant species diversity
- Preparation of Biodiversity Register of any locality
- Preparation of report on the activities of any Biodiversity Board / BMC
- List out the major activities of NGO's with special reference to Biodiversity conservation in Kerala state.

MODULE II

- A record of algal types mentioned below– A study of their morphology and structure.
Hydrodictyon, Ulva, Pithophora, Draparnaldiopsis, Cephaleuros, Halimeda, Acetabularia, Nitella, Padina, Turbinaria, Amphiroa, Gracilaria, Ceramium, Spirulina, Scytonema

MODULE III

- Study of the morphology and reproductive structures of the of the following fungi:
Phytophthora, Pilobolus, Aspergillus, Uromyces, Polyporus, Lycoperdon, Geaster, Ganoderma, Nidularia, Schizophyllum Colletotrichum, Fusarium and Helminthosporium
- Staining of fungal filaments by Cotton Blue, Methylene Blue.
- Study of Thallus of Lichens- *Parmelia, Usnea*

MODULE IV: 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)

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

MODULE V: 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)

MODULE VI: 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.

SEMESTER I	Course Code: BBC- DE- 515	Credits: 2
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NAME OF THE COURSE: RESEARCH METHODOLOGY AND BIOSTATISTICS

COURSE OUTCOMES

CO1: Realize the importance of research in knowledge acquisition

CO2: Formulate and design research experiments

CO3: Prepare scientific reports, proposals and research papers

CO4: Create and interpret visual representations of quantitative information, such as graphs, charts etc.

CO5: Analyze and interpret scientific data using statistical tools

COURSE CONTENT

MODULE I: 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.

MODULE II: 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 III: Biostatistics: Definition, scope, functions of biostatistics, its applications in biological research; Data: Primary and secondary Data; Methods of collection of Data; Sampling techniques; Frequency distribution table. Presentation of Data: Tabulation - general rules for Tabulation, Parts of Tables and types of Tables; Diagrammatic presentation: Line, bar and pie; Graphic representation: Histogram, frequency polygon, frequency curve and Cumulative frequency curve.

MODULE IV: Analysis of Data: Measures of central tendency: Mean, Median and Mode; Measures of Dispersion: Range of variation, quartile deviation, Standard deviation and Standard error and Relative measures of dispersion - coefficient of variation.

Probability basic principles - types - rules of probability - addition and multiplication rules applications-Probability distribution. Patterns of probability distribution; binomial, multinomial, normal and poisson distributions.

MODULE V: Tests of significance- formulation and testing of hypothesis Chi-square test for goodness of fit; Null hypothesis, level of Significance - Level of significance; P – value Degrees of Freedom. Student ‘t’ test – paired sample and mean differences ‘t’ tests. ANOVA (Analysis of variance)- one way and two way method, F test, F value calculation, F table. Basic introduction to Multivariate Analysis of Variance (MANOVA). Correlation and

regression Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation. Regression and types. Rank correlation. Lines of regression- coefficient of regression.

MODULE VI: Design of experiments- replication and randomization. Common designs in biological experiments: Completely randomized design, randomized block design, Latin square design, and Factorial design. Statistical softwares- SPSS, Use of software packages like SPSS, SAS, R, SPAR, MINITAB etc. for the above tests and designs of experiments for analysis.

LEARNING RESOURCES:

REFERENCES

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- Gurumani, N. (2009). Research Methodology: for Biological Sciences. MJP Publishers, New Delhi.
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- Mahajan, B.K. (1984). Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.
- Milton, J. S. (1992). Statistical method in Biological and Health Sciences. McGraw Hill Inc., New York.
- Pillai, R. S. N and Bagavathi, V.S. (2010). Statistics theory and practice. Chand & Co. Ltd, New Delhi.
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- Sobl. R. R and Rohif, F.J. (1969). Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freeman and Co., San Francisco.
- Spiegel, M.R. (1981). Theory and Problems of statistics, Schaum's Outline series McGrawHill International Book Co., Singapore.
- Zar, J. K. (2011). Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Online Resources

Resource	Link	Description
National mission on education through ICT (NME- ICT)	https://youtu.be/y_2mHI6DEvI	Introduction to biostatistics
	https://youtu.be/t9ytURd8ukA	Probability basics
	https://youtu.be/HOxgU3sa-b0	Random variables
	https://youtu.be/mpaXEx2JAPA	Block design analysis
	https://youtu.be/6r6i3gH-fDY	Block design analysis
	https://youtu.be/5kdTTwc1MEs	one way ANOVA
	https://youtu.be/N8Kshscv-Ck	one way ANOVA using R
	https://youtu.be/cCidPgNIxPw	Introduction to multivariate analysis
	https://youtu.be/jqrnBDjZc1w	Sample size determination

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA

First Semester M.Sc. (CSS1) Degree Examination

Branch: Botany (Specialization in Biodiversity Conservation)

BBC-DE-515 RESEARCH METHODOLOGY AND BIOSTATISTICS (ELECTIVE)

Time: 3 hours

Maximum marks: 60

I. Answer all questions in one word or sentence

1. What is meant by plagiarism? Name any two plagiarism checking software
2. Define binomial probability distribution
3. List out any two methods of secondary data collection
4. Define standard deviation
5. Define randomized block design
6. What is the significance of journal impact factor?
7. Define coefficient of regression
8. What is the significance of p value
9. What is IPR?
10. What are INFLIBNET and INSDOC?

(10x1=10marks)

II. Answer any five questions. Each answers not exceeding 150 words.

11. Discuss the features of student 't' test
12. Explain MANOVA
13. Give an account on general rules of tabulation
14. Explain rules of probability
15. What is proof reading? What are standard abbreviations used in proof reading?
16. Discuss the significance of scientific research in environmental impacts and ethical issues
17. What are the features of Chi-square test?

(5x3=15 marks)

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

18. Explain the statistical analysis of data and its significance
19. Give an account on journals and its different types
20. Explain in detail about the patterns of probability distribution
21. Describe the common experimental designs used in biological studies.
22. Discuss the components of a research paper.
23. Give an account on measures of dispersion
24. Differentiate between correlation and regression analysis.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. Discuss the major components of a project proposal. Explain how a project proposal can be prepared with example.
26. Explain in detail about the scope, functions and applications of biostatistics in biological research.

(1X10= 10 marks)

SEMESTER I	Course Code: BBC- DE- 516	Credits: 2
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**NAME OF THE COURSE: PHARMACOGNOSY, PHYTOCHEMISTRY, AND
PHYTOMEDICINE**

COURSE OUTCOMES (CO)

CO1: Develop a comprehensive understanding of natural products.

CO2: Acquire proficiency in analytical techniques commonly used in Phytochemistry.

CO3: Explore the therapeutic potential of plant-derived compounds.

CO4: Foster interdisciplinary thinking and innovation by integrating principles from pharmacognosy, phytochemistry, and phytomedicine.

COURSE CONTENT

MODULE I: Pharmacognosy: Definition, scope and applications in herbal medicine. Historical development of pharmacognosy – centres of origin –Diversity of medicinal plants- Introduction to Ashtanga hridaya- Classification of endemic and exotic plants – General account of medicinal plants used in ayurveda. Classification and identification of drugs: Need for classification of drugs; classical (taxonomic, morphological, organoleptic, therapeutic); microscopy and modern (biogenetic) criteria for classification of powdered drug, methods for documentation of raw drugs.

MODULE II: Quality control of crude drugs: Cultivation of medicinal plants including good cultivation practice, good collection practice, good processing and good storage practice and good manufacturing practices, Processing of plant drugs, purification of raw drugs, factors causing drug contamination, Market study of crude drugs including adulterants and substitutes using standard procedures, Single drug standardisation in Ayurveda, Siddha and Unani. Preparation of monographs.

MODULE III: Forensic pharmacognosy; narcotic drugs; toxic drugs, high value medicinal plants (of RET category). Processing of plant drugs: Methods of collection, process and storage of medicinal and aromatic plants; purification of raw drugs; factors causing drug contamination, methods of storage of drugs.

MODULE IV: Introduction to phytochemical approaches: morphological, organoleptic, microscopic - to study drug and aromatic plants. Extraction of phytochemicals (Extraction and characterisation techniques: cold extraction, hot extraction - soxhlet-clevenger apparatus; Solvents - petroleum ether, chloroform, ethanol, water. Separation techniques - TLC, Column, HPLC. Characterization techniques - GC/MS, HPTLC, UV Spectra, IR Spectra. Effect of phytochemicals: study of the drug plants and their active principles. Alkaloids - introduction, properties, occurrence, structure, classification, functions, and pharmacological uses. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses. Phenolics. Quinines - benzoquinones, naphthoquinones, anthraquinone, and coumarins.

MODULE V: Phytomedicine: Definition, scope and applications in herbal medicines; Ethnopharmacology: Pharmacological evaluation of drugs from ethnomedicine (*Strychnos nux-vomica*, *Rauvolfia serpentina* and *Digitalis species*); Importance of ethnopharmacological studies. Criteria for pharmacological evaluation of drugs: Absorption,

distribution, elimination, pharmacokinetics and drug reception; Drug abuse and iatrogenic diseases. Pharmacological activity of plant drugs: Examples of plant drugs with effects on the autonomous and central nervous systems, cardiovascular system and the gastrointestinal system; Plant drugs with antimicrobial activity

MODULE VI: Plant chemicals in modern pharmacology: Biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, Vinca alkaloids; synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and biotransformation.

LEARNING RESOURCES:

REFERENCES

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
First Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-DE-516 PHARMACOGNOSY, PHYTOCHEMISTRY, AND PHYTOMEDICINE
(Elective)

Time: 3 Hours

Maximum Marks: 60

I. Answer all questions in one word or sentence

1. Which is the major class of secondary metabolite responsible for plant aroma?
2. Highlight the significance of Ashtanga Hridaya in *Ayurveda*.
3. Mention any two narcotic drugs.
4. From which plant, ephedrine is isolated?
5. What are iatrogenic diseases?
6. Give two examples of plant drugs with effects on gastrointestinal system.
7. Name a drug isolated from *Digitalis* species.
8. Define ethnopharmacology.
9. In which class of phytochemicals vanillin belongs to?
10. Specify any one synthetic alternative of quinine that is efficient as anti-malarial drug.

(10X1= 10 marks)

II. Answer any five questions. Each answer not exceeding 150 words

11. Write a short account on different techniques for extraction of phytochemicals
12. Enlist the main criteria for the classification of powdered drugs.
13. What do you mean by AYUSH Systems of Medicine? Describe.
14. Medical education in India needs to focus on developing forensic pharmacology as a subspecialty. Give reasons.
15. What is the major information obtained from Infrared Spectroscopy (IR)?
16. Differentiate adulterants and substitutes of raw drugs with suitable examples.
17. Briefly discuss the need for the classification of drugs.

(5X3= 15 marks)

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

18. Enumerate the scope and applications of pharmacognosy.
19. Discuss the role of biotransformation in drug discovery and development.
20. 'Pharmacopeial monographs for herbal medicines should contain information in the definition that is consistent with the monograph title, followed by specifications for quality including identity, purity, and content.' Comment.
21. Give a general account of medicinal plants used in *Ayurveda*.
22. Write a note on the factors causing herbal drug contamination.
23. Differentiate HPLC and HPTLC
24. Analyze the different methods of collection, process, and storage of medicinal and aromatic plants.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. How will you determine the identity, purity, and strength of a raw drug?
26. Throw light on occurrence, structure, classification, functions, and pharmacological uses of alkaloids.

(1X10= 10 marks)

SEMESTER II	Course Code: BBC- CC- 521	Credits: 3
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NAME OF THE COURSE: CYTOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

COURSE OUTCOMES (CO)

CO1: Analyze the role of different cell organelles in various physiological process.

CO2: Outline the events in cell cycle process and identify various stages of cell division.

CO3: Analyze functioning and significance of immune system and signaling molecules

COURSE CONTENT

MODULE I: Introduction to cell biology – Cellular organization of Prokaryotic and Eukaryotic cells. Ultrastructure, chemistry, functions, interrelationships and origin of the cell, organelles and membrane systems-Cell-wall, Plasma membrane, Cytoplasm, endoplasmic reticulum, ribosomes, Golgi-bodies, plastids, mitochondria, centrioles, lysosomes, peroxisomes, spherosomes. Cytoskeletal structures - microtubules, microfilaments, intermediate filaments. Nucleus - nuclear envelope, nucleoplasm, nucleolus, chromatin reticulum. Chemistry of chromosomes – DNA, histone and non-histone proteins, RNA and organization of these in the three dimensional configuration of the chromosome. A study on the structure and function of the kinetochore, Nucleolar organizer region (NOR) and other secondary constrictions, satellites, heterochromatic segments and telomeres.

MODULE II: Cell division cycle mechanism and regulation- Stages of cell cycle (Mitosis and Meiosis). Cytoskeleton- microfilaments, microtubules and intermediate filaments, Spindle formation and disintegration, mechanism of chromosome movement and separation during anaphase, actin- myosin cytoskeleton, role of cohesins and condensins, role of motor proteins. Cell cycle control mechanisms (Check points), Role of cyclins and cyclin dependent kinases, cdk activating kinase (CAK), cdk inhibitory proteins (CKIs). Synaptonemal complex, structure and function, molecular mechanism of crossing over. Structural (deletions, duplications, inversions and translocations) and numerical (euploid and aneuploid) variations in chromosomes. Meiotic behavior of structural and numerical variants. Genetic and evolutionary significance of chromosomal variations.

MODULE III: 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, DNA gyrases, topoisomerases, ligases, RNA polymerase (primase) and replisome complex- current concept of DNA replication in prokaryotes and eukaryotes. Replication of organelle DNA. Inhibitors of prokaryotic and eukaryotic DNA replication.

