Parvatibai Chowgule College of Arts and Science (Autonomous)

Accredited by NAAC with Grade 'A+'

Best Affiliated College-Goa University Silver Jubilee Year Award

SYLLABUS FOR SEMESTER I AND II UNDERGRADUATE MULTIDISCIPLINARY PROGRAMME IN ENVIRONMENT SCIENCE AND IMPACT ASSESSMENT (HONOURS)

(Implemented from Academic Year 2024-2025)

Annexure A

COURSE STRUCTURE

Semester	Course Code	Course Title	Department	Nomenclature	Credits
I	UG-ESIA-101	Ecology, Ecosystem and Biodiversity	Biotechnology	DSC	4
	UG-ESAI-SEC1	Ecology and Society	Zoology	SEC	3
II	UG-ESAI-102	Environment Issues, Perspectives and Policies	Chemistry	DSC	4
	UG-ESAI-SEC2	Basics of GIS and Remote Sensing	Biotechnology	SEC	3
III	UG-ESAI-201	Conservation Biology	Biotechnology	DSC	4
	UG-ESAI-202	Physics and Chemistry of Environment	Physics and Chemistry	DSC	4
	UG-ESAI-SEC3	Anthropogenic Impact on Food Resources	Biochemistry	SEC	3
IV	UG-ESAI-203	Climate change and Sustainability	Biotechnology, Geology and Geography	DSC	4
	UG-ESAI-204	Water Resources and Management	Geography, Geology, Chemistry and Biotechnology	DSC	4
	UG-ESAI-205	Mineral Resources and Management	Geology	DSC	4

	UG-ESAI-206	Environmental Evaluation and Risk Assessment	Biochemistry	DSC	4
	UG-ESAI-VOC1	Biostatistics	Biotechnology, Biochemistry	VOC	4
V	UG-ESAI-301	Sustainable Development	Biotechnology	DSC	4
	UG-ESAI-302	Wildlife Biology and Conservation	Zoology	DSC	4
	UG-ESAI-303	Environment Impact Assessment (EIA) I	Biotechnology	DSC	4
	UG-ESAI-VOC2	Instrumentation Techniques	Biotechnology and Chemistry	VOC	4
VI	UG-ESAI-304	Natural and Man-made Hazards	Chemistry, Biochemistry and Geology	DSC	4
	UG-ESAI-305	Environment Microbiology	Biochemistry	DSC	4
	UG-ESAI-306	Marine Science	Botany, Zoology, Chemistry, Geology	DSC	4
	UG-ESAI-PRJ	Minor Project	Biotechnology	PRJ	4
	UG-ESIA-VOC3	Environmental Entrepreneurship	Biotechnology, Biochemistry, and Economics	VOC	4
VII	UG-ESAI-401	Environment Chemistry	Chemistry	DSC	4

	UG-ESAI-402	Waste Treatment Technology	Biotechnology	DSC	4
	UG-ESAI-403	Environment Impact Assessment (EIA) II	Biotechnology	DSC	4
	UG-ESAI-404	Green Chemistry	Chemistry	DSC	4
VIII	UG-ESAI-405	Environmental Restoration and Remediation	Biotechnology	DSC	4
	UG-ESAI-406	Land Oceans and Atmospheric Interactions	Geology and Geography	DSC	4
	UG-ESAI-407	Advanced Remote Sensing and GIS	Geography	DSC	4
	UG-ESAI-408	Forestry and Conservation	Botany	DSC	4

LIST OF COURSES

SEMESTER	DISCIPLINE SPECIFIC CORE COURSES (4 credits/course)	MINOR/ VOCATIONAL (4 credits/course)	SKILL ENHANCEMENT COURSES (3 credits/course)
I	Ecology, Ecosystem and Biodiversity		Ecology and Society
II	Environment Issues, Perspectives and Policies		Basics of GIS and Remote Sensing
III	Conservation Biology		Anthropogenic Impact on Food Resources
	Physics and Chemistry of Environment		
IV	Climate change and Sustainability	Biostatistics	
	Water Resources and Management		
	Mineral Resources and Management		
	Environmental Evaluation		
V	Introduction to Sustainable Development	Instrumentation Techniques	
	Wildlife Biology and Conservation		
	Environment Impact Assessment (EIA) I		
VI	Natural and Man-made Hazards	Bioentrepreneurship	
	Environment Microbiology		
	Marine Science		
	Minor Project		
VII	Environment Chemistry		
	Waste Treatment Technology		
	Environment Impact Assessment (EIA) II		
	Green Chemistry		
VIII	Environmental Restoration and Remediation		

