THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

(OBE- 2022 ADMISSION ONWARDS), FOLLOWED BY

TEMU ORDER NO. 1245/2019/GENERAL/P.V. dated 26 February 2021, CREDIT AND SEMESTER SYSTEM, M. A./ M. Sc. PROGRAMME REGULATIONS 2019.

SCHOOL OF ENVIRONMENTAL STUDIES

FACULTY OF ENVIRONMENTAL STUDIES

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PREFACE OF THE PROGRAMME IN MASTER OF ARTS/ SCIENCE IN ENVIRONMENTAL STUDIES

"As long as the last man exists, the history of nature and the history of man will only complement each other. Because this nature is the immaterial body of man himself".

-Karl Marx

Mankind, which imitated what was seen in nature, created the arts and embraced scientific teaching, has over time become one of the most influential social creatures on nature. In an interdependent system of living things intertwined like a cyclical chain, man's interventions for his own narrow conquests have long since reached a point where they affect the earth and all living things as a whole. As a result, we are in the midst of a number of factors that are rapidly disappearing from life on Earth, including environmental changes and global warming that are destroying habitats through endangered species. Natural disasters and nuclear / virus attacks, which are enough to stun the world, have been in the news lately. In fact, it must be assumed that there has never been another time when the conservation of nature has been given so much importance after the creation of mankind.

Gautama Buddha, who came out of the castle to live with nature, and Karl Marx, who observed that human liberation movements could only make sense if they stood with the protection of the environment, and Mahatma Gandhi, who stated that nature exists for the benefit of mankind and not for the sake of mankind, had long been plagued by the effects of exploitation. It has become imperative to mould a generation that knows the inseparable link between nature and man to survive the disasters caused by ignorance about environmental issues. Today, the scientific world and social thinkers are aiming to comprehensively study the interrelationships of human activities, to create living norms and to create awareness about them while minimizing environmental impact. As part of this, it is shaping up to be an environmental curriculum and a top-notch curriculum in universities, incorporating perspectives in the interdisciplinary fields.

This ecology course aims to build an ecologically conscious society in order to take seriously the ideologies of nature conservation and development that are misunderstood as contradictory. This postgraduate course, which is geared towards incorporating the socio-cultural, economic and ethical perspectives that accompany them, will provide students with insights and practices that will preserve the natural benefits for future generations. The structure of this course puts forward a number of ideas to develop the 'environmental skills' of our small state of Kerala, which is facing many ecological features as well as crises, and to treat them in a principled and realistic

manner. Students who study with a meaningful belief in sustainable development and environmental justice should be able to systematically understand Kerala's environmental problems and present sustainable solutions to them.

The course is designed to follow the example of renowned national universities and differentiate between M. A. and M.Sc. on a single platform. In the first two semesters, M. A. and MSc students share the basics and thoughts of the environment through class activities together. Equations based on environmental knowledge such as energy, development, laws, conservation models, climate change and biodiversity conservation will be discussed here. During the third and fourth semesters, M. Sc. students focus on science-based environmental chemistry, environmental geology, environmental pollution, environmental determination strategies, environmental biotechnology, and waste treatment technologies. Students develop an in-depth understanding of environmental history, environmental sociology, environmental philosophy, environmental communication, voluntary organizations and sustainable development. The second year syllabus structure includes practical training in various techniques, field visits, short projects and research projects.

Let us hope that this career-oriented curriculum will lead to the creation of a visionary student body that is aware of nature and lives prudently, spreading environmental awareness in the community.

BOARD OF STUDIES MEMBERS

1. **Dr. Jainy Varghese** (Chair, School of Environmental Studies, Thunchath Ezhuthachan Malayalam University)

2. **Dr. P. A. Aziz** (Former Director, Salim Ali Centre for Ornithology and Natural History)

3. **Dr. Jaya D.S.** (Dean, Faculty of Applied Sciences and Technology, Professor, Department of Environmental Sciences, University of Kerala)

4. **Dr. Vidyasagaran** (Professor & Dean (Retd.), College of Forestry, Vellanikkara)

5. **Dr. T. V. Sajeev** (Chief Scientist, Kerala Forest Research Institute, Peechi, Thrissur)

6. **Dr. C. C. Harilal** (Professor, Coordinator, Department of Environmental Sciences, University of Calicut)

7. **Dr. V. Balakrishnan** (Former Member Secretary, Kerala State Biodiversity Board)

8. **Dr. Jyothi Krishnan** (Head, Disaster Management Department, Loyola College)

9. **Dr. Jude Emmanuel** (Environmental Scientist, Directorate of Environment and Climate Change)

10. **Dr. Dhanya R.** (Assistant Professor, School of Environmental Studies, Thunchath Ezhuthachan Malayalam University)

PROGRAMME REGULATIONS

MASTER OF ARTS/ SCIENCE (M. A./ M. Sc.) IN ENVIRONMENTAL STUDIES, OBE, 2021 ADMISSION ONWARDS, FOR SCHOOL OF ENVIRONMENTAL STUDIES

TITLE OF THE PROGRAMME

MASTER OF ARTS/ SCIENCE (M. A./ M. Sc.) IN ENVIRONMENTAL STUDIES

DURATION OF THE PROGRAMME

The course is conducted in a regular mode with a total of four semesters in which each semester having 90 working days distributed over 18 weeks with each week having 5 working days.

ELIGIBILITY FOR ADMISSION

M. Sc. Environmental Studies

Should have passed Plus Two with Science and obtained a degree in any subject from a recognized university and passed the entrance examination conducted by Thunchath Ezhuthachan Malayalam University. Admission will be subject to the approved exam regulations of Thunchath Ezhuthachan Malayalam University. Also the admission process will reflect the orders issued by University Grants Commission and State Government from time to time. Existing reservation rules at the time of admission will also be strictly adhered to.

ADMISSION PROCEDURE

Merit of entrance examination will be considered for admission. The exam will carry questions related to the aptitude of the candidate towards the discipline of study, language ability and general knowledge.

TEACHING LEARNING STRATEGY

The medium of instruction and learning will be Malayalam. The classroom instructions will be done using modern technology as well as practical training sessions. Fieldwork and laboratory facilities will be used for practical training sessions.

MEDIUM OF INSTRUCTION AND EXAMINATION

The medium of instruction and examination in Thunchath Ezhuthachan Malayalam University is Malayalam language. Encouraging knowledge generation and dissemination through Malayalam language is highly promoted as envisioned by the Thunchath Ezhuthachan Malayalam University.

DISSERTATION AND VIVA

It is intended to be a brief research conducted throughout the fourth semester on environmental issues in Kerala on the basis of precise methodology. Also includes a viva exam led by an external subject expert related to the dissertation. Eighty marks are assigned for dissertation report submission and twenty marks for viva examination.