MODULE IV: RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport). C) Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code,

aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins). D) Control of gene expression at transcription and translation level -regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

MODULE V: Mutation & DNA repair - somatic & germinal mutations, spontaneous & induced mutations, error-prone replication/repair mutation, direct and indirect DNA damage, environmental mutagens, molecular basis of mutation, trinucleotide repeat expansion, DNA repair mechanisms- Photoreactivation, Excision repair, Post replication recombination, Mismatch repair, SOS repair. Senescence & apoptosis, DNA repair-deficiency disorders. DNA recombination- homologous and site-specific recombination

MODULE VI: Immunity-mechanism; Innate and adaptive immune system: cells and molecules involved in innate and adaptive immunity. Antigens, antigenicity and immunogenicity. B and T cell epitopes. Structure and function of antibody molecules, generation of antibody molecules, generation of antibody diversity. Antigen antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cell, B&T cell receptors. Humoral and cell mediated immune responses, primary and secondary immune modulation, the complement system, Toll like receptors cell mediated effector functions. Inflammation, hypersensitivity and auto immunity, immune response during bacterial (tuberculosis) parasitic (malaria) and viral (HIV) infections, congenital and acquired immune- deficiencies, Vaccines. Immunotechniques. Monoclonal antibodies, Antibody engineering. Immuno Assays – RIA and ELISA. Cell signaling and communications: types of signals and signaling molecules, Cell surface receptors, G Protein coupled receptors.

LEARNING RESOURCES:

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Online Resources

Resource	Link	Description
National Center for Biotechnology Information (NCBI)	https://www.ncbi.nlm.nih.gov/	Provides extensive databases including GenBank, PubMed
European Bioinformatics Institute (EBI)	https://www.ebi.ac.uk/	Provides databases, bioinformatics tools, and resources for molecular biology and genetics research.
ExPASy - Swiss Institute of Bioinformatics	https://www.expasy.org/	Access to databases and tools for molecular biology and genetics research.
Pubmed	https://pubmed.ncbi.nlm.nih.gov/	MEDLINE database of references and abstracts on life sciences and biomedical topics.
You tube	https://youtu.be/L-Xq1nyVLVQ?si=r6Hf67oIYDtO6G15 https://youtu.be/TNKWgcFPHqw?si=9ru0IJJoNwCe0aixg https://youtu.be/85FUw8_YZYY?si=846AB5pmVc9ebwMY https://youtu.be/tlztNPKXEmc?si=fk5CnvS4NnFpHLgx https://youtu.be/zddoPknJYtk?si=9CaJCGC2vg9YvcvQ https://youtu.be/oZZMXv19PEU?si=QS4XIkENIvIsLxiG https://youtu.be/fDYIHfV5540?si=suXoSE5F6za6msU	Discovery of the cell and cell theory: DNA Replication : Translation or Biosynthesis of proteins : Post translational modifications : Trancription in prokaryotes: Trancription in Eukaryotes: Central Dogma : DNA Sequencing :

	https://youtu.be/ONGdehkB8jU?si=qboeJWGF5TAnmV5t https://youtu.be/iFgAacVKCrc?si=ou8AllA4kzbQztMR https://youtu.be/DtUmpd7mrZc?si=W1yJhtg0-l1L6MNw	Active and Passive Immunity : T Lymphocytes and Cell mediated immunity :
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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-521 CYTOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

Time: 3 Hours

Maximum Marks: 60

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

1. Name a tumor suppressor gene involved in cell cycle control.
2. Identify the significance of membrane proteins having both hydrophilic and hydrophobic regions?
3. Name one cellular process primarily associated with rough endoplasmic reticulum.
4. Illuminate chromatin remodeling. How does chromatin remodeling contribute to epigenetic regulation?
5. Define the term 'selective permeability' in the context of the plasma membrane.
6. Specify the lock-and-key analogy as it relates to antigen-antibody interactions.
7. Expound the role of MHC molecules in presenting antigens.
8. Identify one cytokine that plays a key role in regulating cell-mediated immune responses.
9. Give an example of a disease associated with cytoskeleton abnormalities.
10. Specify the role of second messengers in cell signaling.

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Specify the term "ER stress". Point out its implications for cellular health.
12. Identify the role of memory cells in acquired immunity? Describe how memory cells are formed during an initial immune response? What signals are involved in their activation during secondary immune responses?
13. How do start and stop codons regulate the initiation and termination of protein synthesis?
14. Give a brief account on the antibody-producing cells derived from activated B cells.
15. Compare and contrast transcriptional regulation in prokaryotic and eukaryotic cells.
16. Outline how epigenetic modifications influence gene expression and cellular identity in eukaryotic cells.
17. Elucidate how does the universality of the genetic code across species provide insights into evolutionary relationships?

(5X3= 15 marks)

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

18. Our modern understanding of DNA's role in heredity has led to a variety of practical applications. Justify the role of DNA as genetic material.
19. Provide an overview of the phases of the cell cycle. Describe the key events that occur during each phase.
20. Discuss the role of second messengers such as cAMP, calcium ions, and IP3/DAG in cellular signal transduction. Provide examples of signaling pathways where these second messengers are involved. Explain their mechanisms of action.

21. Describe the role of the cytoskeleton in muscle contraction. Discuss how actin filaments and myosin motors interact to generate force and movement during muscle contraction.
22. How does RNA processing contribute to the biogenesis and functions of non-coding RNAs, such as microRNAs and long non-coding RNAs? What are the regulatory roles of RNA processing in non-coding RNA-mediated gene regulation?
23. Explain how cells respond to DNA damage or other stresses by halting the cell cycle progression or triggering apoptosis. Discuss the roles of p53 and other signaling pathways in mediating cell cycle arrest and apoptosis in response to stress signals.
24. Enlist the molecular machinery involved in RNA splicing. How do these components coordinate to ensure accurate and efficient splicing? On what characters is the classification of algae by F. E. Fritsch based? Give an outline of his classification.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. An operon is a sequence of DNA containing a cluster of genes under the control of a single promoter. The genes within the operon will always be expressed together. Elaborate positive and negative control of gene expression in Bacteria.
26. Explain the concept of membrane fluidity and its importance in cellular function. Discuss factors that influence membrane fluidity, such as temperature, lipid composition, and cholesterol content. How does membrane fluidity affect the movement of molecules and signalling processes?

(1X10= 10 marks)

SEMESTER II	Course Code: BBC- CC- 522	Credits: 3
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NAME OF THE COURSE: ANIMAL DIVERSITY

COURSE OUTCOMES (CO)

CO1: Identity and classify major groups of animal kingdom

CO2: Apply techniques of animal collection and preservation

CO3: Differentiate the characters and life history of lower and higher invertebrates

CO4: Compare salient features of phylum chordate and Mammalia.

COURSE CONTENT

MODULE I: Introduction to Animal Diversity and Taxonomy - Principles and rules of Taxonomy, ICZN Rules, Concepts of taxon, categories, holotype, paratype, topotype etc. Ethical and Humane treatment to animals, DOs and DON'Ts, Preservation of animal specimens for taxonomic purposes, Field data collection for taxonomic studies.

MODULE II: Animal Study Techniques - Methods of Field data collection for taxonomic studies Use of techniques like net sweeping, pit fall traps, light traps, Berlese funnel, smoking, aspirators, mark- recapture, Use of Taxonomic literature and study of key characters for identification of the specimen.

MODULE III: Lower invertebrate phyla, General Characters – Strictly restrict to salient features only. Classification up to Classes with two examples – Brief account only. General Characters and Classification up to classes in Kingdom Protista: Phylum Porifera: Phylum Cnidaria, Phylum Nematelminthes. Locomotory Organelles and Locomotion in Protozoa, Canal System in Porifera, Polymorphism in Hydrozoa, Life history of Taenia solium Life history of Ascaris lumbricoides and its parasitic adaptations.

MODULE IV: Higher invertebrate phyla, General Characters – Strictly restrict to salient features only. Classification up to Classes with two or three examples – Brief account only- Phylum Annelida, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata. Metamerism in Annelida Vision in Arthropoda, Metamorphosis in Insects. Torsion in gastropods Water-vascular system in Asteroidea. General features and Phylogeny of Protochordata.

MODULE V: Animal Diversity-Phylum: Chordata- General Characters – salient features only Classification up to Classes with two examples – Brief account only Agnatha: General features of Agnatha and classification of cyclostomes up to classes Pisces: General features and Classification up to orders; Osmoregulation in Fishes Amphibia: General features and Classification up to orders; Parental care. Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes Aves: General features and Classification up to orders; Flight adaptations in birds, Birds Songs

MODULE VI: Animal Diversity-Phylum: Mammalia- General Characters – Strictly restrict to salient features only classification up to classes with two or three examples – Brief account only Oviparity; ovoviviparity and viviparity in mammals. Adaptive radiation.

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Online Resources

Resource	Link	Description
You Tube	https://youtu.be/jwVlaPaHPRI?feature=shared	Taxonomy
	https://youtu.be/Y33SjFydM_M?si=rJK4DhKSJ8IazdC	An introduction to invertebrates
	https://youtu.be/pO2ZQVOJEm4?feature=shared	Introduction to Animals:
		Invertebrates Part 1

	https://youtu.be/pSvX9NJM1w8?feature=shared https://youtu.be/lC9s--aiy4g?feature=shared https://youtu.be/vNqfV-bfSws?feature=shared https://youtu.be/n9ud5ZPu2Po?feature=shared	Invertebrates Part 2 Fish Mammals
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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-522 ANIMAL DIVERSITY

Time: 3 Hours

Maximum Marks: 60

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

1. Pinacocytes are specialized cells found in the phylum
2. Most of the echinoderms have hard parts and spines for defense, but the sea cucumbers do not. How do sea cucumbers protect themselves from predators?
3. Comment on Keber's organs.
4. Which organisms commonly utilize evisceration as a defense mechanism?
5. Name the phylum that exhibits trochophore larvae.
6. Identify the symmetry pattern typically displayed by Cnidarians.
7. Name the animals which are known as sea cradles.
8. Give two examples of ovoviviparous animals.
9. Share the primary purpose of using a Berlese funnel in entomological studies.
10. Parapodia are predominantly found in annelids. Mention its functions.

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Sea stars have no teeth, yet they eat other animals such as corals and mollusks. How do they accomplish this?
12. Distinguish between Nereis and Heteronereis.
13. Do you agree with the narrator when he says that the sponge is more complex than we imagined? Explain your answer.
14. Compare and contrast holotype and paratype. Provide an example.
15. Characterize the key evolutionary adaptations that allowed Agnatha to diverge from other vertebrate lineages. How do these adaptations contribute to their survival in diverse aquatic environments?
16. Identify the causative agent of ascariasis? How is ascariasis primarily transmitted to humans?
17. Illustrate the types of Taxonomic Keys. Provide examples.

(5X3= 15 marks)

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

18. Evaluate the importance of osmoregulation in the survival and distribution of fish species.
19. You are curating a museum exhibition on the diversity of life. Design a section focusing on the importance of taxonomy in understanding biodiversity. How would you organize specimens and information to illustrate the principles of classification, phylogeny, and evolutionary relationships?
20. Explore the transmission dynamics of *Taenia solium* within human and pig populations. How do behavioral, cultural, and socioeconomic factors influence the transmission routes and epidemiology of this parasite?
21. Discuss the anatomical features that contribute to the ability of birds to fly, such as lightweight bones, modified forelimbs and the structure of feathers. How do these adaptations optimize efficiency and maneuverability during flight?

22. Explore the diversity of reproductive strategies among amphibians, including variations in breeding habitats, parental care behavior and modes of larval development.
23. Analyze the potential threats to annelid populations from habitat loss, pollution and climate change. Propose conservation strategies to mitigate these impacts.
24. Critically evaluate the impact of flatworm parasites on host organisms health and ecosystems, considering both negative and potentially beneficial effects.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. Discuss the specific adaptations of the water vascular system that enable echinoderms to occupy diverse ecological niches, from shallow tidal pools to deep-sea environments. How do these adaptations reflect their ecological roles?
26. You are conducting field research on a species of amphibian known for parental care. Design an observational study to investigate the factors influencing parental investment in this species. What variables would you measure, and how would you analyze your data to draw conclusions about parental care strategies?

(1X10= 10 marks)

SEMESTER II	Course Code: BBC- CC- 523	Credits: 3
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NAME OF THE COURSE: DIVERSITY IN BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

COURSE OUTCOMES (CO)

CO1: Identify and classify Bryophytes, Pteridophytes and Gymnosperms

CO2: Compare life cycles of different groups of Bryophytes, Pteridophytes and Gymnosperms

CO3: Distinguish morphological and anatomical variations of Bryophyta, Pteridophytes and Gymnosperms

COURSE CONTENT

MODULE I: Bryophyta- General characters and recent systems of classification (Shofield, 1985); Contributions of Indian Bryologists. A general account of morphological and anatomical features, reproduction, life history and phylogeny of: Sphaerocarpaceae, Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales, Andreales, Funariales, Polytrichales.

MODULE II: Life cycle study of the following types: *Lunularia*, *Targionia*, *Cyathodium*, *Reboulia*, *Pallavicinia*, *Porella*, *Anthoceros*, *Sphagnum*, *Polytrichum*. Origin and evolution of Bryophytes, Brief account on Fossil Bryophytes, Economic importance of Bryophytes, Bryophytes as indicators of water and air pollution.

MODULE III: Pteridophytes- General characters, classification (Bierhost, 1971) and life cycle of Pteridophytes; Contributions of Indian Pteridologists. Comparative morphology, Anatomical structure, ecology and phylogeny of the following groups: Psilopsida, Lycopsidea, Sphenopsida, Pteropsida.

MODULE IV: Structure, reproduction and life cycle of the following types: *Isoetes*, *Ophioglossum*, *Angiopteris*, *Osmunda*, *Ceratopteris*, *Blechnum*, *Lygodium*, *Adiantum*, *Trichomanes*, *Acrostichum*, *Salvinia*, *Azolla*.

MODULE V: Telome theory-basis, elementary proves- origin of sporophylls in Lycopsidea, Sphenopsida and Pteropsida- origin of root- merits and demerits of telome theory; Evolutionary trends in the gametophytes of Pteridophytes, Conservation of Pteridophytes: Pteridophytes as ecological indicators. Principles of Paleobotany, Fossil pteridophytes: *Rhynia*, *Lepidocarpon*, *Sphenophyllum*, *Zygopteris*.