	Land Oceans and Atmospheric Interactions		
	Advanced Remote Sensing and GIS		
	Forestry and Conservation		

Minor courses to be offered from departments of Botany, Chemistry, Geology, Geography, Zoology
Multidisciplinary courses to be offered from Group of Humanities and Social Sciences, Mathematics and Computer Science)

SEMESTER I

ESIA-101: ENVIRONMENT, ECOLOGY, AND BIODIVERSITY

COURSE TITLE : ECOLOGY, ENVIRONMENT, AND BIODIVERSITY (THEORY CORE-1)
COURSE CODE : UG-ESIA-101
SEMESTER : I
CREDITS : 03
MARKS : 75
TOTAL HOURS : 45

Course Objective:

The course introduces the concept of environment and provides the fundamentals about ecosystems, their types, distribution, components, functioning, services and their role in biodiversity. Current scenario of Biodiversity in the Indian and world context will be understood. Most importantly the student will be able to understand and measure biotic and abiotic components of the ecosystem and then learn the relationship between them.

Course Learning Outcomes:

On the successful completion of the course, students will be able to:

CLO1 Understand and interpret the structure, variables, processes and functions operating in Environment and ecosystems.
CLO2 Understand the connectivity among all the components of ecosystems and their services.
CLO3 Understand How to identify and group different plants and animal species and the importance of biodiversity and methods to measure it.
CLO4 Gain basic knowledge on the assessment of Biotic and abiotic components
CLO5 Will gain basic knowledge in distribution of species in different ecosystem and threats to species, extinction and indicator species

Module 1: Environment (15 hours)

Concept of environment and types: Physical environment; Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere; biotic environment; biotic and abiotic interactions; Habitat and Niche: Concept of habitat and niche, niche, width and overlap, resource partitioning; natural resources and alternatives.

Biogeographic provinces of the world and agro-climatic zones of India. Concept of sustainable Development.

Module 2: Ecology and Ecosystem (15 hours)

Definitions: Ecology, landscape, habitat, ecozones, biosphere, ecosystems; Autecology, synecology; Types of ecosystem: forest, grassland, lentic, Lotic, estuarine, marine, desert, wetlands; ecosystem: Structure and function; abiotic and biotic components of ecosystem; Ecosystem function; ecosystem metabolism; primary production and models of energy flow; Secondary production and trophic efficiency ecosystem

connections: food chain, food web; detritus pathway of energy flow and decomposition processes; Ecosystem: stability, resistance and resilience.
Biogeochemical cycles and nutrient cycling: Carbon cycle; nitrogen cycle; phosphorus cycle; sulfur cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake; decomposition and nutrient release; Ecological succession: Primary and secondary successions; Ecological pyramids: pyramids of number, biomass and energy, ecological niche.

Module 3: Biodiversity (15 hours)
Definition; the past (diversity and extinction) and present; major groups of biological organisms; evolution of biodiversity and drivers of biodiversity; Patterns in biodiversity: Spatial and temporal patterns at genetic, species and taxonomic diversity, Approaches to biodiversity studies. Loss of biodiversity and biodiversity targets 2030.
Measuring Biodiversity: Species richness and Biodiversity Indices; Methods of Measuring Biodiversity; Alpha, Beta and Gamma-diversity; Genetic, Species and Ecosystem Diversity; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, protocooperation, predation, competition, parasitism, mimicry, herbivory;
Hotspots of Biodiversity and their distribution; Drivers of biodiversity change;Biodiversity of India Bio-geographical regions of India; Forest types and major ecosystems of India. Endemism. Concepts of keystone, umbrella and flagship species. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. National parks, Sanctuaries, Protected areas and Sacred groves in India.

COURSE TITLE : ECOLOGY, ENVIRONMENT, AND BIODIVERSITY (PRACTICAL CORE-1)
COURSE CODE : UG-ESIA-101
SEMESTER : I
CREDITS : 01
MARKS : 25
TOTAL HOURS : 30

1. Introduction to Environment lab and Instruments in Ecology
2. Study of Members: kingdom Plantae
3. Study of Members: kingdom Animalia
4. Measurement of Basic abiotic factors: Temperature; Sunlight; Relative Humidity; Soil Moisture content; Wind speed; Atmospheric Pressure; Type of Soil/substrate
5. Study of grassland vegetation by List Count Quadrat Method to determine the Frequency, Density; Abundance.
6. Estimation of number of animals in population
7. Visit to a sacred grove/Forest/Grassland/Marine ecosystem to assess its biodiversity
8. Study of wetland (source region visit) and its vegetation and seasonal bird diversity

REFERENCES

- Primack, R.B., (2002) Essentials of Conservation Biology (3rd edition). Sinauer Associates, Sunderland, USA.

