



शिवजी कॉलेज
(दिल्ली विश्वविद्यालय)
Shivaji College
(University of Delhi)



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SUPPORTING DOCUMENTS FOR 1.3.2

1.3.2 Number of courses that include experiential learning through project work/fieldwork/internship during the year



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Index Page

Sr No.	Description	Page No.
1	AECC I: Environmental Science	3-10
2	Intellectual Property	11-13
3	Genetics and Evolutionary Biology	14-16



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Environmental Studies (EVS)

Ability Enhancement Compulsory Course (AECC-I) for all undergraduate courses

Ability Enhancement Compulsory Course

3

Introduction

Content: The Compulsory course on Environmental Studies at Undergraduate level (AECC-I) aims to train students to cater to the need for ecological citizenship through development of a strong foundation on the critical linkages between ecology-society-economy.

Learning Outcome based approach to Curriculum Planning

1. Graduate Attributes In Subject

- Disciplinary knowledge**
Enable students to develop a comprehensive understanding of various facets of life forms, ecological processes, and the impacts on them by humans during the Anthropocene era.
- Critical thinking**
Build capabilities to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make Informed decisions.
- Moral and ethical awareness/reasoning**
Develop empathy for all life forms, appreciation for the various ecological linkages within the web of life, awareness and responsibility towards environmental protection and nature preservation.

2. Programme Learning Outcome in course

The course will empower the undergraduate students through:

- Gaining of in-depth knowledge on natural processes and resources that sustain life and govern economy.
- Understanding and predicting the consequences of human actions on the web of life, global economy, and quality of human life.
- Development of critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- Acquisition of values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
- Encouraging adoption of sustainability as a practice in life, society, and industry.

3. Qualification Description

Graduates will evolve into ecologically, environmentally, and socially informed and responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

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Ability Enhancement Compulsory Course (AECC-I)

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4

Environmental Studies

Compulsory course on Environmental Studies at UG level (AECC I)

Course Learning Outcomes

The course will empower the undergraduate students by helping them to:

- Gain in-depth knowledge on natural processes and resources that sustain life and govern economy.
- Understand the consequences of human actions on the web of life, global economy, and quality of human life.
- Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- Acquire values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
- Adopt sustainability as a practice in life, society, and industry.

Unit 1

Introduction to Environmental Studies (2 lectures)

- Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere
- Scope and importance; Concept of sustainability and sustainable development; Brief history of environmentalism

Suggested Readings

- Raven, P.H., Hassenzahl, D.M., Hager, M.C., Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8th Edition. Wiley Publishing, USA. Chapter 1 (Pages: 1-17); Chapter 2 (Pages: 22-23); Chapter 3 (Pages: 40, 41); Chapter 4 (Pages: 64, 66).
- Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. Chapter 1 (Page: 3-28).

Unit 2

Ecosystems (6 lectures)

- Definition and concept of Ecosystem
- Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis
- Types of Ecosystems: Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries); Importance and threats with relevant examples from India
- Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration

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5

Suggested Readings

1. Odum, E.P., Odum, H.T., and Andrews, J. (1971). *Fundamentals of Ecology*. Saunders, Philadelphia, USA. **Chapter 1** (Pages: 1-16); **Chapter 2** (Pages: 16-76); **Chapter 10** (Pages: 414-458).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 3** (Pages: 38-52); **Chapter 4** (Pages: 53-62); **Chapter 5** (Pages: 100-103); **Chapter 6** (Pages: 106-129).
3. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 13** (Pages: 307-323); **Chapter 18** (Pages: 420-442); **Chapter 26** (Pages: 747-769).

Unit 3

Natural Resources (8 lectures)

- Land resources: Minerals, soil, agricultural crops, natural forest products, medicinal plants, and forest-based industries and livelihoods; Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities
- Water resources: Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & inter-state conflicts over water
- Energy resources: Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source
- Case studies: Contemporary Indian issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery river water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, etc)

Suggested Readings

1. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
2. McCully, P. (1996). *Rivers no more: the environmental effects of dams*, In: *Silenced Rivers: The Ecology and Politics of Large Dams*, Zed Books, New York, USA. **Page. 29-64**.
3. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapters 10, 11, 12, 13** (Pages: 180-263); **Chapter 14** (Pages: 272-275); **Chapter 15** (Pages: 286-289).
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 25** (Pages: 623-663).