MODULE VI: Gymnosperms- General characters, affinities, distribution and classification (Sporne, 1965; Christenhurz et al. 2011; Christenhurz & Bing, 2016); phylogeny and economic importance of Gymnosperms. Structural details of vegetative and reproductive parts, phylogeny and inter relationships of the following orders: Cycadofilicales, Caytoniales, Bennettitales, Pentoxylales, Cycadales, Ginkgoales, Coniferales, Gnetales. Structure, reproduction and life cycle of the following types: *Zamia*, *Araucaria*, *Cupressus*, *Podocarpus*, *Ephedra*.

LEARNING RESOURCES:

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Online Resources

Resource	Link	Description
Youtube	https://youtu.be/gQ2Cs_BOaiA?si=uxkwHzQHIWdZf2cZ	A short documentary about bryophytes
	https://youtu.be/_CYom3ccNC8?si=7zHxZRR99YnV-Hr4	Moss Evolution – A Lecture
	https://youtu.be/5hGeUDWMffs?si=0G0KMwzFI35E8xIG	How Ferns Reproduce Fern Life Cycle
	https://youtu.be/NRWru1LGAb?si=bpkX8lR-yDyWGM4Q	How Pine Trees Reproduce Gymnosperm Life Cycle
	https://youtu.be/r4Qw3ecGw9o?si=tqnTOXRsyf6qcfaK	How to Identify the four most common coniferous genera easily and simply.

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-523 DIVERSITY IN BRYOPHYTES, PTERIDOPHYTES AND
GYMNOSPERMS

Time: 3 Hours

Maximum Marks: 60

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

1. Define indusium.
2. A major innovation of land plants is embryo protection. How is a moss embryo protected from desiccation?
3. Name the terrestrial fern growing in mangrove ecosystem.
4. Differentiate between annulus and stomium.
5. Name the bryophyte which harbours nitrogen fixing blue green algae in its thallus.
6. Highlight the functional significance of the response of elaters to moisture.
7. What adaptation do conifers exhibit to capture wind-borne pollen?
8. Mention the ploidy of endosperm of gymnosperm.
9. Ginkgo biloba is often referred to as a living fossil. Why?
10. Specify the advantage of silica deposits in stems, as is found in horsetails.

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Bennettitales, a group of fossil gymnosperms is also called cycadoideales due to their close resemblances with cycads. Comment.
12. Why cycas wood is economically useless?
13. You have been hired as a research assistant to investigate the the originof the angiosperms, specifically the boundary between a gymnosperm and an angiosperm. Which characteristics would you use to clearly define a new fossil as a gymnosperm or an angiosperm?
14. Mention the significance of conserving pteridophytes.
15. Comment on the specialized structures in *Marchantia polymorpha*, which helps the plant to propagate in favourable environment.
16. Diagrammatically represent the life cycle of Podocarpus.
17. *Cycas*, one of the few living members of gymnosperms is called the relic of the past. Can you establish a phylogenetic relationship of *Cycas* with any other group of plants that justifies the above statement?

(5X3= 15 marks)

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

18. Outline the classification of gymnosperms proposed by Sporne (1965).
19. Pteridophytes show a true alternation of generations. The regular alternation of chromosome numbers is sometimes impaired by certain abnormalities. Discuss the abnormalities in the life cycle of Pteridophytes.
20. Discuss the morphological features and life history of the order Marchantiales.
21. Pentoxylales are an extinct order of seed plants known from Jurassic and early cretaceous period. Analyse why this group occupy a unique and rather isolated position among gymnosperms.

22. Give an illustrated account on the stem anatomy of *Ephedra*.
23. Write a note on the factors causing herbal drug contamination. Bryophytes as indicators of water and air pollution.
24. 'The life cycle of *Ophioglossum* shows alternation of generation between diploid sporophyte and haploid gametophyte stage'. Discuss in detail.

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Explain the general characters and outline the recent system of classification of pteridophytes.
26. Elucidate the general characters and economic importance of the largest group of living gymnosperms.

(1X10= 10 marks)

SEMESTER II	Course Code: BBC- CC- 524	Credits: 3
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NAME OF THE COURSE: PLANT PHYSIOLOGY AND BIOCHEMISTRY

COURSE OUTCOMES (CO)

CO2: Explain various physiological processes in plant systems

CO1: Gain knowledge on the chemical constitution, synthesis, storage, function and degradation of carbohydrates, proteins, enzymes, lipids, vitamins and hormones in plants.

CO3: Classify the plant secondary metabolites and decipher their application in pharmaceutical industries to manage human health

COURSE CONTENT

MODULE I: Photosynthesis: Efficiency and turn over. Light harvesting complexes. Photosystem I and II - Structure and function. Mechanism of electron transport. Water oxidizing clock. Rubisco. Structure and function. Photo inhibition. Phytochromes. CO₂ fixation: C₃, C₄ and CAM pathways. Energetics of CO₂ fixation. Photorespiration and glycolate metabolism. Mechanism of photorespiration in C₃ and C₄ plants. Factors regulating photorespiration. Respiration. Anaerobic, aerobic. Glycolysis, TCA cycle, ETS and ATP synthesis, transporters involved in exchange of substrate of products, Pentose phosphate pathway.

MODULE II: Transport of metabolites – Xylem and Phloem sap translocation. Seed metabolism, glyoxylate cycle in fatty seeds during germination. Nitrogen metabolism. Nitrate and ammonium assimilation. Symbiotic and non symbiotic. Role of leg haemoglobin, Plant hormones – Physiological effects and mechanism of action.

MODULE III: Photoregulation and growth responses. Plant morphogenesis. Physiology of flowering, fruit ripening, senescence and abscission. Biological clock and circadian rhythm. Physiological response of plants to stresses like drought, heat and cold. Salt tolerance in plants. Role of phytoalexins. Defense mechanism. Allelopathy – Plant derived compounds.

MODULE IV: Biochemistry – Introduction, pH and buffers. Properties of water, acids bases and buffers. Henderson Hasselbalch equation, pH, pK_a. Common buffers. Structure, function and metabolism of carbohydrates – Synthesis of starch, cellulose and sucrose. Interconversion of hexoses and pentoses. Biosynthesis of lipids: Biosynthesis of fatty acids. Biosynthesis of Triacyl glycerol, diacyl glycerol monoacyl glycerol. Gluconeogenesis. Membrane lipids. Lipid oxidation.

MODULE V: Proteins and amino acids- Structure and classification of amino acids. Biosynthesis of amino acids. Classification of protein based on structure, function and localization sites. Primary, secondary, tertiary and quaternary structure. Protein domains. Ramachandran plot. Purification of proteins. Enzymes: IUB system of classification and nomenclature. Distribution of plant enzymes. Soluble and membrane bound enzymes. Co enzymes, substrate specificity, regulation of enzyme activity, Inhibitors, allosteric enzymes. Isozymes. Ribozymes, Abzymes. Enzyme kinetics. The Michaelis–Menten equation, Lineweaver-Burk plot K_m and V_{max}. Multienzymes.

MODULE VI: 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.

LEARNING RESOURCES

REFERENCES

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Online Resources

Resource	Link	Description
National mission on education through ICT (NME- ICT)	https://youtu.be/mGBloHHZaAw	Phloem Transport
	https://youtu.be/sf2k8Hu6wIk	Photoperiodism
	https://youtu.be/ImPOASwiBOg	Absciscic acid
	https://youtu.be/wctb9d1oKA4	Cytokinins
	https://youtu.be/g2M9ABBrjdM	Ethylene
	https://youtu.be/FYSXn0bXepI	Auxins
	https://youtu.be/J8rpsK8NFDo	Gibberillic acid
	https://youtu.be/J8rpsK8NFDo	Lipids

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-524 PLANT PHYSIOLOGY AND BIOCHEMISTRY

Time: 3 Hours

Maximum Marks: 60

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

1. Define allelopathy.
2. If you provide a deciduous tree with extra auxin, it will not shed its leaves during winter. Why? Mention the consequence.
3. Some leaf molds secrete a chemical that causes guard cells to accumulate K. How does this help the mold infect the plant?
4. are released at a site of infection that triggers the development of general resistance to pathogens.
5. Mention the class of enzyme which transfers a chemical group from one substance to another.
6. Give two examples of unsaturated fatty acids.
7. How do the nitrogen-fixing bacteria of root nodules benefit from their symbiotic relationship with plants?
8. Name the two pathways for synthesis of terpenoids.
9. What is a buffer?
10. A particular short-day plant won't flower in the spring. Suppose a short dark interruption splits the long-light period of spring into two short-light periods. What result do you predict?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Contrast the forces that move xylem sap with the forces that move phloem sap.
12. How do the roles of ubiquinone and cytochrome c differ from the other components of electron transport chain?
13. Discuss the function of amino acids.
14. Given that the function of egg yolk is to nourish and support the developing chick, explain why egg yolks are so high in fat, protein, and cholesterol.
15. Comment on enzyme commission number.
16. Point out the various applications of vernalization.
17. Although floral evocation occurs at the apical meristems of the shoots, some of the events that result in floral evocation are triggered by biochemical signals arriving at the apex from other parts, especially the leaves. Summarize the biochemical signaling involved in flowering.

(5X3= 15 marks)

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

18. Carbohydrates are the most abundant biomolecules on earth. How are carbohydrates classified?
19. Describe the structure of ATP synthase. Explain the chemiosmotic theory of ATP synthesis.
20. Give a detailed account on the regulation of enzyme activity.

21. Why do plant seedlings require the glyoxylate cycle and mention the action of the two key enzymes in the cycle.
22. Comment on the physiological response of plants to drought.
23. Illustrate and explain gluconeogenesis.
24. Proteins fold into stable three-dimensional shapes, or conformations, that are determined by their amino acid sequence. Discuss the four levels of protein structure.

(5X5= 25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. “A major function of secondary metabolites in plants is protection against herbivory”.
Giving specific examples and evidence from plant-insect interactions, write an essay supporting the statement.
26. What is photorespiration? Prepare a schematic representation of photorespiration process. Add a note on significance of photorespiration.

(1X10= 10 marks)

SEMESTER III	Course Code: BBC- CC- 525	Credits: 4
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NAME OF THE COURSE: PRACTICAL II

COURSE CONTENT

MODULE I

- Meiosis - *Rhoeo*, *Chlorophytum*, *Crotalaria*, *Datura* (at least one should be recorded).
- Mitosis – Metaphase and Anaphase
- Calculation of Mitotic index.

MODULE II

- Identification of Type Specimen from the invertebrate and chordates mentioned in the animal diversity syllabus and record submission

MODULE III

- Morphological and anatomical studies of the following Bryophytes :
Lunularia, *Targionia*, *Cyathodium*, *Reboulia*, *Pallavicinia*, *Porella*, *Anthoceros*, *Sphagnum*, *Polytrichum*
- Anatomical structural details of the vegetative and reproductive parts of the Pteridophytes: *Isoetes*, *Ophioglossum*, *Angiopteris*, *Osmunda*, *Ceratopteris*, *Blechnum*, *Lygodium*, *Adiantum*, *Trichomanes*, *Acrostichum*, *Salvinia*, *Azolla*
- Identification of fossil Pteridophytes : *Rhynia*, *Lepidocarpon*, *Sphenophyllum*, *Zygopteris*

MODULE IV

- Anatomy of stem (TS, RLS, TLS), leaf and reproductive structures of the gymnosperm types: *Zamia*, *Araucaria*, *Cupressus*, *Podocarpus*, *Ephedra*.
- Structural details of the following fossil types: *Heterangium*, *Medullosa*.

MODULE V

- Preparation of buffers. Phosphate, carbonate, Tris HCl.
- Extraction and estimation of total proteins by TCA precipitation and Lowry's method.

MODULE VI

- Chlorophyll survey of five plants. Quantification, absorption spectra of chlorophyll and carotenoids using different solvents.
- Hill activity by DCPIP/ ferricyanide reduction.
- Extraction and estimation of total phenols.
- Physiological identification of CAM in plant species.
- Setting up of Plant Physiology experiments: Ganong's potometer, Arc auxanometer, Respirometer, Clinostat

SEMESTER II	Course Code: BBC- DE- 526	Credits: 2
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NAME OF THE COURSE: CLIMATE CHANGE AND CROP ADAPTATIONS

COURSE OUTCOMES (CO)

CO1: Gain knowledge in the basics of climate change and its impact

CO2: Familiarize the environmental issues related to climate change

CO3: Analyse the socio-economic impact of climate change

CO4: Assess different crop management strategies that mitigate the impact of climate change

COURSE CONTENT

MODULE I: Introduction to Climate Change- Greenhouse gases and alteration of climate. Abiotic changes and its consequences. Effects on biotic interactions: Responses of populations, species and ecosystems to climate change, the ozone layer and climate change.

MODULE II: Environmental issues of climate change- Effects of Global warming on aquatic and terrestrial ecosystem of India with particular reference to Western Ghats. Action plans to reverse the Climate Change.

MODULE III: Socio-economic aspects of climate change impacts: Environmental pollution and associated hazards to animals and humans.

MODULE IV: Ecology and its Relevance-Physical and social environment as factors of crop distribution and production. Agro ecology- cropping pattern as indicators of environment.

MODULE V: Impact of Climate Change in Agriculture-Impact on soil-soil microbial activity, soil moisture availability and soil degradation. Impact of climate change on soil productivity-increase in temperature, increase in CO₂. Effects of extreme climatic events on yield crops. Impacts of climate change on insects and pests.

MODULE VI: Impacts of Climate Change and Crop Management-Design of crop simulation models, Development of econometric models, Simulation studies for determining the need of agronomic practices in crop production. Role of Genetic engineering in raising stress tolerant crops as part of climate mitigation strategies. Crop ecosystem response to climate change with examples: Rice, Coconut, Tapioca, Cashew, Pulses, Rubber, Spices, Tea & Coffee.