- Loreau, M. and Inchausti, P., (2002) Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK
- Singh, J.S., Singh, S.P. and Gupta, S.R., (2006) Ecology, Environment and Resource Conservation. Anamaya Publications.
- Gaston, K J. and Spicer, J.I., (1998) Biodiversity: An Introduction. Blackwell Science, London, UK.
- Odum, E.P., (1971) Fundamentals of Ecology. W.B. Sounders.

OPEN SOURCE

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https://www.mospi.gov.in/sites/default/files/reports_and_publication/statistical_publication/EnviStats/Chap7-Biodiversity_envst22.pdf
http://nbaindia.org/

ESAI-SEC 1: ECOLOGY AND SOCIETY

COURSE TITLE : ECOLOGY AND SOCIETY (THEORY SEC-1)
COURSE CODE : UG-ESIA-SEC 1
SEMESTER : I
CREDITS : 02
DURATION : 30 HOURS
MAXIMUM MARKS : 50

Course Objectives:

The course focuses on basic concepts of Ecology and Society. It highlights the interactions between humans and the environment and wildlife that enhance and detract life. The students will have a societal perspective towards the impact of the environment on society and will be made aware of sustainable development that is a dire need in present times.

Course Learning Outcomes:

On completion of the course, the students will be able to

CLO1 Understand the basic concepts of Ecology and Society
CLO2 Gain knowledge on the positive and negative interactions between ecology and society
CLO3 Understand sustainable development
CLO4 Apply basic knowledge, interact and analyze human-environment relations in today's life

Module 1: Introduction to Socio-ecology and positive interactions (15 hours)

An Overview of Ecology: Definition; Ecological basis: Physical and Biological parameters; Levels of Ecology: Organisms, Population, Communities, and ecosystem; Gaia Hypothesis; Importance of Ecology.
Introduction to Ecology and society: History and current status; Development of Cultural Ecology; Human Ecology; Influence of environmental parameters on societal living pattern; Nature and culture cognitive approach, Phenomenological approach, and contemporary approach.
Positive interactions with Environment: Economic and Welfare values; Agricultural and nutritional values; Recreational values; Scientific values; Ecological values; Medicinal values; Potential values; Cultural significance: Religious beliefs, Sacred grooves, Tribes, Food and Sacred Symbols.

Module 2: Negative socio-ecological interactions and Sustainable development (15 hours)

Negative Interactions with Environment: Issues arising of increasing human population; Human related disasters: Intentional (Biological warfare), Unintentional (Wrong environmental conservation practices); Climate disasters: Accidents, Earthquake, landslides, floods, forest fires and cyclones; Human Animal Conflicts: Roadkills, Agro-wildlife interactions; Unsustainable hunting and Poaching; Exotic species: Case studies; Zoonotic diseases: Case studies.
Sustainable Development: Definition, concept and types, Case studies (any two); Importance of Sustainable development; Documentation of cultural practices and biodiversity in Public Biodiversity Register; Sustainable Development Goals (SDGs): Lifestyle for environment.

COURSE TITLE : ECOLOGY AND SOCIETY (PRACTICAL SEC1)
COURSE CODE : UG-ESIA-SEC 1
SEMESTER : I
CREDITS : 01
DURATION : 30 HOURS
MAXIMUM MARKS : 25

1) Visit to an aquatic/terrestrial ecosystem to understand the working of a habitat.
2) Comparative survey and analysis of Avifaunal diversity at Urban and Rural Areas.
3) Documentation and economic value addition to positive interactions of society and environment in your village.
4) Document negative interactions between society and environment in your village and suggest measures.
5) Visit sacred grooves/tribal areas and interact with locals.
6) Awareness through an audio-visual presentation to the public on sustainable development.
7) Participation in documenting data in PBR.