INTERNSHIP

This is intended to visit institutions (non-governmental organisations, government institutions, universities, research institutions) providing exposure to environmental conservation and related subjects, participate in the activities and acquire skills related to environmental activities (for a duration of minimum fifteen days). Examination related to this includes an oral examination led by an external subject expert. 80 marks are provided for submission of internship report and 20 marks for oral examination. The report should be not less than 30 pages with illustrations

INFRASTRUCTURE

Smart classrooms - 2 (Projector - 2, Computer-2, Wi-Fi and LAN facilities)

Laboratory: 1 (It consists of chemicals, glasswares and equipment needed for basic scientific experiments)

STUDENT ORIENTATION

The main purpose of the course is to develop knowledge in various field/ laboratory on appropriate management strategies for environmental protection and conservation. A paper is specially designed in the third semester to help students gain proficiency in laboratory training. After gaining expertise in the theories of the respective subjects in most of the papers, field based work is made compulsory in the final units to enhance field knowledge. It also facilitates visits to non-governmental organisations (NGOs) and research institutes under National and State

governments. The course also facilitates opportunities to enhance laboratory knowledge/ field research in final semester project work.

PROGRAMME OUTCOME (PO) OF THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

PO 1: Growth and development of Malayalam language as priority

Inculcate novel thoughts envisioning strategies to elevate the knowledge status of Malayalam. Realise the scope of regional languages for developing a knowledge society. Understand the potential for exchanging knowledge via language and transform Malayalam as a corridor to enable the transfer of global knowledge.

PO 2: Develop critical thinking

Breed a scientific outlook based on rational/ critical approach applicable at individual, social and institutional levels. Endeavour from a University level to inculcate confidence among the general public by demonstrating every knowledge resources by choosing Malayalam as the medium.

PO 3: Involve in self-driven and lifelong learning and research activities

Perceive the evolutions happening in the fields of science and technology. Envisage a society that can actively participate in resolving the societal hindrances that arise from time to time.

PO 4: Embrace the values and ethics

Adherence to enshrined values and ethics in the Indian constitution and act accordingly with fellow beings. Empower the Kerala society to participate in the rebuilding process at different levels.

PROGRAMME SPECIFIC OUTCOME (PSO) OF MASTER OF SCIENCE (M. Sc.) IN ENVIRONMENTAL STUDIES

PSO 1: Understand the concepts of ecology, biodiversity conservation, natural resource management, climate change, disaster management, environmental impact assessment, environmental laws and policies.

PSO 2: Apply the principles of sustainable development to address the environmental and developmental issues.

PSO 3: Develop skills for the critical evaluation of environmental issues, environmental movements and its political scenario with reference to Kerala.

PSO 4: Practice environmental ethics to become socially and environmentally responsible citizens.

PSO 5: Develop research aptitude in environmental conservation and management and communication skills to solve environmental issues in the state of Kerala.

PSO 6: Apply advanced analytical, scientific, and technological tools for environmental management and policy making.

PSO 7: Develop skills to disseminate scientific knowledge in Malayalam.

SEMESTER WISE MAPPING OF

MASTER OF ARTS/ SCIENCE IN ENVIRONMENTAL STUDIES

OBE PROGRAMME

SEMESTER I

Core/ Elective	Course Code	Course Title	Credit	Internal Marks	External Marks	Internal Evaluation	External Evaluation
Core	MUCC-C 1001	Knowledge Status of Malayalam language	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6106	Ecology: Basic Principles	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6107	Biodiversity Conservation and Management	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6108	Energy and Environment	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6109	Sustainable Development: Theory and Practice	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam

		Total = 20 Credits				

SEMESTER II

Core/ Elective	Course Code	Course Title	Credit	Internal Marks	External Marks	Internal Evaluation	External Evaluation
Core	MUES-C 6211	Environmental Laws and Jurisprudence	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6212	Environmental Impact Assessment and Disaster Management	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6213	Climate and Climate Change	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6214	Natural Resource Management	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUES-C 6215	Research Methodology	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6216	Field visit	2	Field visit report = 80	Viva = 20	Field visit report	Viva
		Total = 22 Credits					

SEMESTER III

Core/ Elective	Course Code	Course Title	Credit	Internal Marks	External Marks	Internal Evaluation	External Evaluation
Core	MUSES-C 6320	Environmental Chemistry and Analytical Techniques	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6321	Conservation Ecology	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6322	Environmental Geosciences	4	30	70	Seminar PresentationAssignmentMid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6323	Environmental Pollution and Control	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6324	Practical	4	Practical record = 80	Viva = 20	Practical record	Practical record, Viva
Open elective	MUEVS-OE 6301	Environmental Health and Education	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Open elective	MU EVS-OE 6302	Environment and Society	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam

		Total = 24 Credits				

SEMESTER IV

Core/Elective	**Course Code**	**Course Title**	**Credit**	**Internal Marks**	**External Marks**	**Internal Evaluation**	**External Evaluation**
Elective	MUSES-E 6424	Environmental Economics	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Elective	MUSES-E 6425	Environmental Biotechnology and Ecotoxicology	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Elective	MUSES-E 6426	Environmental Health and Education	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Elective	MUSES-E 6427	Waste Management and Techniques	4	30	70	Seminar Presentation Assignment Mid Semester Exam Attendance	End Semester Exam
Core	MUSES-C 6428	Dissertation	4	Project report = 80	Viva = 20	Project report	Viva, Project report
Core	MUSES- C 6429	Internship	2	-	-	Internship report	Viva, Internship report
		Total =14 Credits					

SEMESTER WISE COURSE OUTCOME,COURSE CONTENT & TAGGING

SEMESTER I

CORE:

MUCC-C 1001 KNOWLEDGE STATUS OF MALAYALAM LANGUAGE (4 CREDITS)

COURSE OUTCOME (CO):

On successful completion of this course the students will be able to

CO 1: Understand the relationship between Mother tongue and social development

CO 2: Classify the development of Malayalam language in the fields of technology, science, academic and political extents

CO 3: Conduct political analysis based on social justice

CO 4: Create concepts based on language technology

CO 5: Develop capacity to craft language planning for language technology and lexicon

CO 6: Discover the importance of translation in the development of mother tongue

COURSE CONTENT:

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TAGGING:

CO	**COURSE OUTCOME**	**PO**	**PSO**	**CL**	**KC**	**THEORY HOURS**	**PRACTICAL/ LAB/FIELD HOURS**
CO. 1	Understand the relationship between Mother tongue and social development	PO2, PO4		Re, Un, An	F, C	12	0

CO. 2	Classify the development of Malayalam language in the fields of technology, science, academic and political extents	PO1, PO3		Ev, Re, Un, An	F, C	12	0
CO. 3	Conduct political analysis based on social justice	PO1, PO3, PO4		An	C	12	0
CO. 4	Create concepts based on language technology	PO2, PO3		An, Ev	C, P	12	0
CO. 5	Develop capacity to craft language planning for language technology and lexicon	PO3		An, Ap, Ev	C, P	12	0
CO. 6	Discover the importance of translation in the development of mother tongue	PO1, PO3,PO 4		An, Ap, Ev	C	12	0

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER I

CORE:

MUES-C 6106 Ecology: Basic Principles

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Describe the basic concept and emergence of ecology.