LEARNING RESOURCES:

REFERENCE

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Second Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-DE-526 Climate Change & Crop Adaptations (Elective)

Time: 3 Hours

Maximum Marks: 60

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

1. Define ecosystem.
2. Farmers who modernize their methods and diversify their fields will be in an advantageous position in future. How?
3. What is greenhouse effect?
4. Is there a direct link between indigenous trees and climate change mitigation? Comment your opinion.
5. What is aerosol?
6. How do clouds affect the Earth's climate?
7. is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems.
8. Define electromagnetic spectrum.
9. Expand CFC
10. Unlike in seasonal crops, the impact of climate change will have long-standing ill effects in coconut. Do you agree? Give reason. **(10x1=10 marks)**

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Biotechnological approaches could provide new opportunities for producing crops that can adapt to the fast-changing environment and still produce high yields under severe environmental stress conditions. How?
12. Enlist greenhouse gases and explain its effects.
13. What are the main indicators of climate change?
14. Examine the effects of global warming in the aquatic ecosystem
15. What are the components in the climate system?
16. How is climate change related to soil productivity?
17. Climate change is widely expected to make pest infestations more unpredictable and increase their geographic range. Suggest some adaptation and mitigation strategies for pest management in a changing climate. **(5X3=15 marks)**

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

18. What are the remedial measures to reduce the harmful effects of climate change?
19. Briefly explain socio-economic aspects of climate change.
20. Write a note on biotic interaction of global warming.
21. Analyse the impact of climate change in crop ecosystem response.
22. How do humans have a major impact on the climate change?
23. What are the major effects of global warming? Suggest control measures.
24. 'Climate change will have some good effects', Comment. **(5X5=25 marks)**

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

25. Write an essay on natural resources, their sustainable management and conservation?
26. Comment on environmental pollution and associated hazards to crops. **(1X10= 10 marks)**

SEMESTER II	Course Code: BBC- DE- 527	Credits: 2
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NAME OF THE COURSE: WILDLIFE ECOLOGY AND MANAGEMENT

COURSE OUTCOMES (CO)

CO1. Develop a comprehensive understanding of wildlife ecology.

CO2. Study the principles and techniques for managing wildlife populations sustainably.

CO3. Analyze the current events and public information related to wildlife conservation and management.

CO4. Describe the local, national and international conservation legislations, policies, problems and prospects.

COURSE CONTENT

MODULE I: Definition of Wildlife: Causes of wildlife depletion; Economic importance of wildlife; need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India- India as a mega wildlife diversity country. Behaviour of wildlife: Instinctive behaviour-classical and modern concepts-fixed action pattern and ritualization; Learning-Imprinting-habituation. Analysis of behaviour pattern- taxis, kinesis and reflexes; Biological rhythms and bird migration; Types of animal communications; Courtship, display, sexual selection and parental care in mammals and birds; Social behaviour in animals - Honey bees, Elephants.

MODULE II: Wildlife management techniques: Vegetative analyses – Point Centered Quadrat, Quadrat, Strip transect; GIS and Remote sensing in wildlife habitat surveys-Habitat manipulation: food, water, shade improvement; impact and removal of invasive alien species; Making observations and records: field notes, datasheets

MODULE III: Wildlife Photography - Types of cameras, camera traps; Field equipments-altimeter, pedometer, field compass, binoculars; radio collaring; GPS; Human wildlife conflicts: Basic concepts, reasons for conflicts, Identification of damages caused by wild animals and control measures; Case studies – Elephant, gaur, wild boar, monkey, tiger and leopard; Translocation of Wild animals – Principles, Methods and applications.

MODULE IV: Ecological basis of wildlife management: concept of carrying capacity, home range and territory, Management of rangelands (Types of rangeland, Characteristics, Rangeland carrying capacity, Forests and wildlife corridors, rangeland conditions). Conservation Schemes: Wildlife (Protection) Act, 1972 – IUCN – CITES – NBA – IBA, Project Tiger (Initiation, Finance, Objective, Management, Status, Threats), Gir Lion Sanctuary Project (Threats, Management, Work plan and achievements), Crocodile Breeding Project (Causes of depletion, Work Plan, achievement), Project Elephant, Conservation of Sea Turtle in India.

MODULE V: Conservation of wildlife: in-situ and ex-situ conservation: Wildlife Sanctuaries, National Parks, Tiger Reserves and Biosphere reserves: Definition, formation, management and administration; Wildlife Projects: Tiger, Elephant, Lion and Hangul; Zoos and Zoological Parks: Definition- Aims of Zoos- Formation and Management of Zoos and Zoological Parks - Central Zoo Authority of India; Captive breeding: Aims, Principles, methods; Role of Government and Non-Governmental organizations in conservation; Wildlife Crimes: Wildlife forensics and its applications in detecting wildlife crimes;

MODULE VI: Wildlife Toxicology: Types of contaminants, methods of toxicity evaluation, bioconcentration- bioaccumulation and biomagnifications; impacts of pesticides and heavy metals on birds and mammals; CAMP and PHVA – Analyses and Reports; Environmental Impact Assessment (EIA) methods and their role in wildlife conservation.

LEARNING RESOURCES:

REFERENCES

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA

Second Semester M.Sc. (CSS) Degree Examination

Branch: Botany (Specialization in Biodiversity Conservation)

BBC-DE-527 WILDLIFE ECOLOGY AND MANAGEMENT (Elective)

Time: 3 Hours

Maximum Marks: 60

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

1. What is the aim of NBA.
2. What is the aim of a reintroduction project according to 'The IUCN guidelines for reintroduction'?
3. Mention the major components of wildlife conservation and management
4. What is the difference between reintroduction biology and translocation with reference to a wild mammal or bird?
5. Differentiate bioaccumulation and biomagnification.
6. Give the harmful effect of any one heavy metal on birds.
7. What are wildlife corridors?
8. How do you define instinctive behaviour?
9. Expand CITES
10. Identify any two examples of paternal care in mammals. (10x1=10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Define wildlife management and give two examples of the implementation of wildlife management.
12. What are the key management questions that should be addressed before deciding on the feasibility of a wildlife management objective?
13. List out the main objectives of Wildlife (Protection) Act, 1972.
14. Examine the applications of wildlife forensics in detecting wildlife crimes.
15. Will there be any impact on wildlife if you remove invasive alien species. Give reasons to support your answer.
16. What are the complexities that must be understood to effectively understand carrying capacity from a conservation perspective?
17. Highlight the role of Environmental Impact Assessment (EIA) in wildlife conservation

(5X3=15 marks)

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

18. Discuss the advantages and disadvantages of captive breeding.
19. Briefly explain any two wildlife projects and their effectiveness in conservation of the concerned species.
20. Discuss whether translocating rogue tuskers is an effective strategy to ease human-elephant conflict.
21. Throw light on the different field equipments use in wildlife documentation.
22. Analyse the role of wildlife photography in conservation efforts.
23. Why India is a mega wildlife diversity country? Explain in detail.
24. Elaborate on the different in-situ strategies for the conservation of wildlife.

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Explain how human-wildlife conflict can arise? Briefly outline solutions to any five human-wildlife conflicts.
26. Discuss in detail, the role of government and nongovernmental organizations in the conservation of wildlife. (1X10= 10 marks)

SEMESTER III	Course Code: BBC- CC- 531	Credits: 3
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NAME OF THE COURSE: ANGIOSPERM TAXONOMY, ECONOMIC BOTANY AND ETHNOBOTANY

COURSE OUTCOMES (CO)

CO1: Gain knowledge about systems of plant classification, nomenclature, and Botanical gardens

CO2: Analyse the relationships of plants between families, genus and species level.

CO3: To acquire the skill for plant identification and herbarium techniques

CO4: Recognize economically important crop plants.

CO5: Identify the ethnic societies of Kerala and the applications of ethnobotanical research.

COURSE CONTENT

MODULE I: Taxonomy of angiosperms- Scope and importance of taxonomy. Taxonomic structure- Taxonomic hierarchy, Taxonomic categories – supra specific and infra specific categories; Concept of species, genus and family. Systems of classification: Brief study of Artificial (Linnaeus), Natural (Bentham and Hooker) and Phylogenetic (Bessey and Takhtajan) systems. History and development of taxonomy in India. Contributions of pioneers of Indian taxonomy - William Roxburgh, J. D. Hooker and J. S. Gamble. Taxonomical literature: General indices, floras, revisions, manuals, icons, monographs, reviews and Journals. Study of basic principles and recent Angiosperm Phylogeny Group (APG) system of classification.

Module II: Plant nomenclature: Brief history on the origin and development of nomenclature; Contents and major provisions of latest International Code of Nomenclature for algae, fungi, and plants (ICN) - Author citation, Typification and different kinds of types, Effective and valid publication of names, Principle of priority and its limitations, Conservation of names, Names of hybrids. Definition of nomenclature terms- autonym, homonym, basionym, tautonym and nomen nudum. A very brief account on International Code of Nomenclature of Cultivated Plants (ICNCP)

Module III: Herbarium & Botanical Garden- Definition, techniques involved in the preparation of herbarium, utility of herbarium and their maintenance. General account of national and regional herbaria - Central National Herbaria, Calcutta (CAL) Madras Herbarium (MH), Botanical Survey of India (BSI). Construction of taxonomic keys (indented and bracketed) and its utilization. Botanical garden and its importance in taxonomic studies. Important National and International Botanical gardens - Royal Botanical Garden, Kew; Indian Botanical Garden, Calcutta; National Botanical Garden, Lucknow and Tropical Botanical Garden, Trivandrum. Role, organization and achievements of Botanical Survey of India.

Module IV: Biosystematics – Turesson's concept and categories. Trends in plant taxonomy – i. Cytotaxonomy ii. Chemotaxonomy iii. Numerical taxonomy iv. Molecular taxonomy v. Phylogenetic systematics - basic principles. Current ideas on the origin of angiosperms -

Bennettlean, Pteridospermean and Caytonialean ancestry. General evolutionary trends in flowering plants: With reference to habit and habitat, leaf structure, nodal anatomy, xylem and phloem, inflorescence, flower, androecium, pollen grains, gynoecium, placentation, ovules, seeds, seedlings and fruits.

Study of the following angiosperm families giving importance to morphological peculiarities, if any. Special emphasis should be given on morphological and phylogenetic interrelationships, recent revisions and rearrangements between and within the families and its critical analysis.

Ranunculaceae	Magnoliaceae	Capparidaceae	Polygalaceae
Caryophyllaceae	Portulacaceae	Dipterocarpaceae	Malvaceae
Rhamnaceae	Vitaceae	Sapindaceae	Leguminosae
Combretaceae	Rhizophoraceae	Myrtaceae	Melastomataceae
Passifloraceae	Cucurbitaceae	Apiaceae	Rubiaceae
Asteraceae	Sapotaceae	Oleaceae	Asclepiadaceae
Boraginaceae	Solanaceae	Scrophulariaceae	Acanthaceae
Verbenaceae	Lamiaceae	Amaranthaceae	Aristolochiaceae
Piperaceae	Lauraceae	Loranthaceae	Euphorbiaceae
Orchidaceae	Scitamineae	Amaryllidaceae	Liliaceae
Arecaceae	Araceae	Poaceae	

MODULE V: Detailed study of the occurrence, morphology of the useful part and uses of the following crop plants with their botanical details. a) Cereals and Millets: Rice, Maize, Wheat; Bajra, Sorghum, Ragi b) Pulses: Soybean, Horse gram, Red gram, Black gram and Bengal gram. c) Sugar yielding plants: Sugarcane. d) Plantation crops: Coconut, Cocoa, Coffee, Tea and Rubber. e) Spices and condiments: Pepper, Ginger, Turmeric, Cardamom and Nutmeg. e) Tuber crops:- Potato, Sweet potato, Taro and Tapioca. f) Fruits: Mango, Banana, Citrus, Guava, Cashew nut and Jack fruit. g) Vegetables: Brinjal, Cucumber, little gourd, Bitter gourd, snake gourd, Winged bean and Sword bean, Amaranthus, Spinach, Cabbage, Cauliflower, Lady's finger h) Narcotics: Cannabis, Opium i) Gums and Resins and Latex: Gum Arabic, Asafoetida, Amber, Turpentine j) Timber yielding plants: Rose wood, Teak Wood. k) Medicinal plants: Sarpagandha, *Vinca*, *Glycirriza*, *Adhatoda* and *Andrographis*.

MODULE VI: Ethnobotany- Plants and civilization. Ethnobotany- relevance in Modern medicine. Ethnic societies of Kerala and their traditional herbs. Methodology and documentation of ethnobotanical research. Medicines derived from herbal drugs. Status of ethnobotanical studies in Kerala. Contributions of S. K. Jain and E. K. Janaki Ammal. Relevance of IPR in Ethnobotany.

LEARNING RESOURCES:

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-531 ANGIOSPERM TAXONOMY, ECONOMIC BOTANY
AND ETHNOBOTANY

Time: 3 Hours

Maximum Marks: 60

I. Answer all questions in one word or sentence

1. Which is the binomial of Nutmeg
2. Explain the Latin term *Nomina conservanda*?
3. State the native place of Ooralikuruma tribes in Kerala?
4. Interpret Linnaean hierarchy.
5. Expand KIRTADS.
6. In which family teak is included as per APGII classification?
7. Write Botanical name and ethno medicinally useful part of Arogyappacha.
8. Define the morphology of coconut milk?
9. What is the characteristic inflorescence type in Lamiaceae?
10. Define condiments

(10x1=10 marks)

II. Answer any five questions. Each answer not exceeding 150 words.

11. Mention the use of dendrograms in evolutionary taxonomy.
12. Differentiate Ethnotaxonomy and ethnoecology?
13. Interpret double citation in taxonomy with suitable example
14. List the binomial of two ethnomedicinal herbs and the drugs obtained from them
15. Name an eminent Indian ethnobotanist. Mention his/her important contribution.
16. Describe the special type of pollination mechanism and adaptation seen in grasses.
17. Point out the significance of IPR in ethnobotany.

(5X3=15 marks)

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

18. Discuss the role of BSI in the floristic and conservation studies in India.
19. Write a short essay on molecular evolution.
20. Critically evaluate the present status and need of ethnobotanical documentation in India
21. Describe the advanced features seen in family Poaceae and Orchidaceae with appropriate examples.
22. Mention the primitive features of the families Ranunculaceae and Magnoliaceae. Substantiate with suitable examples.
23. Prepare a model questionnaire for analyzing ethnomedicinal uses of herbs used by tribal people in Kerala.
24. Explain the different techniques involved in herbarium preparation.