Unit 4

Biodiversity and Conservation (8 lectures)

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity
- India as a mega-biodiversity nation; Biogeographic zones of India; Biodiversity hotspots; Endemic and endangered species of India; IUCN Red list criteria and categories
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples; sacred groves and their importance with examples

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Ability Enhancement Compulsory Course (AECC-I)

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6

- Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife; Man-wildlife conflicts; Biological invasion with emphasis on Indian biodiversity; Current mass extinction crisis
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; National Parks, Wildlife Sanctuaries, and Biosphere reserves; Keystone, Flagship, Umbrella, and Indicator species; Species reintroduction and translocation
- Case studies: Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

Suggested Readings

1. Primack, R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA. Page. 1-536.
2. Raven, P.H., Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. Chapter 5 (Pages: 97-99); Chapter 15 (Pages: 299-315).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. Chapters 24 (Pages: 669-690); Chapter 26 (Pages: 664-714).

Unit 5

Environmental Pollution (8 lectures)

- Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues, Plastic waste management rules, Bhopal gas tragedy, etc

Suggested Readings

1. Brusseau, M.L., Pepper, I.L. and Gerba, C.P. (2018). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. Chapter 16 (Pages: 243-265); Chapter 18 (Pages: 280-306); Chapter 21 (Pages: 352-358); Chapter 22 (Pages: 366-374); Chapter 23 (Pages: 378-388); Chapter 25 (Pages: 416-426).
2. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt, USA. Pp. 1-264.
3. Raven, P.H., Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. Chapter 19 (Pages: 359-381); Chapter 21 (Pages: 401-421); Chapter 23 (Pages: 440-463).
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. Chapters 19, 20, 12 (Pages: 445-535).

Unit 6

Global Environmental Issues and Policies (7 lectures)

- Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain; Impacts on human communities, biodiversity, global economy, and agriculture

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- International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity (CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc
- Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions
- Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Suggested Readings

1. Divan, S. and Rosencrenz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. Chapter 2 (Pages: 23-30); Chapter 3 (Pages: 41-86).
2. Raven, P.H., Haezenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. Chapter 19 (Pages: 370-376); Chapter 20 (Pages: 385-390).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. Chapter 23 (Pages: 555-596); Chapter 30 (Pages: 801-807).

Unit 7

Human Communities and the Environment (8 lectures)

- Human population growth: Impacts on environment, human health, and welfare; Carbon foot-print
- Resettlement and rehabilitation of developmental project affected persons and communities; relevant case studies
- Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnoi of Rajasthan, Narmada Bachao Andolan, etc
- Environmental justice: National Green Tribunal and its importance
- Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation
- Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc)

Suggested Readings

1. Divan, S. and Rosencrenz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. Chapter 10 (Pages: 416-473).
2. Raven, P.H., Haezenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. Chapter 2 (Pages: 33-36); Chapter 8 (Pages: 148-162).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. Chapter 1 (Pages: 23-26); Chapter 31 (Pages: 826-842).

Field work/ Practicals

(Equal to 5 lectures, including two mandatory field visits)

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural

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history museum in and around Delhi, such as Okhla bird sanctuary/ Aeola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom

- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Study of common plants and animals; basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students

Essential Readings

1. Brusseau, M.L., Pepper, I.L., and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. (pp. 1-520).
2. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. (pp. 1-837).
3. Gadgil, M., and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
4. Raven, P.H., Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8th Edition. Wiley Publishing, USA. (pp. 1-472).
5. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. (pp.1-842).

Weekly Lesson Plan

Week 1

Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere
Scope and Importance; Concept of sustainability and sustainable development; Brief history of environmentalism

Week 2

Definition and concept of Ecosystem: Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis

Week 3

Types of Ecosystems: Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries); Importance and threats with relevant examples from India
Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration

Week 4

Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities
Natural and man-made sources of water; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and International & Inter-state conflicts over water

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9

Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source

Case studies: Contemporary Indian Issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery river water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Singh, etc).

Week 6

Definition of Biodiversity; Levels of biological diversity; India as a mega-biodiversity nation; Biogeographic zones of India; Biodiversity hotspots; Endemic and endangered species of India; IUCN Red list criteria and categories

Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples; sacred groves and their importance with examples

Week 7-8

Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife; Man-wildlife conflicts; Biological invasion with emphasis on Indian biodiversity; Current mass extinction crisis; Biodiversity conservation strategies: In-situ and ex-situ methods of conservation; National Parks, Wildlife Sanctuaries, and Biosphere reserves; Keystone, Flagship, Umbrella, and Indicator species; Species reintroduction and translocation

Case studies: Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

Week 9

Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards
Related case studies

Week 10

Nuclear hazards and human health risks; Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal
Related case studies

Week 11

Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain; Impacts on human communities, biodiversity, global economy, and agriculture
International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity(CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc

Week 12

Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions
Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Week 13

Human population growth: Impacts on environment, human health, and welfare; Carbon foot-print; Resettlement and rehabilitation of developmental project affected persons and communities; relevant case studies; Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan, Narmada Bachao Andolan, etc; Environmental justice: National Green Tribunal and its importance

Week 14

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10

Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation
Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc)

Week 15-18

Practical/project

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, such as Okhla bird sanctuary/ Asola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students
- Basic exercise to Calculate and Assess carbon footprint/ Solid waste generation/ water consumption for a specific duration at individual/ family/ college/ locality level.