CO2. Understand the basic structure, function and different types of ecosystems.

CO3. Understand the basic concepts of biogeochemical cycles.

CO4. Understand the basic principles of population ecology.

CO5. Understand the basic concepts of biogeography and new methods of ecosystem restoration.

CO6. Develop the skills to identify the problem that persists in the locally existing food chains**.**

COURSE CONTENT:

Unit 1

Emergence of Ecology: Henry David Thoreau and Natural History, Darwin's Theory of Evolution, Ernst Haeckel's The Politics of Ecology,Gifford Pinchot - Resource Conservation, Aldo Leopold - Land Ethics, Rachel Carson - Silent Spring.**The Science of Ecology**- Contributions of Eugene Odum.An Introduction to Environmental science - Definition, Principles and Importance.

Unit 2

Ecosystem: Ecology:, Ecosystem: Definition, Concept, Structure (Biotic factors, abiotic factors: Light, temperature, rainsall, humidity, atmosphere, height, direction and slope of mountains and valley, soil).Functions-trophic levels in ecosystem, energy flow, food chain, food web, biogeochemical cycles. Global water cycle, carbon cycle, nitrogen cycle, sulfur and phosphorus cycle, mercury cycle. Ecological succession, ecotone, edge effect, niche, ecosystem services.

Different types of ecosystems- Terrestrial ecosystem (Forest, grassland, desert, mountains, islands, coral reefs), aquatic ecosystems-inland ecosystem-lentic:ponds, lakes, wetlands,

mangroves. Lotic-streams, rivers). Marine ecosystems. Estuarine ecosystem. Examples with special reference to Kerala.

Unit 3

Population Ecology - Population Density and Related Equilibrium - Variations in Population - Natality - Infant Mortality - Population Structure, Population dispersal, Growth Variations, Population Variation and Cyclical Movements, Population Control, R & K selections, Keystone species. Population dynamics, Migration, and Immigration. Isolation corridors, locality, population interactions, mutualism, symbiosis, parasitism, antibiosis, predation, competition.

Unit 4

Biogeography: Definition, Concept, Structure. Biomes: concepts, classification, distribution. Different types of biomes, characteristics-Tundra, taiga, grassland, deciduous forest biome, highland icy alpine biome, chaparral, savanna. Tropical rain forests. Ecosystem restoration(soil, river, forests).

Unit 5

Practical Training: Identify food webs in different habitats and conduct village visits to study and review the human-based food chain.

Additional classes and discussion on topics suggested by students based on Basic principles of ecology

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO 1	Describe the basic concept and emergence of ecology	PO 2	PSO 1	Re	Co	10	0
CO 2	Understand the basic structure, function and different types of ecosystems.	PO 2	PSO 1	Un	Co	5	0
CO 3	Understand the basic concepts of biogeochemical cycles.	PO 2	PSO 1	Un	Co	20	0
CO 4	Understand the basic principles of population	PO 2	PSO 1	An	Co	20	0

	ecology.						
CO 5	Understand the basic concepts of biogeography and new methods of ecosystem restoration.	PO 2, PO 3	PSO 1	Ev	Co	10	0
CO 6	Develop the skills to identify the problem persist in the locally existing food chains	PO 2	PSO 3	Cr	Pr	15	2

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER I

CORE:

MUES-C 6107 Biodiversity Conservation and Management

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1: Understand the basic concepts of biodiversity

CO2: Analyze the importance of biodiversity in sustaining local livelihoods.

CO3: Understand people's participation in biodiversity conservation

CO4: Understanding the causes of biodiversity loss and 'constraints' to conservation measures.

CO5: Practicing field-oriented methods of biodiversity estimation.

CO6: Practice methods used for population data analysis of species.

COURSE CONTENT:

Unit 1

Biodiversity - basic concepts: concepts, dimensions, genetic, species and ecosystem diversity. Biodiversity transformation according to earth's chronology (diversification through geological time scale). Bio-protected areas - biodiversity hotspots, biosphere reserves, national parks, wildlife sanctuaries, community reserves., IUCN bio-protected area categories, UNEP-WCMC, UNESCO-World Heritage Sites.

Unit 2

Biodiversity—services and society: Biodiversity values and services, biodiversity and livelihoods. People's participation in biodiversity conservation- Kerala Biodiversity Board, Biodiversity Management Committee, People's Biodiversity Register (PBR), Joint Forest Management (JFM), National Afforestation Programme (NAP scheme), Compensatory Afforestation Fund Management and Planning Authority (CAMPA), National REDD+ Policy-2014), Ethnoecology, Eco-linguistics, Biodiversity and Ethno-taxonomy, and Agricultural Biodiversity and Sustainability.

Unit 3

Decline in Biodiversity and Conservation: Decline of Flora and Fauna. Threatened species, IUCN classification, species included in the IUCN Red Data Book index, RET species-In the Kerala context, the main causes of threats to biodiversity - habitat destruction, environmental pollution, mining, climate change and invasion of exotic/ invasive species. Evolution of Biodiversity Conservation - Stockholm to Biodiversity Decade (2011-2020). National Forest Policy, National Environment Policy, National Biodiversity Policy.

Unit 4

Measurements of biodiversity: Population Sampling of Flora and Fauna,Necessity of sampling, characteristics of good sampling, determination methods: Observational methods; Direct quadrats, fixed area plots, permanent plots, line transect, Focal Animal Sampling, Visual Encounter Survey, Pollard Walk.
Point count method. **Species Dominance:** Dominance, abundance, evenness, diversity indices (Shannon & Weiner, Simpson), Important Value Index. Data analysis using software (Biodiversity Pro, Estimates).

Unit 5

Practical Experience: Field Studies Related to Biodiversity Assessment/Conservation, Biodiversity conservation and management, classes and discussions based on topics suggested by students.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand the basic concepts of biodiversity	PO 2	PSO 1	Un	Co	10	0
CO2	Analyze the importance of biodiversity in sustaining local livelihoods.	PO 2	PSO 1	Un	Co	10	0
CO3	Understanding the causes of biodiversity loss and 'constraints' to conservation measures.	PO 2	PSO 3	An	Co	15	0
CO4	Differentiate the causative factors of biodiversity loss and conservation measures	PO 2	PSO 3	An	Co	12	0
CO5	Practicing field-oriented methods of biodiversity estimation.	PO 2, PO 4	PSO 5	Ev	Co	10	0
CO6	Practice methods used for population data analysis of species.	PO 2	PSO 5	Ap	Pr	12	3

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate

Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER I

CORE:
MUES-C 6108 Energy and Environment
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Understand the principles of production and use of renewable and non-renewable energy resources.

CO2. Compare the global, national, and local energy use patterns.

CO3. Explain various methods of generating renewable energy.

CO4. Analyze the social and environmental impacts of energy production, transformation and consumption.