(5X5=25 marks)

IV. Answer any one of the following, not exceeding 500 words

25. Discuss the modern concepts and trends in Plant Taxonomy.
26. Explain in detail about the ethnic societies of Kerala and medicines derived from their traditional herbs. Add notes on their uses.

(1X10= 10 marks)

SEMESTER III	Course Code: BBC- CC- 532	Credits: 3
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NAME OF THE COURSE: GENETICS, PLANT BREEDING AND EVOLUTION

Course Outcomes (CO)

CO1: Students get a deep knowledge base on genetics and evolution.

CO2: Gain knowledge on population and developmental genetics.

CO3 : Get the skill in plant breeding techniques

CO4: Evaluate the types, genetics, biochemical and molecular basis of incompatibility and sterility between genotypes and devise methods to overcome them

COURSE CONTENT

MODULE I: 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. 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, Holandric genes, Penetrance and expressivity, Pleiotropy. Mechanisms of sex determination- genetic, hormonal, environmental and chromosomal mechanisms. Dosage compensation, Barr body, Lyon's hypothesis. Linkage, recombination and linkage maps – Bateson's concept of coupling and repulsion. Morgan's concept of linkage, linear arrangement of genes, linkage groups, complete and partial linkage, recombination linkage maps, three point test crosses, interference, coefficient of coincidence and negative interference. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

MODULE II: Microbial Genetics– Genetic recombination in viruses, bacteria, fungi, Biochemical Genetics –Inborn errors of metabolism- Major types of metabolic errors in man, Gene concept – Allele, Multiple alleles, pseudoallele, polygenes. Gene-Enzyme relationship, One gene - One enzyme hypothesis. Benzer's concepts of cistron, muton and recon, types of genes- smart genes (luxury genes), housekeeping genes, Barbara Mc Clintock's transposons, overlapping genes, split genes, homeotic genes, pseudogenes, orphan genes, selfish genes, gene cluster, gene families.

MODULE III: Population Genetics and Developmental Genetics- Systems of mating and their genetic effects. Hardy Weinberg law and its applications. Factors affecting gene frequencies – mutation, migration, selection, genetic drift, genetic polymorphism and selection, founder effect, genetic load. Consanguinity and its genetic effect. Human genetics: Pedigree analysis, Karyotypes, genetic disorders. Developmental genetics- Genetic control of development in plants and animals with stress to developmental genes in *Arabidopsis* and *Drosophila*. Role of cytoplasm in development.

MODULE IV: Plant Breeding: Introduction- Objectives of plant breeding- history, some important achievements, undesirable consequences. Importance of floral biology in plant

breeding. Methods of crop improvement i. Plant Introduction: Definition, types and procedure. Sources of germplasm. Centres of genetic diversity. Concepts of de Candolle and Vavilov. Primary, secondary and microcenters. Genetic erosion. Preservation and utilization of germplasm. Gene banks. NBPGR. International exchange of germplasm. Selection: Principles, genetic basis and methods: Mass selection, pure line selection, clonal selection. Hybridization: Objectives. Procedure. Major achievements. Problems and causes of failure of hybridization. Handling of hybrids - Bulk method and pedigree method of selection. Distant hybridization - Role of interspecific and intergeneric hybridization in crop improvement.

MODULE V: Genetics of incompatibility and sterility. Role in crop improvement. Types of male sterility: Gametic and zygotic sterility. Somatoplastic sterility. Cytoplasmic and genetic sterility. Methods to overcome incompatibility. Backcross breeding: Theory and procedure. Inbreeding: inbreeding consequences. Heterosis- Definition. Genetic and physiologic basis. Application in plant breeding. Steps in the production of single cross, double cross, three way cross, synthetic cross, multilines. Ideotype breeding: Concept, Achievements: (Wheat – Asana, Donald. Rice – Super Rice). Polyploidy breeding: induction of autopolyploidy and allopolyploidy. Role of chromosome manipulation. Chromosome addition and substitution lines. Achievements. Mutation breeding: Principles, objectives, procedure. Induction of mutations: Physical and chemical mutagens - Recurrent irradiation, Split dose irradiation, Combination treatment. Achievements. Breeding for special purposes- breeding for pest, disease and stress resistance. Seed production and certification. Centres of crop breeding: International and National (with special reference to Kerala) Plant breeder's rights Act. National Biodiversity Policy.

MODULE VI: Evolution- Origin and evolution of life. Concepts and theories of evolution. Classical and synthetic theories of evolution, Forces and mechanism of evolution, Speciation. Isolation mechanism, Evolution above species level, Molecular evolution.

LEARNING RESOURCES:

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Online Resources

Resource	Link	Description
Youtube	https://youtu.be/GpDbKfTLLzs	Activities in plant breeding.
	https://youtu.be/iyClj1zaQQg	Self Incompatibility in plants

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-532 GENETICS, PLANT BREEDING AND EVOLUTION

Time: 3 Hours

Maximum Marks: 60

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

1. Our genes often bear evidence of recent human evolution. The Y chromosome has been used by evolutionary biologist to trace male lineage. Why is the X chromosome not useful for tracing female lineage?
2. Can you explain the hypothesis proposed by Mary Lyon regarding X chromosome inactivation in females?
3. Give an example for selfish gene.
4. What is the term used for the development of an organism from an unfertilized egg?
5. What is introgression?
6. Explain why isolated island chains provide opportunities for adaptive radiations.
7. Define gene bank?
8. Expand NBPGR.
9. Why would natural selection tend to reduce genetic variation more in populations of haploid organisms than in populations of diploid organisms.
10. How might gene flow between populations living in different habitats actually interfere with each population's adaptation to its local environment?

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Explain why allopatric speciation would be less likely on an island close to mainland than on a more isolated land?
12. Why do more men than women have colour blindness?
13. Distinguish between single cross and double cross.
14. Briefly explain the features of gametophytic incompatibility
15. Write a brief account on any three centres of crop breeding.
16. Differentiate mass selection and pureline selection.
17. Define the five processes that can cause evolutionary change.

(5X3= 15 marks)

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

18. Give an account on prenatal diagnosis of genetic disorders
19. State Hardy Weinberg law and discuss its applications.
20. Explain the experiment which led to the discovery of transposons in Maize. What were the other types of transposons detected in Maize subsequently?
21. Homozygous rice plants can produce heterozygous progenies. Substantiate your answer.
22. Briefly explain about different types of genetic male sterility.
23. Give an account on the various centers of origin of plants.
24. Discuss how evolutionary processes can work simultaneously, but in opposing ways.

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Describe the method for the production of interspecific hybrids.
26. Explain why the presence of DNA in organelles leads to non-Mendelian Inheritance.
Describe the inheritance pattern of organelle DNA.

(1X10= 10 marks)

SEMESTER III	Course Code: BBC- CC- 533	Credits: 3
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**NAME OF THE COURSE: HISTOLOGY AND PLANT REPRODUCTIVE
BIOLOGY**

Course Outcomes (CO)

CO1: Understand the anatomical features of plant parts

CO2: Identify the anomalous growth in growth

CO3: Correlate the anatomical features to taxonomy

CO4: acquire knowledge on plant reproduction and development

COURSE CONTENT

MODULE I: Origin, structure and function of cambia and their derivatives. Seasonal variation in cambial activity, role of cambium in wound healing and grafting Anomalous cambial activities in *Bignonia*, *Amaranthus*, *Mirabilis*, *Bougainvillea*, *Piper*, *Aristolochia*.

MODULE II: Structure of wood TS, TLS and RLS - Soft wood, Hard wood, Sap wood, Heart wood. Role of extractives in wood quality. Wood anatomy of the following wood yielding plants of Kerala: *Artocarpus integrifolia*, *Tectona grandis*, *Dalbergia latifolia*, *Ailanthus malabarica*, *Alstonia scholaris*. Nodal anatomy, root –stem transition, transfer cells. Floral anatomy. Organization of shoot and root apex, shoot and root development, leaf development and phyllotaxy. Anatomy in relation to taxonomy

MODULE III: Asexual reproduction: Vegetative apomixis. Adventive embryony. Non recurrent apomixis, diplospory, apospory, parthenogenesis, androgenesis, automixis, semigamy, agamic complex.

MODULE IV: Sexual reproduction: Microsporogenesis - male gametophyte - Role of tapetum, Pollen development, Male sterility, Sperm dimorphism, Pollen tube growth and guidance pollen fertility and sterility. Pollen storage. Pollen viability and germination. Megasporogenesis-embryosacs-development and types. Structure and organization of the embryo sac . Nutrition of the embryo sac.

MODULE V: Pollination biology - primary and secondary attractants of pollination - ultra structural and histochemical details of style and stigma - significance of pollen-pistil interactions. Sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects).

MODULE VI: Fertilization-barriers to fertilization- intra ovarian pollination and in vitro fertilization - embryo rescue. Embryo, endosperm and seed development. Polyembryony, Parthenocarpy. Androgenesis and gynogenesis. Application of Palynology in taxonomy Economic importance of pollen, Pollen allergy - Pollen analysis of honey - role of apiaries in crop improvement. Seed Dormancy i) Importance and types of Dormancy ii) Overcoming seed dormancy dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

LEARNING RESOURCES:

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA

Third Semester M.Sc. (CSS) Degree Examination

Branch: Botany (Specialization in Biodiversity Conservation)

BBC-CC-533 HISTOLOGY AND PLANT REPRODUCTIVE BIOLOGY

Time: 3 Hours

Maximum Marks: 60

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

1. What is acetolysis, why is it necessary for studying pollen grains?
2. Name the types of cambia found in primary stem of plants.
3. Which part of the ovule forms the seed coat ?
4. are the outgrowths from xylem parenchyma cells that grow into the lumen of tracheary cells through pits, balloon out, and occlude the cell interior.
5. Some large tree can survive after a tunnel has been cut out through their centre. Why?
6. How does the nutritive tissue of a gymnosperm seed differ from that of an angiosperm seed?
7. Can you name the developmental process by which seedless fruits of Pineapple, grapes develop?
8. The microscopic pollen grains of the past are obtained as fossils. Mention the characteristics of pollen grains that make it happen.
9. Mention the significance of embryo rescue technique.
10. Define Phyllotaxy.

(10x1=10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Differentiate between 'spring wood' and 'autumn wood'
12. Analyse the role of extractives in wood quality.
13. What is Pollenkitt? Explain its function.
14. Why cambium is essential for grafting in plants?
15. Enlist the symptoms of pollen allergy.
16. Explain the molecular basis of male sterility
17. What are the major causes of seed dormancy?

(5X3=15 marks)

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

18. Write notes on theories related to shoot apex organisation in plants.
19. Describe the anomalous secondary growth in *Bignonia* with diagram.
20. Discuss cases where palynological data has been helpful in solving angiosperm taxonomical problems.
21. Elaborate on different barriers of fertilization in plants.
22. Give a brief account on floral anatomy.
23. What is the role of apiary in crop production?
24. Explain how genetic control can block self-pollination?

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Explain the peculiarities in wood anatomy of any two popular hardwood timber trees of Kerala.
26. With suitable diagrams explain the various types of Embryo sac organisation encountered in plants.

(1X10= 10 marks)

SEMESTER III	Course Code: BBC- CC- 534	Credits: 3
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NAME OF THE COURSE: GENETIC ENGINEERING AND PLANT BIOTECHNOLOGY

Course Outcomes (CO)

CO1: Get the knowledge on the tools and techniques for molecularanalysis

CO2: Familiarize the techniques in genetic engineering, gene sequencing and gene expression studies.

CO3: Acquainted with the methods and applications of plant biotechnology.

CO4: Evaluate the ethical, legal and biosafety issues in geneticengineering

COURSE CONTENT

MODULE I: Genetic engineering: Methods and applications. Applications of gene cloning techniques in plants. Gene targeting and sequence tags. 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.

MODULE II: Recombinant DNA Technology: DNA cloning. Cutting and joining DNA Molecules, Restriction endonucleases, Cloning vectors-features. Restriction digestion and ligation; Restriction mapping. Plasmids, Cosmids, Bacteriophage vectors, Phagemids, Yeast artificial chromosome(YAC), Bacterial artificial chromosome (BAC) and P1 phage vectors. Selection and analysis of cloned DNA sequences. Generation of genomic and cDNA libraries.

MODULE III: Techniques in Molecular Biology- Polymerase chain reaction (PCR) Procedure and Components Types of PCR i) inverse PCR. ii) Rapid amplification of cDNA ends (RACE) iii) Real- time quantitative PCR. PCR applications. Molecular markers - RFLP, RAPD and AFLP techniques. Blotting techniques: Southern, Western, Northern and Dot Blot. Chromosome walking and Jumping, Gene Sequencing and Gene Expression - Sequencing genes and short stretches of DNA including Sanger dideoxy sequencing and Next Generation Sequencing Protein sequencing methods, Footprinting Assay, Protein engineering and proteome analysis- Objectives of protein engineering, Techniques of protein engineering, chemical modifications, applications of protein engineering. *In vitro* mutagenesis and detection techniques, gene knock out in bacterial and eukaryotic organisms.

Module IV: Scope and impact of biotechnology - an overview. Plant tissue culture techniques: Culture media and culture conditions, hormonal regulation of growth and differentiation, micropropagation; shoot tip, nodal segment, meristem cultures: callus culture,

callus mediated organogenesis, cell suspension culture. Somatic embryogenesis. Artificial seeds. Applications. Protoplast culture, Somatic hybridization and its impact on plant breeding. Use of protoplasts in genetic transformations. Somaclonal and Gametoclonal variations. Genetic basis. Haploid production: anther and ovule culture. Applications. Production of secondary metabolites. Cell immobilization. Bioreactor technology. Cryopreservation

MODULE V: Methods of gene transfer in plants. Agrobacterium and CMV mediated gene transfer; direct gene transfer using PEG, microinjection, electroporation, microprojectile (biolistics) method, liposome mediated DNA delivery, Transposons as vectors. New Trends in Gene modification: CRISPR/CAS System.