REFERENCES:

- Sharma P.D. (2015): Ecology and Environment, Rastogi Publications. Meerut (12th revised edition)-25002.
- Wilkinson DM (2007), Fundamental Process in Ecology: An Earth System Approach, Oxford University press, UK.
- Verma P.S. and Agarwal V.K. (2004) Cell biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi-110055.
- Rana, S.V.S. (2003): Essentials of Ecology and Environmental Science, Prentice-Hall of India Private Limited, New Delhi-110001
- Chapman JL and Reiss MJ (1999), Ecology: Principles and Application, Cambridge University Press.
- Descola, P and Pálsson, G. (1996) Nature and Society: Anthropological perspectives, Routledge, London and New York.
- Ellen, R, Parkes, P and Bicker, A. (2005) Indigenous Environmental Knowledge and its Transformations Critical Anthropological Perspectives, Harwood academic publishers, U.K.
- Gottlieb, S. R. (2004) This Sacred Earth: Religion, Nature, Environment, Routledge, New York and London.

SEMESTER II

ESIA-102: Environment Issues, Perspectives and Policies

COURSE TITLE : ENVIRONMENT ISSUES, PERSPECTIVES AND POLICIES (THEORY-CORE 2)
COURSE CODE : UG-ESIA-102
SEMESTER : II
CREDITS : 03
DURATION : 45 HOURS
MAXIMUM MARKS : 75

Course Objectives:

The course focuses on environmental pollution and different types of environmental issues. It deals with their causes and impact on the environment. Students will learn about the different types of wastes generated which affects the environment. Most importantly, students will be able to understand the different types of environmental policies and laws.

Course Learning Outcomes:

On the successful completion of the course, students will be able to:

CLO1 Understand pollution and its harmful effects on the environment.
CLO2 Acquire knowledge about various environmental issues, causes and effects of different types of wastes.
CLO3 Acquire knowledge about environmental policies and laws.
CLO4 Apply the basic knowledge of environmental issues and policies through field work.

Module 1: Environmental Pollution (15 hours)

Pollution: Introduction; pollutants and their statutory limits, types of pollution, air, water, and soil pollution; their causes and impact on the environment; measures to control the pollution; Acid rain: causes and its harmful effect (example of Taj Mahal), causes and prevention of Corrosion (example of rusting of iron), impact of toxic chemicals in environment. Pollution case studies with key lessons; role of an individual in prevention of pollution.

Module 2: Environmental Issues (15 hours)

Introduction, causes and impact on the environment due to global warming, climate change, ozone layer depletion, greenhouse effect, deforestation, and overpopulation; preventive measures; case studies with key lessons.

Types, causes and effects of wastes: Solid waste, plastic waste, hazardous waste, e-waste, biomedical waste and batteries waste; waste management; control measures of urban and industrial wastes.

Urban problems related to energy; from unsustainable to sustainable development. Environmental ethics: issues and possible solutions.

Module 3: Environmental Policies and Laws (15 hours)

History of Global and National policies; Stockholm conference, constitutional provision of environmental law; significance, amendments, and applications of the Wildlife (protection) Act, 1972; the water pollution act, 1974; Toxic Substances Control Act, 1976; Soil pollution Act, 1980; Forest Conservation Act, 1980; Air pollution Act, 1981; the Environment (protection) Act, 1986; National Forest Policy, 1988; Oil Pollution Act, 1990; Biological Diversity Act, 2002; the National Green Tribunal Act, 2010 and Compensatory Afforestation Fund Act, 2016, SWM rules, EIA Notification and requirements.

Various sections under the Code of Civil Procedure 1908 ('CPC'), the Indian Penal Code 1860 ('IPC') and the Code of Criminal Procedure 1973 ('CrPC') for the prevention and control of pollution with case studies (any two). Issues involved in enforcement of environmental legislation; public awareness.

COURSE TITLE : ENVIRONMENT ISSUES, PERSPECTIVES AND POLICIES (PRACTICAL-CORE 2)
COURSE CODE : UG-ESIA-102
SEMESTER : II
CREDITS : 01
DURATION : 30 HOURS
MAXIMUM MARKS : 25

1) Field visits to the local polluted area (Urban/Rural/Industrial/Agricultural) and prepare a report.
2) Field survey on environmental issues.
3) Identification of primary and secondary impacts of nearby ongoing developmental activity.
4) Study of physical and chemical parameters of soil and water.
5) Understanding compliance mechanisms and reports.
6) Understanding the procedure for environmental clearance for any sector.
7) Suggestions and Recommendations for a better plan of surrounding environments.