CO5. Evaluate the possibility of alternate energy sources at the local level.

CO6. Device sustainable energy conservation methods.

COURSE CONTENT:

Unit 1

Energy and Environment: Introduction. Energy - History, Definition, Types of energy, energy forms, major energy sources, energy and society, global energy production and use pattern; energy use pattern in India, Emission of carbon dioxide from developed and developing countries including India, Social and environmental aspects of energy production and energy use patterns.

Unit 2

Non-renewable Energy Resources: Fossil fuels - coal, petroleum and natural gas, Coal beds, Peate, Oil, Oil shale, Tar sands. Thermal power plants, nuclear fuels, Nuclear Power Plants **Renewable Energy Resources:** Solar energy:Technique for harvesting solar energy - thermal conversion, thermo-mechanical conversion, Helio-electric conversion, Photo-voltaic conversion Solar ponds, wind energy, geothermal energy, water energy, ocean energy, biomass energy: biofuels - National and Kerala Scenario.

Unit 3

Socioeconomic and environmental effects on energy production and consumption: Socioeconomic and environmental consequences of renewable and non-renewable energy sources – pollution, habitat destruction and biodiversity loss, global warming, climate change, health issues, and energy crises. Energy and economic crises.

Unit 4

Alternative energy sources: Green energy–green nuclear fusion energy, hydrogen, fuel cell, and batteries. Smart grids, supercapacitors, and efficient energy storage systems. Energy and nanotechnology, and the role of nanotechnology in energy storage systems. Hybrid fuels, compressed natural gas (CNG), oxygenated fuels, biofuels, gas hydrates, Hybrid fuels, CNG, oxygenated fuels, biofuels, Alternative fuel use patterns:Global, Indian and Kerala scenario.

Unit 5

Energy Conservation Methods: Various energy conservation projects at the national level, energy pricing technique. Energy Efficiency Standards, Energy Audit - Types (Walkthrough Audit, Intermediate Audit, Comprehensive Audit). Energy audit execution and report preparation, recommendation activities, and sustainable energy use practices – energy use control at the household and community levels, green buildings-Leeds certification. The study of indigenous energy conservation activities and sustainable energy consumption practices. Classes and discussion based on topics suggested by students based on energy and environment.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS

CO1	Understand the principles of production and use of renewable and non-renewable energy resources	PO 2	PSO 1	Un	Fa, Co	15	0
CO2	Compare the global, national, and local energy use patterns	PO 2	PSO 2	An	Co, Pr	10	0
CO3	Explain various methods of generating renewable energy	PO 2	PSO 2	An	Co	15	0
CO4	Analyze the social and environmental impacts of energy production, transformation and consumption	PO 2	PSO 3	Ev	Pr	10	0
CO5	Evaluate the possibility of alternate energy sources at the local level	PO 2, PO 3	PSO 1, PSO 2	An	Pr	10	0
CO6	Device sustainable energy conservation methods	PO 3	PSO 2	Cr	Pr	8	4

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER I

CORE:

MUES-C 6109 Sustainable Development: Theory and Practice

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the student will be able to

CO1. Understands the fundamental concepts and governance policies of sustainable development.

CO2. Discuss the existing policies and framework for achieving sustainable development.

CO3. Explain the evolution and current trends of resource utilization in the industrial and energy sector.

CO4. Evaluate the opportunities for sustainable development in cities, lifestyles, communities, and cultures.

CO5. Appraise the Kerala Development Model in the context of Sustainable Development.

CO6. Apply appropriate sustainable development strategies in the context of Kerala

COURSE CONTENT

Unit 1

Fundamental Principles of Sustainable Development: Sustainable Development: Background and Definition, Importance of Sustainable Development, Necessity of Sustainable Development, Impact of Sustainable Development. Social, Economic, and Environmental Goals of Sustainable Development, Rural-Urban Divide, Rich-Poor Divide, Sustainable Urban Vision for Poverty Eradication and Equality, Environmental Interdependence and Sustainability. Carrying Capacity of the Earth and Sustainable Development, Intergenerational and Intragenerational Equity and Sustainable Development, Climate Change and Sustainable Development.

Unit 2

Sustainable Development - Policies and Governance: Global Initiatives, Brundtland Report, Earth Summit, Johannesburg Summit – 2002, Millennium Development Goals, Sustainable Development Goals, Agenda 2030, Sustainable Development Index (SDG Index), Challenges in Achieving Sustainable Development Goals, Sustainable Development Goals and India, Economic Revitalization for Sustainable Development, National and State Green Initiatives, Environmental Taxation, Decentralization and Sustainable Development, Gross Domestic Product (GDP), Gross National Product (GNP), Human Development Index (HDI).

Unit 3

Sustainability in the Industrial and Energy Sectors: Sustainability of Products, Resource Efficiency, Recycling, Domestic Processing of Waste Materials, Reduction of Industrial Waste, Closed-loop Production Methods, Circular Economy, Corporate Ethics and Triple Bottom Line (Economy, Environment, Society), Transitions and Challenges Towards Sustainable Energy, Alternative Energy Systems, Role of Technology and Innovation in Achieving Sustainable Development.

Unit 4

Sustainable Development and Society: Environmentally Friendly Cities, Decentralized Urbanization and Small Cities, Marginalized Communities and Sustainable Development, Development and Gender Inequality, Indigenous Cultures: Lessons in Sustainability, Lifestyle Changes - Alternative Healthcare, Role of Government and Non-Governmental Organizations in Sustainable Development, Role of Local Self Governments in Sustainable Development.

Unit 5

Sustainable Development in Kerala: Geographical Features of Kerala, Primary Sectors and Sustainability, Western Ghats, Biodiversity Conservation, Restoration of Water Sources (Wetlands, Rivers), Revival of Agriculture, Sustainable Fisheries Development Policy, Revival of Fallow Lands, Sustainability and the Kerala Development Model, Alternative Development Models, Sustainable Energy, Green Transportation, Sustainable Tourism, Creation of Green Job

Opportunities in Kerala, Sustainable Rehabilitation of Housing Issues in Kerala, Alternative Construction Practices, Waste Management: Problems and Solutions, Information Technology and Sustainable Development, Classes and discussions based on topics suggested by students with a focus on the theory and practice of sustainable development.