MODULE VI: Application of Plant Biotechnology: - Transgenic plants -Traits for improved crop production. Field testing of transgenic plants. Herbicide Resistance, Vaccines for Plants, Genetic Pesticides, Pathogen resistance Molecular farming of antibodies in plants and Enhanced Nutrition. Plants as bioreactors; phytopolymers and biodegradable plastics. Technique and Controversy of Terminator Gene Technology Genetically modified organisms and foods (GMO/GMF) - Social and ethical considerations. IPR issues. Patents. Biopiracy. Application of nanotechnology in plant sciences. Metabolic engineering for plant secondary metabolites

LEARNING RESOURCES:

REFERENCES

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Online Resources

Resource	Link	Description
Genetic Literacy Project	https://geneticliteracyproject.org/	Resources on genetic engineering, biotechnology, and related topics.
e-PG Pathshala National Mission on Education through ICT(NME-ICT)	https://epgp.inflibnet.ac.in/Home https://youtu.be/jY-hCW1g8cc	<i>Agrobacterium tumefaciens</i> and <i>Agrobacterium rhizogenes</i> in genetic engineering
	https://epgp.inflibnet.ac.in/Home https://youtu.be/3655sKQEggs	Choice of promoters for targeted expression of transgene, synthetic promoters
	https://epgp.inflibnet.ac.in/Home https://youtu.be/Em1-mctJsfs	Co-integrate and binary vectors
	https://epgp.inflibnet.ac.in/Home https://youtu.be/q5K_WLhhwLg	Direct gene transfer strategies
	https://epgp.inflibnet.ac.in/Home https://youtu.be/JJXCRVKYC7A	Host genes in entry and integration of T-DNA
	https://epgp.inflibnet.ac.in/Home https://youtu.be/ILH9bkE4QhE	Selectable and Screenable Markers

	https://epgp.inflibnet.ac.in/Home https://youtu.be/Oq8jZkLVGDQ	Strategies for the development of marker-free transgenics
	https://epgp.inflibnet.ac.in/Home https://youtu.be/x7mXe6cQNN4	Techniques used for analysis of transgenics
	https://epgp.inflibnet.ac.in/Home https://youtu.be/0NnaZceEuBw	Tools for genetic engineering – REs, ligases, kinases. phosphatases, topoisomerases
	https://epgp.inflibnet.ac.in/Home https://youtu.be/PW798deDIZM	Use of RNAi as tool for crop improvement

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-534 GENETIC ENGINEERING AND PLANT BIOTECHNOLOGY

Time: 3 hours

Maximum marks: 60

I. Answer all questions in one word or sentence

1. *Agrobacterium* is known as natural genetic Engineer. Can you name two of its species
2. How will you calculate minimum number of clones required to construct genomic library of an organism?
3. Mention desirable properties of a gelling agent used in tissue culture.
4. How will you produce fertile homozygous diploids from sexually sterile haploid plants obtained through pollen culture.
5. How are plasmids different from cosmids?
6. Name any two artificial chromosomes
7. Internodal elongation of *in vitro* plants can be achieved by supplementing to the culture medium.
8. Expand HEPA filter.
9. In what scenarios would micro-injection be an effective technique, and why?
10. Give the expansion of the term AFLP

(10X1= 10 marks)

II. Answer any five questions. Each answer not exceeding 150 words

11. *Bacillus thuringiensis* is a bacterium that is pathogenic for many insect pests. What is its role in Genetic Engineering ?
12. Differentiate close continuous culture and open continuous culture.
13. Explain the CTAB method for the isolation of plant genomic DNA
14. How can PCR be used in forensic investigations to analyze DNA evidence and establish genetic profiles for identification purposes?
15. Enlist the basic requirements of gene cloning and expression vectors. Illustrate the characteristic features of any one vector of your choice.
16. Mention the different stages of micropropagation.
17. Write a short account on any two types of bioreactors.

(5X3= 15 marks)

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

18. There is vector mediated and vector-less gene transfer methods. Discuss the vector-less gene transfer methods in plants.
19. Somatic hybridization is a technique that has been used to tap the potential of related or distant species/genera of crops for creating novel combinations of nuclear and/or cytoplasmic genomes. Schematically represent the steps involved in the technique.
20. Enlist the objectives of protein engineering
21. Citing suitable examples, explain the role of elicitors in *in vitro* secondary metabolite production.
22. Explain the steps involved in the construction of a genomic DNA library. How does it differ from a cDNA library?

23. Discuss the importance of understanding restriction enzyme properties, such as cleavage sites and enzyme specificity, in designing effective molecular cloning experiments and genetic engineering projects.

24. What are the different application of nanotechnology in plant sciences?

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. There is a never ending controversy on Terminator genes. Briefly explain it.

26. Mention the technique employed for the long term preservation of plant germplasm in which the cells can be stored for unlimited period without a subculture. Enumerate the steps involved in the technique.

(10X1= 10 marks)

SEMESTER III	Course Code: BBC- CC- 535	Credits: 4
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NAME OF THE COURSE :PRACTICAL III

COURSE CONTENT

MODULE I

- Study of representative members of all the prescribed families as evidenced by record of practical work (to be submitted during the practical examination).
- Identification of fresh specimens using flora and other supportive documents like monographs.
- Preparation of dichotomous key (minimum 5 keys).
- A minimum of 10 abbreviations of authors' names to be presented in the record.
- Expansion of 10 floral formulas.
- Exercises in nomenclatural citations and solving nomenclatural problems (At least 10).
- A minimum of 50 herbarium specimens giving representation of minimum of 40 families to be submitted for valuation
- Identification of economically important plants and plant parts, and submission of five botanical specimens/ products of economic importance

MODULE II

- Visit to a recognized herbaria (The report of the same should be submitted separately).
- Field work for familiarizing the local flora under the supervision of teachers, and documentation of the proceedings.
- Study tour of minimum three days should be conducted to biodiversity rich zones of Western Ghats, for familiarizing the floristic wealth (The report of the same should be submitted for evaluation).

MODULE III

- Work out problems in linkage, chromosome mapping, microbial genetics, molecular genetics and population genetics.
- Emasculation; preparation of the inflorescence for crossing.
- Estimation of pollen sterility and fertility percentage.
- Pollen germination: in vitro and in vivo viability tests
- Study of pollen types using acetolysed and non-acetolysed pollens
- Developmental stages of anther, ovule, embryo and endosperm.

MODULE IV

- Anomalous structures of the types mentioned in the syllabus.
- Leaf anatomy: epidermal peels, stomatal study, T.S. of lamina.
- Nodal anatomy and root-stem transition.
- Maceration of herbaceous and woody stems- separation of different cell types.

MODULE V

- Isolation and purification of genomic DNA.
- Demonstration of electrophoresis – Horizontal and Vertical
- Isolation of total RNA (Demonstration only).
- Isolation and Partial Purification of Proteins.
- Isolation and estimation of genomic DNA, Primer design, PCR, cDNA synthesis
- Demonstration of Agarose gel electrophoresis.

MODULE VI

- Preparation of culture medium (MS), sterilization and inoculation.
- Shoot multiplication, Callus culture and organogenesis of Important crops/medicinal plants/ornamentals.
- Green pod (embryo culture) culture of orchid
- Encapsulation of seeds/embryos in calcium alginate

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

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

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

MODULE III: 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.

MODULE IV: 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, Protein Identity based on composition, Physical properties Based on Sequences, Secondary structure analysis – PSIPRED, SOPMA, GORIV, Protein Structure Prediction: Homology modeling and Ab initio, Protein structure validation.

MODULE V: 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.

MODULE VI: Scope and applications of in silico modeling in modern biology. Pharmacogenomics and drug designing, admit properties and toxicity, and drug designing tools- Auto doc Vina, Pirex, Schrodinger.

LEARNING RESOURCES:

REFERENCES

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-DE-536 Bioinformatics (Elective)

Time: 3 Hours

Maximum Marks: 60

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

1. Expand the term 'PHYMLIP'.
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* questions. 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?
24. Explain the helix-turn-helix motif with suitable diagrams.

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Highlight the importance of sequence analysis in biological research. Add a note on molecular phylogeny. Describe the operation of CLUSTAL in phylogenetic analysis
26. 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: BBC- DE- 537	Credits: 2
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NAME OF THE COURSE: REMOTE SENSING APPLICATIONS AND GIS

Course Outcomes:

CO1: Gain knowledge in various remote sensing signals, processes and sensors.

CO2: Analyse spectral characteristics and data

CO3: Discuss digital data processing and GIS

CO4: The students get introduced with various GIS software, analysis and get an insight on application of GIS in various fields for the welfare of human.

COURSE CONTENT

MODULE I: Fundamentals of Remote Sensing- Definition, Electromagnetic spectrum, Interaction with atmosphere-Reflection and scattering of EM radiation, Sensing- Visible, near infrared, thermal & microwave sensors- Multispectral scanner, Thematic mapper, Spectral bands, High resolution Visible Imaging System, Linear imaging self-scanning system.

MODULE II: Space Platform for remote sensing- Ground based platforms, airborne platforms, Space borne platforms, geostationary satellites, and Sun synchronous satellites, Instantaneous Field of View, Spatial, Spectral, and Radiometric& Temporal Resolution. Satellites-Polar & geostationary, Sensors & Resolution, Indian Satellites, Spectral characteristics, Present satellites- atmospheric and terrestrial studies- data acquisition from satellites, preprocess.

MODULE III: Remote sensors- Classification of Sensors- on the basis of source of energy used, on the basis of function of sensors, on the basis of technical components of the system. Function of remote sensing.

MODULE IV: Image Processing- Fundamentals of Digital Image Processing, Processing Techniques- Structure of a digital image, Image display processor. Data preprocessing-digital techniques, restoration, enhancement, band rationing, stretching, convolution and rotation, contrast enhancement, thresholding-different output formats, Image enhancement techniques. Pattern recognition for remote sensing, Spatial information system.

MODULE V: Geographical information system- Development of GIS, Components of geographical information system, GIS software modules, Geographical data, Representation of topographical data, Comparison between vector & raster methods, Function of GIS.

MODULE VI: Remote Sensing Application to Forestry & Environment- Introduction, Loss of biological diversity, Biosphere reserves, The present issues on environment, Ecologically Hot Spot Areas, Marine environment, Wetland environment, Degradation of Ecosystems, Forestry-Forest cover mapping & Surveillance, Forest Type Mapping, Identification and Mapping of Major Forest Plantations, Forest Stock Mapping, Monitoring of Deforestation and Afforestation, Grassland Mapping. Coastal vegetation, Wildlife habitat Assessment, Wastelands, Desertification. Use of space technology in Disaster Warning/Mitigation, Geosphere-Biosphere studies.

LEARNING RESOURCES:

REFERENCES

- Avery, T. E. and Berlin, G.L. (2001). Fundamentals of Remote Sensing and Air photo Interpretation, 6th Ed., MacMillan Publ. Co., pp 472.
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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Third Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-DE-537 Remote Sensing Applications and GIS (Elective)

Time: 3 Hours

Maximum Marks: 60

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

1. Define remote sensing
2. Which region of the EMR spectrum is absorbed by the chlorophyll in green vegetation?
3. What is signature?
4. Which is the major wavelength range used for remote sensing?
5. What is radiance?
6. Name one Indian satellite.
7. What is GIS?
8. What is a platform?
9. Name a biosphere reserve in India.
10. Expand SPOT

(10x1=10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. Write a short note on multi spectral remote sensing.
12. Explain briefly on non-imaging sensors.
13. What are different types of remote sensing based on function of sensors?
14. Differentiate between thermal infrared remote sensing (3 -100 μm) and visible and near infrared (0.4 – 2.5 μm) based remote sensing.
15. Give an account on ecological hotspot.
16. What is geometric restoration?
17. Distinguish between microwaves and UV waves.

(5X3=15 marks)

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

18. What are the platforms used for remote sensing? Explain.
19. Briefly explain geostationary orbit.
20. Comment on the present issues on environment.
21. How is passive remote sensing different from active remote sensing? Give example.
22. Describe the purpose of principle components analysis.
23. What are the different image enhancement techniques? Explain.
24. Discuss about the various causes of loss of biodiversity.

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Explain how is remote sensing applicable in forestry?
26. Write a note on image transformation in digital image processing.

(1X10= 10 marks)

SEMESTER IV	Course Code: BBC-CC 541	Credits: 3
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**NAME OF THE COURSE : ENVIRONMENTAL BIOLOGY, FOREST BOTANY
AND PHYTOGEOGRAPHY**

Course Outcomes (CO)

CO1: Identify the interactions between environment and biota

CO2: Gain knowledge about population and community

CO3: Gain knowledge about the global climate change and its impact

CO4: Identify the different types of forest ecosystems and phytogeographical zones.

CO5: Analyse the relationships of soil, climate and vegetation in India.

CO6: Analyse the applications of remote sensing in ecosystem management.

COURSE CONTENT

MODULE I: The Environment: Physical environment; biotic environment. Levels of organization and habitat- interaction between environment and biota. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Application of Law of thermodynamics, food chain, food web, trophic levels, ecological pyramids and recycling - energy flow and transaction. Productivity and Biogeochemical cycles. Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; Types – Freshwater, marine and terrestrial. Components of ecosystem, Development and evolution of ecosystems. structure and function of some Indian ecosystems: Grass land, terrestrial, forest, and aquatic (fresh water, marine, estuarine).

MODULE II: Characteristics of a population- population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. Concept of carrying capacity, Population fluctuation and regulation. Nature of communities; community structure and attributes; levels of species diversity and its measurement; edge effect and ecotone. Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Ecological interactions - interspecific competition, herbivory, carnivory, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predatism, competition – intra-specific and inter- specific; Ecological and environmental significance of interactions.

MODULE III: Study of climate- their distribution and adaptation to the environment. Deserts (dry and cold) Tundra, Grassland, Savannah, Temperate forests, Tropical rain forests, Mangrove Ecological concepts of species: Autecological level (genecology), Synecological level. Ecads (Ecophenes), Ecotypes, Ecospecies. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.