REFERENCES:

Mandatory Reading:

- Bharucha E. (2013): Text Book of Environmental Studies. University Press (India) Private Limited, Hyderabad (A.P.) India.
- Kaushik, A., Kaushik, C. P. (2004): Perspectives in Environmental Studies. 2nd Edition. New age international limited publishers, New Delhi.

Supplementary Reading:

- Asthana, D. K., Asthana M. (2009): A Text book of Environmental Studies. S Chand and Company Limited, New Delhi.

WEB REFERENCES:

- https://www.shivajicollege.ac.in/Study/Environmental%20Pollution.pdf
- https://www.unescap.org/sites/default/files/CH08.PDF

- https://tmv.ac.in/ematerial/geography/SEM-4_CC10T%20ENVIRONMENTAL%20POLICY%20AND%20PROGRAMMES%20IN%20INDIA.pdf
- https://www.slideshare.net/SurajPoudel11/a-report-on-a-visit-to-a-local-polluted-site

ESIA-SEC 2: BASIC OF GIS AND REMOTE SENSING

COURSE TITLE : BASICS OF GIS AND REMOTE SENSING (THEORY-SEC 2)
COURSE CODE : UG-ESIA-SEC2
CREDITS : 2
DURATION : 30 HOURS
MAXIMUM MARKS : 50

Course Objectives:
The course focuses on the fundamentals concept Geographical Information System, GPS and Remote Sensing. The aim is to Gain basic experience in the hands-on application of use of GPS, GIS and remote sensing data through visual interpretation and digital image processing exercises.

Course Learning Outcomes:
On completion of the course, the students will be able to
CLO1 Demonstrate proficiency and conceptual understanding in techniques to carry out GIS and Remote Sensing maps
CLO2 Have thorough understanding of the different type of datasets and software's available for GIS and Remote sensing applications
CLO3 Be equipped with practical skills and the ability to apply their theoretical concept to design, perform experiments, analyze, and interpret GIS & RS data and maps
CLO4 Develop proficiency in GIS based Software.

Module 1: Introduction to GIS and GPS (15 hours)
History and development of GIS; Data: Types- Spatial, Attribute and metadata; GIS file formats: raster and vector; spatial relationships and linear networks; GIS Data Capture Methods: primary and secondary; GIS maps; Introduction to GIS software: EpiCollect, QGIS, and ArcGIS; GPS: Description, Error Sources and Receiver; Uses and Applications of GIS

Module 2: Introduction to Remote Sensing (15 hours)
Introduction to RS: History and development; Stages in RS; Electromagnetic Spectrum & EMR; Interaction of EMR with atmosphere and earth surface; Platform: Ground based, air-borne, space-borne; Geostationary satellite and polar orbiting satellite; Sensors: Sensor types- analogue and digital and Sensor resolution; processes of sensor and its characteristics, Whiskbroom and Push broom cameras; Interpretation of Satellite Imageries: Elements of visual interpretation: Tone, Color, Texture, Pattern, Shape, Size and associated features

COURSE TITLE : BASICS OF GIS AND REMOTE SENSING (PRACTICAL-SEC 2)
COURSE CODE : UG-ESIA-SEC2
SEMESTER : II
CREDITS : 01
DURATION : 30 HOURS
MAXIMUM MARKS : 25

1. Working with Global Positioning System (GPS)
2. Introduction to QGIS software
3. Base map preparation
4. Georeferencing and Projection of the base map
5. Data Conversion – Vector to Raster, Raster to Vector
6. Adding Attribute Data – Querying On Attribute Data
7. Vector Analysis
8. Raster Analysis
9. Developing Digital Elevation Model
10. Identifying visual features marked on IRS IC LISS III imagery

REFERENCES:

- Joseph, George (2007) Fundamentals of Remote Sensing Universities Press India.
- Lillesand, T.M.; R.W. Kiefer, and J.W. Chipman (2007). Remote sensing and image interpretation, 5th ed., Wiley. ISBN 0-471-15227-7.
- Chang, K. (2007) Introduction to Geographic Information System, 4th Edition. McGraw Hill.
- Campbell, J.B. (2002). Introduction to remote sensing, 3rd ed., The Guilford Press. ISBN 1-57230-640-8.
- Curran Paul, J. (2000) Principles of Remote Sensing UK: ELBS.
- Burrough, P.A. and McDonnell, R.A. (1998) Principles of geographical information systems. Oxford University Press, Oxford, 327 pp.

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