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TAGGING:

CO	**COURSE OUTCOME**	**PO**	**PSO**	**CL**	**KC**	**THEORY HOURS**	**PRACTICAL/ LAB/FIELD HOURS**
CO1	Understands the fundamental concepts and governance policies of sustainable development	PO 2	PSO 2	Un	Fa	10	0
CO2	Discuss the existing policies and framework for achieving sustainable development	PO 2, PO 3	PSO 1	Un	Co	15	0
CO3	Explain the evolution and	PO 2	PSO 1	An	Pr	10	0

	current trends of resource utilization in the industrial and energy sector						
CO4	Evaluate the opportunities for sustainable development in cities, lifestyles, communities, and cultures	PO 3	PSO 2 PSO 4	Ev	Pr	15	0
CO5	Appraise the Kerala Development Model in the context of Sustainable Development	PO 3	PSO 5	Ev	Pr	10	0
CO6	Apply appropriate sustainable development strategies in the context of Kerala	PO 2, PO 3	PSO 2	Ev	Pr	12	0

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

MODEL QUESTION PAPER

UNIVERSITY EMBLEM

THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

NAME OF EXAMINATION MONTH – YEAR

COURSE CODE

PROGRAMME TITLE

COURSE TITLE

TIME: 3HRS **MAXIMUM MARKS: 70**

I.Answer all questions (5X2=10)

(Cognitive Level: Remembering/ Understanding)

1.
2.
3.

4.
5.

II.Answer any six questions not exceeding two pages (6X6=36)

(Cognitive Level: Analyse/ Apply)

6.
7.
8.
9.
10.
11.
12.
13.

III.Answer any two questions not exceeding five pages (2X12=24)

(Cognitive Level: Apply/ Analyse/ Evaluate/ Create)

14.
15.
16.

SEMESTER II

CORE:

MUES-C 6211 Environmental Laws and Jurisprudence

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the student will be able to

CO1: Understand the history and development of the environmental laws in India.

CO2: Analyze the laws related to natural resources and environmental pollution.

CO3: Analyze the importance of laws in environmental cases in India.

CO4: Evaluate the environmental laws and jurisprudence in Kerala.

CO5: Evaluate the practice of laws and justice through National Green Tribunal (NGT), Public Interest Litigation (PIL) and public strikes in Kerala scenario.

CO6: Evaluate environmental Impact Assessment and green accounting.

COURSE CONTENT:

Unit 1

Environmental Laws and Policies: Introduction: Environment and laws, Sources of law, General principles for environmental protection: Public Trust Doctrine, Precautionary Principle, Polluter Pays Principle, Strict Liability, Absolute Liability, Intergenerational and Intragenerational Equity, Common but Differentiated Responsibility, Good Neighborliness Principle, Sustainable Development. Environmental treaties and conventions: Ramsar Convention 1971, Stockholm Conference 1972, Montreal Protocol 1987, Convention on Biological Diversity 1992, Convention on International Trade in Endangered Species (CITES), Earth Summit 1992, Convention to Combat Desertification, Kyoto Protocol 1997, Paris Agreement 2015, Basel Convention 1989, United Nations Convention on the Law of the Sea (UNCLOS)

Unit 2

Indian Legal Framework and Environmental Protection: Indian Legal System: Constitution, laws, and regulations, Tort law, public nuisance, Constitutional provisions for environmental protection: Article 14, Article 19(1)(g), Article 21, Article 32, Article 47, Article 48A, Article 51A(g), Article 226, Article 253. Wildlife (Protection) Act 1972, Forest Conservation Act 1980, Indian Forest Act, Biological Diversity Act 2002, Coastal Regulation Zone (CRZ) Rules, Forest Rights Act 2006, River interlinking and interstate water sharing, National Forest Policy 1988, National Water Policy 2002, National Environment Policy 2006, Public Interest Litigations, National Green Tribunal (NGT), Green Bench.

Unit 3

Pollution Control Laws in India: Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981, Environment (Protection) Act 1986, Noise Pollution Rules 2000, Waste Management Rules: Solid Waste, Plastic Waste, Electronic Waste, Construction and Demolition Waste, Hazardous Waste, Batteries. Public Liability Insurance Act 1991, Responsibilities of Pollution Control Boards.

Unit 4

Environmental Laws and Policies in Kerala: Laws related to the protection of paddy fields and wetlands, Laws related to sand mining, Laws related to the protection of forests and trees, Laws related to groundwater, Environmental sensitive areas, Protection systems, Role of local self-government institutions in environmental laws within the Kerala context.

Unit 5

Cases Related to Environmental Protection: Trail Smelter Arbitration, Rylands vs. Fletcher, Municipal Council Ratlam vs. Vardichand, L.K. Koolwal vs. Rajasthan, Vellore Citizens Welfare Forum vs. Union of India, M.C. Mehta vs. Kamal Nath, S. Jagannath vs. Union of India, Rural Litigation and Entitlement Kendra vs. Uttar Pradesh, M.C. Mehta vs. Union of India, Oleum Gas Leak Case, Union Carbide Corporation vs. Union of India (Bhopal Gas Tragedy), Narmada Bachao Andolan vs. Union of India, Lafarge Umiam Mining Limited vs. Union of India, T.N. Godavarman Thirumulpad vs. Union of India 2006, B.L. Wadehra vs. Union of India 2001, Classes and discussions based on topics suggested by students, grounded in environmental systems and laws.

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TAGGING:

CO	**COURSE OUTCOME**	**PO**	**PSO**	**CL**	**KC**	**THEORY HOURS**	**PRACTICAL/ LAB/FIELD HOURS**
CO1	Understand the history and development of the environmental laws in India	PO 4	PSO 1	Un	Fa, Co	10	0
CO2	Analyze the laws related to natural resources and environmental pollution	PO 3	PSO 1, PSO 5	An	Co, Pr	15	0
CO3	Analyze the importance of laws in environmental cases in India	PO 2	PSO 1, PSO 4	An	Pr	15	0
CO4	Evaluate the environmental laws and jurisprudence in Kerala	PO 2	PSO 3	Ev	Pr	10	0
CO5	Evaluate the practice of laws and justice through	PO 2, PO 3	PSO 1, PSO 3	Ev	Fa, Pr	12	0

	National Green Tribunal (NGT), Public Interest Litigation (PIL) and public strikes in Kerala scenario						
CO6	Evaluate environmental Impact Assessment and green accounting	PO 3	PSO 3	Ev	Co, Pr	10	0

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER II

CORE:

MUES-C 6212 Environmental Impact Assessment and Disaster ManagemenTt

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1: Explain the basic concepts and methods of Environmental Impact Assessment (EIA) & Life Cycle Assessment (LCA).

CO2: Understand the basic concept of disaster and disaster management.

CO3: Evaluate the environmental clearance process and EIA procedures for developmental projects in India.

CO4: Evaluate the role of government/non-government sectors in disaster management.

CO5: Evaluate the role of laws and policies in disaster management.

CO6: Appraise the role of EIA, LCA & Disaster management in achieving sustainable development.

COURSE CONTENT:

Unit 1

Environmental Impact Assessment (EIA): Introduction, Definition, Goals, Evolution, Advantages, Participants in EIA process, Stages in EIA, Types of EIA. Baseline data in EIA process - environmental data, project data, project alternative data, Characteristics of impacts, impact analysis methods - impact identification (Ad hoc method, checklists, matrices, networks, overlays, quantitative or index method), impact prediction, impact evaluation, impact mitigation cost benefit analysis, Environment Management Plan (EMP), Statement (EIS), Structure of EIA report, Social Impact Assessment, Cumulative Impact Assessment.