MODULE IV: Applied ecology- Environmental pollution; global environmental change; biodiversity-status, management approaches, Current environmental issues in India, Environmental education and awareness. Green Protocol. Global environmental problem, ozone depletion, greenhouse effect, global warming, acid rain, nuclear hazards – Climate change, Eutrophication. Environmental Impact Assessment (EIA): Definition, purpose and

characteristics of EIA; participants in EIA process, stages of EIA and types of EIA. Disaster management: Disaster Management: Definition of disaster management; components of disaster management cycle- crisis management & risk management.

MODULE V: Forests- definition, General account on the forests of the world and India. Forest Types: Central characters and distribution of the different forest types of India with special emphasis to the Western Ghats. Forest products – Major and minor with reference to state of Kerala, sustainable use of bioresources. Influence of forest on environment. Climate change and Forestry: Impact of climate change on forests, adaptation of trees to climate change. Forest Effects- General effects of forests on climate, control of runoff, effects on snow, soil erosion, wild life, pollution control, nutrient cycling, social values and ecotourism, economic values, floods, green belts and control of temperature

MODULE IV: Phytogeography – Definition, Phytogeographic regions of the world (Vegetational belts). Principles governing the static and dynamic plant distribution, different types of distribution of vegetations on the earth, continuous and discontinuous distribution. Geological history and evolution of plant life- Factors of plant distribution. Theories concerning present and past distributions-continental drift, glaciations, existence of land bridges and their effect on plant distribution. Soil, climate and vegetation of India - climate, vegetation and botanical zones of India, role of precipitation and temperature in determining the major types of vegetation and endemism in India. Scope and relevance of GIS and Remote sensing in vegetation classification, understanding the key environmental issues and ecosystem management.

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Online Resources

Resource	Link	Description
National mission on education through ICT (NME- ICT)	https://youtu.be/RgaGSx6WEOE	Ecosystem concept
	https://youtu.be/s6D2Kwn-bEM	Global Environmental Change
	https://youtu.be/MUFxwB4Ziuo	Habitat and niche
	https://youtu.be/PzyEIxLKmG0	Metapopulation
	https://youtu.be/erCNyR06vCg	Project tiger
	https://youtu.be/GfgMmPUngH4	Species interaction
	https://youtu.be/IBKixBQFOaY	Species interaction
	https://youtu.be/zt7WfGVAnEg	Theory of island Biogeography
	https://youtu.be/VqApSGcd8Go	Succession
	https://youtu.be/E3ldVSri3P0	Tesrrestrial Biomes

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Fourth Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-541 ENVIRONMENTAL BIOLOGY, FOREST BOTANY AND
PHYTOGEOGRAPHY

Time: 3 Hours

Maximum Marks: 60

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

1. Name the forest type which is characterized by the shedding of leaves during a specific season.
2. What are green belts?
3. In which period of geological time scale vascular plants originated?
4. The first truly detailed and comprehensive theory of continental drift was proposed in 1912 by
5. Mention the population growth that leads to S-shaped growth curve.
6. Cite the significance of ecotone.
7. Syrphid flies, which are striped black and yellow resemble stinging bees and wasps but are themselves harm. Specify the type of defense.
8. 'Both abiotic and biotic factors help to shape the niche of an ecosystem'. Give your opinion on this statement.
9. Mention any two manmade sources of nuclear pollution.
10. Define metapopulation.

(10x1=10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. The endemic species have been grouped into several categories. Can you differentiate between palaeoendemics and pseudoendemics.
12. 'Ecotourism can provide local communities with motivation to maintain and protect forests and wildlife.' Do you agree with the statement? Substantiate giving reasons.
13. Define the concept of carrying capacity of an ecosystem as relevant to an environment. Explain how understanding this concept is vital while planning for sustainable development of a region.
14. The theory of island biogeography predicts species richness based upon the distance of the island from the mainland and the size of the island. Describe how these two factors interact with colonization and extinction rates to predict species richness.
15. Giving suitable examples, briefly explain mutualistic interactions between organisms.
16. crisis management & risk management
17. An energy pyramid graphically illustrates how energy is transferred from a lower to a higher trophic level. How is food pyramid related to thermodynamics?

(5X3=15 marks)

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

18. The most common hazard in forests is forest fire. Discuss the ecological, economic and social impacts of forest fire.
19. Phytogeography is concerned with all aspects of plant distribution. Discuss the principles governing the static and dynamic plant distribution.
20. Identify and write a short note on the major limiting factors in the growth of a population.

21. An ecological pyramid is the representation of energy flow in an ecosystem. Talk about the types of ecological pyramids.
22. Biogeochemical cycles keep essential elements available to plants and other organisms. Discuss the various steps involved in carbon cycle.
23. Analyse the importance of protecting Western Ghats.
24. What are the different stages of ecological succession?

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. The integration of mangroves into the national programmes for reducing emissions from deforestation and forest degradation is the need of the hour. Enumerate on how mangroves help in averting climate change risks
26. Indian phytogeographic classification is a division of the country based on a variety of climate types and distinctly recognizable flora. Explain the different Phytogeographic regions of India

(1X10= 10 marks)

SEMESTER IV	Course Code: BBC-CC 542	Credits: 3
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NAME OF THE COURSE: MICROBIOLOGY AND PLANT PATHOLOGY

CO1: Familiarize with classification, structure, metabolism, bacterial culture and microbial diseases.

CO2: Understand the role microbes in Agricultural, Environmental and industrial applications

CO3: Gain knowledge on various plant diseases caused by different types of pathogens

COURSE CONTENT

MODULE I: Microbes- Brief history of Microbiology. Experiments of Pasteur and Tyndall, Koch's postulates. Methods of sterilization. Major groups of microorganisms and their characteristics -prions, viroids, viruses, bacteria, archaeobacteria, mollicutes, actinomycetes, viable but nonculturable (VBNC) bacteria. Introduction to Blue Green Algae (Cyanobacteria), Classification of Cyanobacteria according to Desikachary (1959), economic importance.

MODULE II: Bacteria - Classification based on Bergey's Manual. Significance of 16 S rDNA in Bacterial identification. Morphology and ultrastructure of a typical bacterium. Growth and nutrition of microorganisms. Growth characteristics. Continuous culture devices - Chemostat. Extremophiles – Acidophilic, Alkalophilic, Thermophilic and halophilic bacteria. Stress response in bacteria. Microbial diseases. Human diseases: Bacteria (Rickettsia), Virus (AIDS). Animal diseases: Anthrax (Bacteria).

MODULE III: Applications of Microbial Fermentation and Agricultural microbiology: Industrial microorganisms and products, primary and secondary metabolites, production of alcohol, vinegar, antibiotics, vitamins, steroids, vaccines, organic acids, enzymes, fermentation technology - fermentor design and operation, upstream and downstream processes, Management of agricultural soils, biofertilizers and biopesticides. Applied Environmental Microbiology: Water Purification and Sanitary Analysis. Wastewater Treatment (primary secondary and tertiary), Bioremediation and Metal Bioleaching

Module IV: Plant pathology: History, General principles and concepts of host-parasite interaction. Defense mechanisms - Systemic Acquired Resistance and Induced Systemic Resistance are major signaling pathways of plant defense mechanisms. Epidemiology and quarantine. Mycotoxins. Plant disease forecasting. Principles and methods of plant disease control: Fungicides and pesticides, natural pesticides, sanitation, disease resistance. Biological control: biocontrol agents, bio- inoculants, natural enemies, bio-traps.

MODULE V: Major crop diseases of Kerala. Study of the following plant diseases with reference to symptoms, causal organism, disease cycle, and control measures. Cereals: Rice – blast disease, bacterial blight and Brown spot. Vegetables: Tomato - Bacterial wilt; Chilly - leaf spot; *Abelmoschus* - Yellow vein mosaic. Fruits: Banana – bunchy top; Mango – Anthracnose; Papaya – mosaic. Spices: Ginger – rhizome rot; Pepper – quick wilt; Cardamom - Mosaic disease. Oil seeds: Coconut – grey leaf spot, bud rot disease. Rubber-

yielding crops: *Hevea braziliensis*. Abnormal leaf fall and powdery mildew. Sugar yielding crops: Sugarcane – red rot. Cash crops: Arecanut – nut fall disease. Cashew nut: Gummosis. Beverage crops: Tea – blister blight and Red rust; Coffee – rust. Tuber crops: Tapioca - mosaic virus; Elephant Foot yam - Collar rot.

MODULE VI: Important pests, fungus and microorganisms associated with stored grains, their identification, distribution, host range, biology, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes. Insecticide resistance in stored product pests and its management; recent advances in storage pest management; integrated approaches to stored grain pest management.

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Fourth Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-542 MICROBIOLOGY AND PLANT PATHOLOGY

Time: 3 Hours

Maximum Marks: 60

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

1. Name the causative agent of grey leaf spot of coconut.
2. Give the composition of Bordeaux mixture.
3. Define rhizosphere.
4. Name one toxin responsible for plant disease.
5. Why do scientists use 16S rRNA to identify microbial species?
6. Plants cannot fix nitrogen, yet some plants do not need nitrogen from the soil. Why?
7. Identify the epidemiology of Anthrax.
8. Mention the features that distinguish archaea from both bacteria and eukaryotes.
9. Most biologists believe that viruses evolved following the origin of the first cells. Defend this concept.
10. Give an example for natural pesticide.

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. A definitive identification scheme for bacteria was first presented in 1984 in a book called Bergey's Manual of Systematic Bacteriology. On what basis bacteria are classified in this scheme? Explain.
12. Point out any two positive and negative impacts cyanobacteria have on environment.
13. In what three general ways can epidemics be controlled? Give one specific example of each type of control measure.
14. Differentiate between systemic acquired resistance and induced systemic resistance.
15. Write the diseases, causative organism and symptoms of any two beverage crops
16. How might microbial fuel cells involved in waste water management?
17. What are the important pests associated with stored food grains.

(5X3= 15 marks)

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

18. Give the causal organism, symptoms, disease cycle, and control measures of blast disease of Rice.
19. Describe in detail the biological control of plant diseases. Give some examples where it has been successfully used to control plant disease.
20. Enlist different methods of sterilization used to kill microbes.
21. Illustrate the structure of a typical fermenter. Examine the important factors to consider when designing a fermenter.
22. Give a detailed account on host parasite interaction.
23. How is bioleaching carried out and what microbes are involved?
24. Write a detailed account on the ultrastructure of a typical bacterium with a neat labelled diagram.

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Analyse the application of microbiology in genetic engineering and biotechnology.
26. Elaborate on integrated approaches in management of pests of stored grains.

(1X10= 10 marks)

SEMESTER IV	Course Code: BBC-CC 543	Credits: 3
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**NAME OF THE COURSE: COASTAL, MARINE AND WETLAND DIVERSITY
AND CONSERVATION**

Course Outcomes (CO)

CO1: Know about the coastal and marine ecosystem, and importance of conservation

CO2: Identify the threats of marine biodiversity and provide conservation and management strategies

CO3: Use legislation for the protection of biodiversity of wetlands

CO4: Develop skill for identification of coastal, marine and wetland organisms

COURSE CONTENT

MODULE I: Coastal Zone Diversity and Conservation - Coastal resources management programme. Integrated Coastal Zone Management - need, scope, potentials and constraints for ICZM. Coastal settlements - human impacts on the coastal zones with special emphasis on artisanal fishing, coastal aquaculture and coastal tourism. Effect of port activities and coastal pollution on mangroves, corals and beaches. Role of national and international agencies for coastal and Ocean management. GIS and remote sensing for ICZM.

MODULE II: Marine Biodiversity- Sea and Oceans - Physico chemical properties and biogeochemical interactions. Understanding the marine biodiversity and conservation, world's marine biological diversity, marine hot spots-cold seeps, hydrothermal hotspots, marine biosphere reserves and their importance in India and abroad. Benthic Floral Components- Seaweeds-classification, occurrence, economic importance, sea grass and salt marshes distribution, their role in coastal ecosystems, algal blooms: Nekton oceanography: Nektonic crustaceans, cephalopods, marine reptiles, seabirds, marine mammals-cetaceans, sirenians, pinnipeds, importance of marine mammals, Benthic Faunal Community Zonations-rocky shores, sandy shores, estuaries and kelp forest, marine sponges-their types and importance, Cnidarians-classification, coral reefs-structure, distribution and limiting factors

MODULE III: Threats to Biodiversity in special ecosystems with reference to mangroves and coral reefs. global climate change and impact on marine biodiversity-coral bleaching, ocean acidification. Marine Pollutants: Types, sources and ecological effects on marine environment. Ecological impact of pollutants on marine organisms. Effect of mining and dredging operation on marine environment. Conservation Strategies- Importance of conservation, IUCN and their importance, various conservation strategies- germplasm banks, cryopreservation, marine protected areas, sea ranching, mesh size regulation, TED, fishing holidays, conservation and development at national and international level. Coastal and ocean resource management - endangered coastal biota, marine biosphere reserves and marine parks

MODULE IV: Conservation Policies and Legislations- Various legislations and regulations in conservation of marine biodiversity-the role of MoEF in conservation, Ministry of Environment Forest and Climate change in conservation, MOES and COMAPS, NGO's involvement in conservation and various case studies related to coastal marine conservation

science and policy with reference to Indian maritime states. United Nations Convention on the Law of the Sea (UNCLOS), International Convention for the Prevention of Pollution from Ships (MARPOL).

MODULE V: Wetlands: Introduction, basic concepts on wetland ecology, definition and classification of wetlands: wetlands as ecosystems, distribution and typology, wetland habitat and ecology, physico-chemical parameters-hydrology and soils. Unusual and extreme habitats. Biodiversity in wetland systems. Wetland functions and values, ecosystem services. Nutrient cycling in aquatic systems. productivity, trophic states and eutrophication. Freshwater ecosystems management techniques and the conservation of rare species. Wetlands for disaster risk reduction: effective choices for resilient communities. Special type of wetlands: Myristica swamps.