Teaching Learning process

The teaching-learning methodologies are designed to provide the undergraduate students a comprehensive understanding of the subject in a simplistic manner as well as evoke critical reasoning and analytical thinking among them. The various approaches to teaching-learning process include classroom lectures, video presentations, and ICT enabled teaching tools. For enhancing practical understanding, field visits are encouraged to relevant places in Delhi like Biodiversity parks, Protected areas, Wetlands, Sewage treatment plants, etc.

Assessment methods

1. Written examinations (Semester exams, Internal assessment)
2. Project work and reports related to field visits and practical learning
3. Assignment/presentations on any contemporary environmental issue

Keywords

Environment, Ecosystem, Biodiversity, Conservation, Pollution, Natural Resources, Environmental Degradation, Protection, Sustainable Development, Climate Change, Environmental Justice, Environmental Ethics, Environmental Communication

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**Syllabus of Intellectual Property Rights
B.Sc. Life Science, Semester IV**

**Intellectual Property Right
(LSSE6)
Skill-Enhancement Elective Course - (SEC) Credit:4**

Course Objective(2-3)

To have knowledge of roles regulations, laws and processes of patents, copyright trademarks and concepts of traditional knowledge and protection of plant varieties.

Course Learning Outcomes

Students would have deep understanding of patents copyrights, their importance. They can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions

Unit 1

Introduction to intellectual property right (IPR) (2 lectures)
Concept and kinds.Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

Unit 2

Patents (3 Lectures)
Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents.Infringement.

50

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Unit 3

Copyrights (3 Lectures)

Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement

Unit 4

Trademarks (3 Lectures)

Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name

Unit 5

Geographical Indications (3 Lectures)

Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position

Unit 6

Protection of Traditional Knowledge (4 Lectures)

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Unit 7

Industrial Designs (2 Lectures) Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Unit 8

Protection of Plant Varieties (2 Lectures)

Plant Varieties Protection- Objectives, Justification, International Position, Plant varieties protection in India, Rights of Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.

Unit 9

51

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Information Technology Related Intellectual Property Rights (4 Lectures)
Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection

Unit 10
Biotechnology and Intellectual Property Rights (4 Lectures)
Patenting Biotech Inventions

Practical

1. Patent search
2. Trademark search
3. copyright infringement (Plagiarism checkby Urkundand other available software,
4. Geographical Indicators
5. food- Malabar pepper, Basmati rice, Darjeeling Tea, and Requefort cheese.
6. handlooms (Kota Doria, Banarasi Sari, Muga Silk, Kanchipuram),
7. Industry (Mysore agarbatti, Feni Goa, ChampagneFrance).
8. Natural resources- Makrana marbles Two example of each category Biopiracy- neem, turmeric
9. Industrial designs- Jewelry design, chair design, car design, Bottle design, Aircraft design,
10. IPR e diary

References

1. Acharya, N.K. (2001). *Text Book on Intellectual Property Rights: (copyright, Trademark, Patent Design, Geographical Indications, Protection of New Plant Varieties & Farmers Rights and Protection of Biodiversity)*. Hyderabad: Asia Law House.
2. Bhandari, M.K. (2017). *Central Law Publication's Law Relating to Intellectual Property Rights (IPR)*. Uttar Pradesh, Central Law Publications.
3. Gogia, S.P. *Intellectual Property Rights (IPR) For B.S.L & L.L.B*. Hyderabad: Asia Law House.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

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Shivaji Sooden

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B. Sc. Life Science Semester IV

Syllabus for Core Paper: Genetics and Evolutionary Biology

LS Core IV: Genetics and Evolutionary Biology

Course Learning Objective:

The focus of first half of this course is to familiarize students with basic principles of genetics and its application in understanding of real-life hereditary conditions. The second half of the course aims at imparting fundamental understanding of evolutionary processes and how it works in context of populations.

Learning Outcome:

Students would be able to understand the fundamentals of Mendelian inheritance and its exceptions. They would be able to appreciate various other gene interactions like co-dominance, incomplete dominance, lethal alleles and pleiotropy. Further, students would be able to describe the concepts of linkage and crossing over and their usage in constructing gene maps.