Unit 2

Environmental Impact Assessment in India: Procedures and guidelines for environmental clearance, EIA Notification 1994, 2006, amendments, EIA experts, Overview, current procedures and guidelines for environmental clearance, EIA notification, EIA consultants. Case studies for EIA in Kerala scenario - water projects, industries, mining and quarrying, highway construction, tourism, building construction, and energy (water- thermal - atomic - oil - natural gas - solar - power).

Unit 3

Life Cycle Assessment (LCA): Goal and scope, Different stages of life cycle assessment, types (cradle to grave, gate to gate, cradle to cradle, cradle to cradle to gate, etc.), uses of LCA, specialists in LCA, applications of LCA- case studies.

Unit 4

Disaster - Basic Concept: Definitions (disaster, hazard, vulnerability, risk). features of disaster, Cause factors of disaster, Risk assessment -Hazard Identification, Hazard Accounting, Scenario of Exposure, Risk Characterization & Management. Classification of disasters. Classification of disasters. Database of disasters: at the global national and regional level. General status of disasters in Kerala, natural disasters and environmental issues in Kerala.

Unit 5

Disaster Management and Policies: Disaster Management - Definition, stages in Disaster Management Cycle (Prevention, Preparedness, Response and Recovery), Role of Various Departments in the Disaster Management Process (Health, Communication, Insurance, Fire Brigade, Police, Military and Paramilitary Forces, Voluntary Organizations, Local Self-Governing Bodies.Various policies for disaster management: Sendai Framework, Disaster Management Act 2005, National Disaster Management Authority (Origin and Functions), State Disaster Management Authority. The role of advanced technologies such as remote sensing and geographic information system (GIS) in disaster management. Classes and discussion based on topics suggested by students based on environmental impact assessment and disaster management

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Explain the basic concepts and methods of Environmental Impact Assessment (EIA) & Life Cycle Assessment (LCA)	PO 2	PSO 1	Un	Co	15	0
CO2	Understand the basic concept of disaster and disaster management	PO 2	PSO 2	Un	Co	15	0
CO3	Evaluate the environmental clearance process and EIA procedures for	PO 2	PSO 1	An	Pr	15	0

	developmental projects in India						
CO4	Evaluate the role of government/non-government sectors in disaster management	PO 2	PSO 2	Ev	Pr	5	0
CO5	Evaluate the role of laws and policies in disaster management	PO 2	PSO 1	An	Pr	10	0
CO6	Appraise the role of EIA, LCA & Disaster management in achieving sustainable development	PO 2, PO 3	PSO 2	Ev	Pr	12	0

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER II

CORE:

MUES-C 6213 Climate and Climate Change

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO 1: Understand the scientific concepts and history of climate change.

CO 2: Describe the factors influencing climate change.

CO 3: Examine the environmental, social and economic impacts of climate change on global, national and Kerala scenarios.

CO 4: Appraise the mitigation and adaptation measures for climate change.

CO5: Compare the global, national and state level initiatives for addressing climate change.

CO 6: Report the impacts of climate change based on field visit.

COURSE CONTENT:

Unit 1

Climate Change: Science and History: Climate change - definition, concepts - day conditions and weather. Climate classification, climatic variability, Measurement of climate change, monitoring and assessment. Causes - Global warming, greenhouse effect, urban islands, ozone layer depletion, air pollution, heat and cold waves, global dimming, use of fossil fuels, global dimming, the use of fossil fuels, the amount of carbon in the atmosphere that resulted from the Industrial Revolution and the Scientific Revolution, El Nino and La Nina - shocks.

Unit 2

Climate change and its Implications: Temperature rise, changes in agriculture and living organisms, Diseases, Sea Level Rise, Changes in the Geographical Distribution of flora and Fauna and Microorganisms, Ice melting, Fluctuations in the amount and duration of rainfall, Socio-Economic and environmental impacts of Climate Change - global, national and Kerala scenario.

Unit 3

Climate Change: Solution Setting: Carbon Management - Carbon Sequestration, Soil carbon Sequestration, ways to increase carbon sequestration- bio-fencing in coastal areas, afforestation, use of Biofuel, Carbon Farming and Carbon Trading. Climate change and

disasters - mitigation measures - farming methods, land use, technologies, potential of solar energy, smart grid, hydrogen fuel, green building

Unit 4

Climate Change: Global Initiatives: Global Warming - Sustainable Lessons - Resilient Cities, Global Agreements, Clean Development Mechanism (CDM), Protocols, Programs in collaboration with the United Nations – UNEP, UNSD, UNFCCC, Climate change in Indian Context: National Action Plan on Climate Change (NAPCC), Climate change in Kerala Context, State Action Plan on Climate Change, Local Action Plan on Climate Change, Indian Participation in International Agreements.

Unit 5

Climate change: Practical training: Implications of climate change – an indigenous-level review (review of field visits/related studies). Classes and discussion based on topics suggested by students based on climate and climate change.

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Toman, Michael, A., Ujjayant Chakravorty and Sreekant Gupta, 2004, India and Global Climate Change, New Delhi: Oxford University Press.

Further Reading

Hansen, James, 2009, Storms of my Grandchildren, London: Bloomsbury.

Lynas, Mark, 2007, Six Degrees: Our Future on a Hotter Planet, London: Fourth Estate (Harper Collins)

Monbiot, George, 2006, Heat How we can stop the Planet Burning, Allen Lane (Penguin Books).

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand the scientific concepts and history of climate change	PO 2	PSO 1	Un	Fa, Co	15	0
CO2	Describe the factors influencing climate change	PO 2	PSO 1, PSO 2, PSO 3	Un	Co	15	0
CO3	Examine the environmental,	PO 2	PSO 3	An	Co	10	0

	social and economic impacts of climate change on global, national and Kerala scenarios						
CO4	Appraise the mitigation and adaptation measures for climate change	PO 2, PO 3	PSO 2	Ev	Co, Pr	5	0
CO5	Compare the global, national and state level initiatives for addressing climate change	PO 2	PSO 3	Cr	Pr	10	0
CO6	Report the impacts of climate change based on field visit	PO 2, PO 3	PSO 5	Cr	Pr	10	7

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER II

CORE:

MUES-C 6214: Natural Resource Management

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1: Understand the concepts and approaches of natural resource management, ecosystem services and their conservation.

CO2: Understand the political environment in natural resource management

CO3: Explains the relationship between the concepts of natural resource development and poverty inequality

CO4: Explaining the different types of natural resources

CO5: Understanding international and national resource consumption patterns

CO6: Introducing technology for natural resource management

CO7: Understand the legal framework for resource management

COURSE CONTENT:

Unit 1

Natural Resources: Concept, Classification. Factors Affecting Resource Availability and Distribution. Environmental, Social, and Economic Dimensions of Resource Management. Natural Resources and Development. Poverty in Developing Countries, Resource Scarcity, and Causes of Poverty. Evolution and History of Resource Management Models. Conflicts Related to Resource Utilization: Resource Utilization, Availability. Natural Resources - Marginalization, Gender, Inequality. Political Ecology of Natural Resource Management.