MODULE VI: Wetland protection and legislation, wetlands (Conservation and Management) rules, Issue of wetlands conservation and management, Major threats to wetlands Wetland conservation in India, Wetland policy: National Wetland Rules, Wetland ecology: wetland ecosystem service and restoration, wetlands and people, Lake and watershed management National Wetland Conservation Programme (NWCP), Management of aquatic weeds, monitoring of wetlands, managing hydrology; control of siltation and pollution. Involvement of local communities in conservation of wetlands, Functioning of Lake Development Authorities. Major Wetlands of the World, Ramsar Convention; Wetland conservation vis a vis other conventions (CBD, CMS, CITES, UNFCCC). Wetlands in India: Ramsar significance and sites in India

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Online Resources

Resource	Link	Description
You Tube	https://youtu.be/LyKkyL1hPPs?si=B0QLAvi7dnfkGQqv	The deep Ocean
	https://youtu.be/73hSF4kC0Lg?si=AFdehE_HhlcJ_OIL	Sustainable Oceans: Marine Biodiversity for the Future We Want
National Mission on Education through ICT (NME-ICT)	https://youtu.be/Ka8rcmbbPgg	Wetlands Types
	https://youtu.be/jqEkipqIMxc	Wetland Conservation

Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
Fourth Semester M.Sc. (CSS) Degree Examination
Branch: Botany (Specialization in Biodiversity Conservation)
BBC-CC-543 COASTAL, MARINE AND WETLAND DIVERSITY AND
CONSERVATION

Time: 3 Hours

Maximum Marks: 60

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

27. Outline the primary goal of marine protected areas.
28. Provide one major threat to coral reefs.
29. How can the concepts of flagship, keystone, umbrella, and indicator species be integrated into conservation strategies?
30. Cite one common application of GIS.
31. Define Integrated Coastal Zone Management.
32. When can a wetland be struck off the Montreux Record?
33. Expand CITES.
34. How will you restore a wetland in your area which lack vegetation and the water is in turbid state.
35. Comment on Myristica swamps.
36. Differentiate between bog and fen

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

37. How do urbanization, tourism, and infrastructure development contribute to habitat loss and degradation? What strategies can be implemented to mitigate these impacts?
38. Assess the various types of marine pollution and their sources. How do pollutants such as plastics, chemicals, oil, and sewage enter marine environments? What are their effects on marine ecosystems and biodiversity?
39. Examine the relationship between overfishing and marine biodiversity loss. Propose solutions to balance fisheries management with conservation goals.
40. Explore the conservation challenges facing marine mammals today. What are the major threats to their populations? What strategies are being implemented to protect and conserve them?
41. Summarize how watershed management can fulfil the needs of water in India?
42. Highlight the ecosystem services of coastal lagoons.
43. Large dams and barrages are an increasing threat to wetland-dependent birds. Do you agree with the statement? Give reasons supporting your opinion.

(5X3= 15 marks)

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

44. Analyze the role of international agreements and conventions in marine biodiversity conservation. How do these agreements address challenges faced by marine ecosystems?
45. Investigate the role of international policies and agreements in combating marine pollution. Evaluate the effectiveness of conventions such as MARPOL and the Paris Agreement in addressing marine pollution. What improvements or additional measures could enhance their effectiveness?
46. Evaluate the vulnerability of a coastal community to climate change impacts such as sea level rise and extreme weather events. Develop adaptation strategies as part of an

ICZM plan to enhance coastal resilience, protect infrastructure, and preserve ecosystem services.

47. What effects do invasive species have on wetlands? Give three examples from your area. Review the different weed management strategies in wetlands.
48. Enlist the specialized adaptations used by plants growing in and near the wetlands water? Many wetland plants actually grow somewhat better at high elevations than those in which they normally occur. Why might this be the case?
49. India is evaluated to have lost nearly one-third of its natural wetlands over the last four decades. Critically examine how and why wetlands in Indian cities are adversely affected.
50. Draw a soil profile in a wetland, and contrast it with a terrestrial soil profile.

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

51. Explore the importance of coral reefs and mangroves in supporting marine biodiversity. How do these ecosystems contribute to the overall health of marine environments and the livelihoods of human communities? What are the broader implications of their degradation for global marine biodiversity?
52. Elaborate on the Ramsar concept of 'wise use' in the context of wetland conservation. Cite five examples of Ramsar sites from India. What qualifies a wetland for Ramsar Recognition?

(1X10= 10 marks)

SEMESTER IV	Course Code: BBC-CC 544	Credits: 3
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NAME OF THE COURSE : PRACTICAL IV

COURSE CONTENT

MODULE I

- Analysis of vegetation - Quadrat /line transects to find frequency and interpret the vegetation in terms of Raunkier's frequency formula.
- To find out the dissolved oxygen content in the given water sample (pond, lake, well etc).
- To find out the primary production in the given water sample using light and dark bottle method.
- Estimation of carbonate and bicarbonate content in water samples.
- Estimation of total organic carbon content in the given soil sample
- Visit to a local area to document environmental assets river/ forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Report of the items 6 and 7 should be included in the record.

MODULE II

- Collection, identification and submission of non-wood forest products
- Report on different vegetation types (minimum two)
- Notes on Diseases of forest plants (any four)

MODULE III

- Practical involving preparation of media, principles of isolation, pure culturing aspects and maintenance of culture.
- Differential staining -Gram staining of pure cultures of *Bacillus/ Lactobacillus/ Rhizobium/ Escherichia coli*.
- Demonstration of bacterial motility by hanging drop method.
- Isolation of *Rhizobium* from root nodule of legumes.
- Test for coliforms in contaminated water.
- Isolation of pure bacterial culture by streak plate method

MODULE IV

- A record of all diseases mentioned in the syllabus.
- Collection, identification and familiarization with the diseases of stored grains and nature of damage caused
- Field visits to FCI warehouses and institutions engaged in research or practice of grain storage

MODULE V

- Phytoplankton- identification of common forms
- Identification of common zooplankton
- Collection and identification of locally available seaweeds, seagrasses, mangroves and preparation of herbarium
- Seaweeds-identification of commercially valuable groups
- Mangroves-identification of common species.
- Coral reef and associated organisms.
- Field visit to intertidal environments/ estuaries and Mangroves/ Marine Biosphere Reserve/ coastal zones.

MODULE VI

- Field study on revival and restoration of Wetlands: Field visit to a Wetland in India (Any Ramsar site) to study restoration and revival efforts. Submission of the report.
- Wetland Ecosystem - spot identification

SEMESTER IV	Course Code: BBC- D- 545	Credits: 6
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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, analyse and interpret the results obtained and conclude.**
- CO3: Understand the methodologies to be adopted for scientific research and publication**
- CO4: Develop creative ideas/ strategies for the conservation of natural resources/ biodiversity**
- CO5: Conserve and sustainably utilize natural resources**
- CO6: Disseminate the ideas of conservation to community and participate in biodiversity registry.**

SEMESTER I- IV	Course Code: BBC- GC- 501	Credits: 2
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NAME OF THE COURSE : GERMPLASM CONSERVATION

COURSE OUTCOMES

CO1: Identify the threats and conservation strategies of biodiversity

CO2: Assess the importance and conservation measures of sacred grooves and wetland ecosystem

CO3: Analyse ex situ and in situ germplasm conservation strategies.

COURSE CONTENT

MODULE I: Introduction, Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. Bio-geographic classification of India. Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation

MODULE II: Threats to Biodiversity: Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Endangered and endemic species of India

MODULE III: Conservation strategies:- *In-situ* biodiversity conservation - conservation of species within their natural habitats. Wild sanctuaries, protected areas, national parks Biosphere reserve, Wild life sanctuaries in Kerala. Biosphere reserve and National parks in India.

MODULE IV: Sacred Grooves and Wetlands- Sacred groves- significance, important sacred groves in Kerala, Socio economic aspects of sacred groves. Wetlands and Ramsar sites. Important wet lands in India. Economic benefits of wetlands. Myristica swamps and its importance, myristica swamps in Kerala. Mangrove ecosystems and its economic importance.

MODULE V : Ex-Situ conservation methods- Zoo and Botanical garden, seed bank, in vitro bank, pollen bank. Captive breeding of animals and artificial propagation of plants, with possible reintroduction into the wild

MODULE VI: 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, cryoprotection, 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.

LEARNING RESOURCES:

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc. (CSS) Degree Examination
BBC-GC-501 Germplasm Conservation (Generic Course)

Time: 3 Hours

Maximum Marks: 60

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

1. Define species diversity
2. What do you mean by habitat loss?
3. What is vitrification?
4. What do you mean by invasive species?
5. Expand UNEP
6. Which National Park is famous for one- horned rhinoceros
7. Name an extinct plant species
8. What is seed bank?
9. Name a national park
10. What do you mean by recalcitrant species?

(10x1=10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. What is the difference between rare and endangered species?
12. What do you mean by ecosystem degradation? How does it affect biodiversity
13. Write a note on in situ conservation
14. What is endemism? List any three endemic plant and animal species of India
15. Define biosphere reserve. Name the three zones of a biosphere reserve and the activities permitted in each.
16. Differentiate alpha, beta and gamma diversity?
17. Describe the significance of sacred groves in germplasm conservation

(5X3=15 marks)

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

18. Discuss the importance of myristica swamps
19. Give an account on the international organizations involved in the conservation of wildlife
20. Describe the various ex-situ methods for germplasm conservation
21. What do you mean by hot spots of biodiversity? What are the criteria for identifying hot spots? Which are the biodiversity hotspots in India
22. Explain the measures taken for conservation of biodiversity in India
23. Describe the consumptive value of biodiversity as food, drugs & medicines, and fuel & fiber with suitable examples
24. Elaborate on the economic importance of mangrove ecosystem.

(5X5=25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Discuss the applications of cryopreservation by explaining the methods adopted for germplasm conservation
26. What are the threats to biodiversity? Suggest measures to overcome its harmful effects.

(1X10= 10 marks)

SEMESTER I- IV	Course Code: BBC- GC- 502	Credits: 2
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NAME OF THE COURSE: PRINCIPLES AND PRACTICES OF SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES (CO)

CO1. Understand and appreciate the role of sustainability in environmental management and societal development

CO2. Outline the concepts related to conventional and non-conventional energy.

CO3. Evaluate and summarize the role of citizens and eco-movements to achieve the objectives of sustainability.

CO4. Examine the key governance and policy interventions needed to improve the wellbeing of the environment.

CO5. Identify and implement the concept on various energy efficient systems and green buildings.

CO6. Justify the role of ecotourism in sustainable development

COURSE CONTENT

MODULE I: Introduction, Concepts- Social, economic and environmental Sustainability and Sustainable development, Nexus between Technology and Sustainable development overview of Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) Role of individuals and society in achieving SDGs, Sustainable agriculture: Natural farming / Organic farming methods, Urban agriculture and hydroponics, Concept of Green buildings and GRIHA rating norms, Swachh Bharat Abhiyaan

MODULE II: Eco development Sustainability of Natural resources; Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from Oceans and Geothermal energy, Natural Resource Management (with special reference to Fisheries & Forestry).

MODULE III: Green practices to conserve natural resources. Regulations on fishing, Estimating sustainability of fish populations; Concept of MSY in marine resources, Regulations on use of forest produce, Controlled logging, Alternate energy sources, their applications and practice.

MODULE VI: Sustainability, Bioethics and tribal population; Sustainable development rights; Forest Resources – sustainable utilization and development; GMOs and their applications, Ecological effects, Potential threats, Field trials, some success stories.

MODULE V: Algal flora as natural resource for sustainable agriculture, biomass to biofuel processes, biofuel production, advantages and disadvantages, Organic agriculture certifications and agencies in India. Eco-labelling, ISO 14001:2019 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Bio-mimicking.

MODULE VI: Eco-tourism, Scope of Eco tourism in India Hospitality & Logistics in Eco-tourism Planning and executing Eco-tourism Customized Eco-tours (e.g. Bird watching,

Adventure Tourism, Agro-tourism) Local community's participation in Eco-tourism Public awareness & Interpretation towards environment Orienting Corporate Social Responsibility towards environment Sustainable tourism practices - Community-based tourism and its benefits. Challenges and solutions in ecotourism. Ecotourism and ethics. Ecotourism centres in Kerala Thenmala/ Thattekkad-A case study.

LEARNING RESOURCES:

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Model Question Paper
DEPARTMENT OF BOTANY
UNIVERSITY OF KERALA
M.Sc. (CSS) Degree Examination
BBC-GC-502 PRINCIPLES OF PRACTICES OF SUSTAINABLE DEVELOPMENT
(Generic Course)

Time: 3 Hours

Maximum Marks: 60

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

1. Define biomimicking?
2. Name the cleanest form of renewable energy?
3. Mention the purpose of an ecolabel.
4. In which year was the concept of sustainable development popularized?
5. The first international treaty to set legally binding targets to cut greenhouse gas emissions is
6. Who framed SDGs?
7. What is forest produce under Indian forest Act?
8. Do GMOs play a role in sustainable agriculture? If yes, How?
9. What do you mean by life cycle analysis?
10. Identify the nodal institution for achieving SDGs in India.

(10X1= 10 marks)

II. Answer any *five* questions. Each answer not exceeding 150 words.

11. What are the steps taken by the Indian government to conserve natural resources?
12. How and to what extent can tribals contribute to sustainable development?
13. What are the different elements of adventure tourism?
14. Give a brief note on any three organic certification agencies in India
15. Highlight the advantages of participating local communities in ecotourism.
16. Differentiate renewable and non-renewable energy with suitable examples.
17. Briefly discuss the need for organic farming.

(5X3= 15 marks)

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

18. Write about the importance of traditional ecological knowledge in global conservation strategies.
19. Discuss the major challenges in achieving SDG with suitable examples.
20. Analyse the scope of algal flora as natural resources for sustainable development
21. Discuss in detail the major objectives and fundamental principles in Green building concept and describe any one Global Green rating system.
22. What is ISO 14001 ? Discuss its advantages.
23. Enlist the different agrotourism activities you can experience on an agrotourism farm.
24. Give a detailed account on the production of biofuel production, highlighting its advantages and disadvantages.

(5X5= 25 marks)

IV. Answer any *one* of the following, not exceeding 500 words

25. Why Alternative Energy Sources Are the Future? Elaborate on the different alternative energy technologies.
26. Throw light on the scope of ecotourism in Kerala citing any five ecotourism destinations.

(1X10= 10 marks)