- Help students understand the basic principles of pedigree analysis and will be able to construct and analyse pedigree related problems for inherited traits.
- Students would gain knowledge on chromosomal and genetic mutation.
- Students would be able to describe the chromosomal sex-determination mechanisms and dosage compensation.
- Students would be able to understand the major events in history of life and major theories of evolution.
- Students would be able to appreciate the contribution of fossil studies in evolution and the phylogeny of horse.
- Students would be able to calculate the gene and allele frequency using Hardy-Weinberg law and analyse population genetics problems. T
- Students would understand the fundamental concepts of natural selection, speciation, mass extinction and macro-evolution.

Course Content:

Theory (Credit 4)

60 hrs

Unit 1: Mendelian Genetics and its Extension

10hrs

Mendel's work on transmission of traits, principles of inheritance, chromosome theory of inheritance, incomplete dominance and co-dominance, multiple alleles, lethal alleles, epistasis, pleiotropy, polygenic inheritance, sex linked inheritance, extra-chromosomal inheritance
Chapter-3, 4, 9, 23: Klug & Cummings

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

6hrs

Linkage and crossing over, recombination frequency as a measure of linkage intensity, two factor and three factor crosses, interference and coincidence, somatic cell genetics - an alternative approach to gene mapping
Chapter-5: Klug & Cummings; Chapter-7: Pierce

Unit 3: Mutations

5hrs

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Shivaji Sandhu

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Chromosomal mutations (classification, types and examples), gene mutations (types and classification)

Chapter-8, 1: 5 Klug & Cummings

Unit 4: Sex Determination

2hrs

Chromosomal mechanisms, dosage compensation

Chapter-7: Klug & Cummings

Unit 5: History of Life and Introduction to Evolutionary Theories

5hrs

Major events in history of life, Lamarckism, Darwinism, Neo-Darwinism

Chapter-22: Campbell

Unit 6: Direct Evidences of Evolution

4hrs

Types of fossils, incompleteness of fossil record, dating of fossils, phylogeny of horse

Chapter-4: Futuyama

Unit 7: Population Genetics and Processes of Evolutionary Change

12hrs

Hardy-Weinberg law (statement, derivation and applications), evolutionary forces upsetting H-W equilibrium (concepts only), organic variations, isolating mechanisms, natural selection and its types, artificial selection

Chapter-25: Klug & Cummings

Unit 8: Species Concept

6hrs

Biological species concept (advantages and limitations), modes of speciation

Chapter-24: Campbell; Chapter-24: Strickberger

Unit 9: Macro-evolution

5hrs

Macro-evolutionary principles (example: Darwin's Finches)

Chapter-21: Futuyama

Unit 10: Extinction

5hrs

Mass extinction (causes, names of five major extinctions, K-T extinction in detail), role of extinction in evolution

Chapter-23: Ridley

Practical [Credits: 2]

1. Study of Mendelian inheritance and gene interactions (non-Mendelian inheritance) using suitable examples (chi-square analysis).

2. Study of linkage, recombination, gene mapping using data.

3. Study of human karyotypes (normal and abnormal).

4. Study of homology and analogy from suitable specimens/pictures.

5. Pedigree analysis of some human inherited traits.

6. Study and verification of Hardy-Weinberg Law by Chi-square analysis.

7. Visit to natural history museum and submission of report.

Teaching-Learning Process:

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The whole course envisages a lot of student-teacher interactions. The real-life relevance of both genetics and evolution makes it necessary that the teaching-learning strategies should involve discussions among students, guided by the teacher. There is ample opportunity for students to analyse genetic and evolutionary data, and develop skills in various simulation exercises. Visit to a natural history museum could be suitably integrated with the course content.

Assessment Methods:

Following assessment methods are suggested:

- Summative assessment comprising of written tests and *viva-voce*.
- Formative assessment with exercises involving genetic data analyses, evolutionary processes' simulations, and linkage mapping.
- **Written report on the learning of museum visit.**

Keywords:

Mendelian inheritance, Multiple alleles, Penetrance, Epistasis, Pleiotropy, Gene, Chromosomal mapping, Recombination, Interference, Mutations, Mutagens, chromosomal aberrations, Sex determination, Dosage compensation, Nuclear inheritance, Mitochondrial inheritance, Polygenic inheritance, Complementation, Transposons, Ty elements, Ac-Ds elements.

Recommended Books:

- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons In.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cumming
- Pierce B. A. (2012). *Genetics-A Conceptual Approach*. IV Edition. W. H. Freeman and Company

Suggested Readings:

- Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India

Online Tools and Web Resources:

- <https://swayam.gov.in/courses/4922-genetics-and-genomics>
- <https://swayam.gov.in/course/96-genetics>
- <https://www.coursera.org/learn/genetics-evolution>
- <https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/>
- <https://learn.genetics.utah.edu/>

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