Unit 2

Forest Resources: Forests and wildlife resources, current status, distribution, usage, services (water cycle, carbon sequestration, etc.), overexploitation, deforestation, timber consumption, mining, dams, the impact on tribal communities, forest products. Conservation and management strategies in developed and developing countries. Kerala case studies.

Food Resources: Global food issues, changes due to agriculture and overgrazing, impacts of modern agriculture, problems related to chemical fertilizers and pesticides. Kerala case studies.

Unit 3

Land Resources: Land resources, land use classification, desertification. Land resource management and key issues. Kerala case studies.

Water Resources: Surface and groundwater usage and exploitation, drought, conflicts, dams – benefits and issues, water ecology, and management. Water sources. Kerala case studies.

Mineral Resources: Usage and exploitation, environmental impacts of extraction and use of mineral resources. Kerala case studies.

Energy Resources: Increasing energy needs, renewable and non-renewable energy sources, use of alternative energy sources. Kerala case studies.

Unit 4

Approaches to Resource Management: Ecological approach (Ecorestoration, afforestation projects, etc.), economic approach (Industrial revolution, capitalism, neo-liberalization, LPG policies, ownership structures, externalities, Pigovian tax, Coase theorem, valuation methods - compensatory payment, contingent valuation), technical approach, social approach (integrated resource management strategies), impacts of approaches. Legal framework for resource management (IPR, laws, and policies).

Management of Common Resources: International scenario - oceans, climate, international fisheries and management commissions. Antarctica: evolution as an international resource management regime. National scenario - sustainable agriculture, non-timber forest products (NTFP), community tourism, responsible tourism, sustainable tourism.

Unit 5

Group project on environmental/economic/technical/social aspects of natural resource management. Classes and discussions based on topics suggested by students focusing on natural resource management.

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Shailendra K. Singh, Subhash C, Kundu and Shobhu Sing, 1998, Disaster Management, New Delhi, Mittal Publications.

TAGGING:

CO	**COURSE OUTCOME**	**PO**	**PSO**	**CL**	**KC**	**THEORY HOURS**	**PRACTICAL/ LAB/FIELD HOURS**
CO1	Understand the concepts and approaches of natural resource management, ecosystem services and their conservation.	PO 2	PSO 1	Un	Fa	6	0
CO2	Understand the political environment in natural resource management	PO 2	PSO 3	Un	Fa	6	0
CO3	Explains the relationship between the concepts of natural resource development and poverty inequality	PO 2	PSO 3	Un	Fa	6	0
CO4	Explaining the different types of natural resources	PO 2, PO 3	PSO 2	Un	Fa	8	0
CO5	Understanding international and national resource consumption patterns	PO 2, PO 3	PSO 5	An	Co	8	0
CO6	Introducing technology for natural resource management	PO 2	PSO 5	Ev	Co	12	0
CO7	Understand the legal framework for resource	PO 3	PSO 5	Cr	Pr	15	5

	management						

CO1: CO2: Understand the political environment in natural resource management

CO3: Explains the relationship between the concepts of natural resource development and poverty inequality

CO4: Explaining the different types of natural resources

CO5: Understanding international and national resource consumption patterns

CO6: Introducing technology for natural resource management

CO7: Understand the legal framework for resource management

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER II

CORE:
MUES-C 6215: Research Methodology
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Understand the basic concepts, types and stages of research.

CO2. Explain scientific methods of sampling and data collection.

CO3. Understand the basic statistical methods and tools used in science and social science research.

CO4. Develop data analysis and interpretation skill.

CO5. Understand the methods of participatory research.

CO6. Develops skills in writing scientific and research reports.

CO7. Understand the basic concept of research quality indicators and research ethics.

COURSE CONTENT:

Unit 1

Research: Definition, Origin, Meaning, Objectives, Qualities and Criteria for Good Research. Types of research (Theoretical, Applied, Descriptive, Historical, Observational, Experimental, Qualitative, Quantitative).

Unit 2

Different Stages of Research: Formulating research problem, Extensive Literature Survey, Development of working Hypothesis, Preparing Research Design, Determining Sample Design,Sampling Strategies: Probability Sampling (Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, multi-stage sampling). Non-probability sampling (Convenient sampling, Judgment sampling, Quota sampling, Snowball sampling). Data collection, Execution of the Project, Analysis of data, Generalisations and Interpretations, Preparation of Thesis Writing.

Unit 3

Data Collection and Analysis: Data collection - primary data collection methods (observation, interview, questionnaire, schedule), Secondary data collection, Data Analysis: Editing, coding, classification, tabulation, table, graphs. Familiarizing the basic concept of statistical methods used in data analysis (Measures of Central Tendency & Dispersion, Standard Error, measurement of Skewness & Kurtosis, Correlation Analysis, Regression Analysis, ANOVA, Hypothesis testing- t-test, F-test, Chi-Square test. Basic Concepts of Non Parametric Test - Kruskal-Wallis test, Mann-Whitney U test. Wilcoxon Test). Data analysis using softwares.

Unit 4

Methodology of Participatory Research: Different types of participatory research methods - Rapid Rural Appraisal, Participatory Rural Appraisal, Ethnography, case study, Focus Group Discussion.

Unit 5

Research and Related Components: Footnote, Reference Preparation, Various Models of Reference. Preparation of Research Papers / Research Report (Technical Report, Popular Report) / Synopsis. Differences between Seminars, Symposiums and Workshops. ISSN, ISBN. Research Quality Indicators: Impact Factor, h-index. Research proposal preparation and funding agencies.Research Ethics.Plagiarism.

Additional classes and discussion on topics suggested by students based on research methodology.

References

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Dr. Vimalkumar V., 2022, Gaveshanasahayi.ISBN: 978-93-5445-397-7

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand the basic concepts, types and stages of research	PO 2	PSO 1	Un	Co	10	0
CO2	Explain scientific methods of sampling and data collection	PO 2	PSO 1	Un	Co	10	0
CO3	Apply basic statistical methods and tools used in science and social science research	PO 2	PSO 1	Ap	Pr	10	0
CO4	Develop data analysis and interpretation skill.	PO 2	PSO 1	Ev	Co, Pr	10	0
CO5	Understand the methods of participatory research.	PO 2, PO 3	PSO 1	Ev	Co	10	0
CO6	Develops skills in writing scientific and research reports.	PO 3	PSO 6	Cr	Pr	12	2
CO7	Understand the basic concept of research quality indicators and research ethics.	PO3	PSO 6	Un	Co	10	0

TERMINOLOGIES USED

CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

CORE:
MUSES 6315 Field Visit/Study Tour report
(2 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Discover an integrative approach to environmental issues with a focus on sustainability.

CO2. Examine the real world situations in and around a selected ecosystem.

CO3. Analyze the field data to identify environmental problems and its sustainable solutions.

CO4. Apply the concepts of environmental management and its applications in environmental problem solving.

CO5. Appraise the activities of the common public, organizations and institutions in environmental conservation.

CO6. Develop skills to analyze field observations and to write report.

COURSE CONTENT:

Students are required to visit locations emphasizing environmental conservation and submit a short report on their findings (up to 30 pages, including photographs).

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Discover an integrative approach to environmental issues with a focus on sustainability.	PO3	PSO3	Un	Pr	1	14
CO2	Examine the real world situations in and around a selected ecosystem..	PO3	PSO3	Ap	Pr	1	14
CO3	Analyze the field data to identify environmental problems and its sustainable solutions	PO3	PSO3	An	Pt	1	14
CO4	Apply the concepts of environmental management and its applications in environmental problem solving.	PO3	SO3	p	Pr	1	14
CO5	Appraise the activities of the common public, organizations and institutions in environmental conservation.	PO3	SO3	Ev	Pr	1	14
CO6	Develop skills to analyze field observations and to write report.	PO3	SO7	Cr	Pr	1	6

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create

KC	Knowledge Category
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

MODEL QUESTION PAPER

UNIVERSITY EMBLEM

THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

NAME OF EXAMINATION MONTH – YEAR

COURSE CODE

PROGRAMME TITLE

COURSE TITLE

TIME: 3HRS **MAXIMUM MARKS: 70**

I.Answer all questions **(5X2=10)**

(Cognitive Level: Remembering/ Understanding)

1.
2.
3.
4.
5.

II.Answer any six questions not exceeding two pages **(6X6=36)**

(Cognitive Level: Analyse/ Apply)

6.
7.

8.
9.
10.
11.
12.
13.

III.Answer any two questions not exceeding five pages (2X12=24)

(Cognitive Level: Apply/ Analyse/ Evaluate/ Create)

14.
15.
16.

SEMESTER III

CORE:
MUSES-C 6320 Environmental Chemistry and Analytical Techniques
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Describe the basic concepts of environmental chemistry.

CO2. Explain the physical and chemical properties of air, water and soil.

CO3. Explain the types and consequences of toxic chemicals.

CO4. Understand the principles of analytical techniques and instruments.

CO5. Develop skills to apply analytical techniques in environmental chemistry.

CO6. Explain the concepts of green chemistry.

COURSE CONTENT:

Unit 1

Environmental Chemistry: Concept and Scope of Environmental Chemistry, Major environmental segments. Natural cycles of the Environment: Endogenic and Exogenic cycles. Laws of thermodynamics, heat transfer processes, Mass and Energy transfer across the various interfaces, material balance. Fundamentals of Environmental Chemistry.; Stoichiometry, Gibbs' energy, Chemical potential, chemical equilibrium, acid·- base reaction. solubility product,

solubility of gases in water, the carbonate system. Unsaturated and saturated hydrocarbons, radioisotopes.

Unit 2

Atmospheric chemistry: Structure and Composition of Atmosphere, Particles, ions and radicals in the atmosphere, Earth's Radiation Balance, chemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry, Ozone hole, Photochemical smog, Acid rain, Chemical processes in the formation of inorganic and organic particulate matter, Peroxyacyl nitrates (PAN), Volatile Organic Carbon (VOC), aerosol chemistry.

Aquatic chemistry: The physical and chemical properties of water, physical chemistry of sea water, complexation in natural water and wastewater, sedimentation, coagulation, filtration, pH and Redox potential (Eh).

Soil Chemistry: Structure and Composition of soil, weathering of rocks- physical, chemical and biological processes. Factors controlling the formation of soil; soil profile and classification of soil. water and air in soil, Inorganic and organic components of soil, acid-base and ion exchange reactions in soils, macro and micronutrients in soil, Nitrogen, Phosphorus and Sulphur pathways, NPK in soils. The role of microorganisms in soil.

Unit 3

Toxic chemicals: Pesticides: Classification & Consequences - Organochlorine, Organophosphate, Carbamates, Dioxin, Furan, Polychlorinated Biphenyls (PCBs), Polynuclear Aromatic Hydrocarbons (PAHs).

Biochemistry of heavy metals (mercury, cadmium, lead, chromium) and trace metals (arsenic, selenium). Bioaccumulation & Biomagnification. Toxicity and bioconcentration of heavy metals, speciation of heavy metals. Emerging contaminants, Persistent Organic Pollutants (POP), carcinogens in air and water.

Unit 4

Fundamentals of Analytical Methods: Different type of Microscopes: Light Microscope, Electron Microscope - SEM, TEM - Working Principles and Uses, Titrimetry: Acid - Base Titration, Indicators, Environmental application of titrimetric analysis. Gravimetry. Complexometric titration, Colorimetry, Spectrophotometry, Beer-Lambert law.

Spectrophotometer: Types & uses (UV- Vis, AAS, ICP-AES, ICP-MS). Flame photometry. Fluorimetry: Fluorescence and Phosphorescence. Chromatographic Methods, (Paper Chromatography, TLC, GC, HPLC, GC-MS). Centrifuge; Types, Uses, Electrophoresis: Basics, Classification and Applications. Fundamentals and Applications of XRF, XRD, NMR, FTIR.

Unit 5

Green Chemistry: Definition & Principles of Green Chemistry, History and Development of Green Chemistry, Role of Chemistry in Addressing Environmental Problems, Emerging Trends in Green Chemistry, Role of Green Chemistry in Sustainable Development, Case Studies and Discussion.

Additional classes and discussion on topics suggested by students based on Environmental Chemistry and Analytical Techniques

References

Ramachandran Kodappalli, Kalesh R. Science Encyclopedia, Dronacharya Publication Kozhikode 2014,

Papootty K., Balakrishnancheruppa (Editors), 2016, Dictionary of Science, Kerala Sastra Sahitya Parishad.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL / LAB/FIELD HOURS
CO1	Describe the basic concepts of environmental chemistry	PO2	PSO 1	Un	Co	8	--
CO2	Explain the physical and chemical properties of air, water and soil	PO2	PSO 1	Un	Co	15	--
CO3	Explain the types and consequences of toxic chemicals	PO2	PSO 3	Ap	Co	12	--
CO4	Understand the principles of analytical techniques and instruments	PO3	PSO 1	Un	Co	15	--
CO5	Develop skills to apply analytical techniques in environmental chemistry	PO3	PSO 5	Ap	Pr	14	--
CO6	Explain the concepts of green chemistry	PO2	PSO 1, PSO 2	Un	Co	8	--

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse

Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

CORE:

MUSES-C 6321 Conservation Ecology

(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Illustrate the basic principles of environmental conservation.

CO2. Explain the benefits of environmental conservation and the importance of ecosystem services

CO3. Understand the process of species extinction and its causes

CO4. Evaluate different methods for species conservation and its management

CO5. Illustrate the importance of global environmental conservation efforts

CO6. Develop skills to explore and evolve ways to resolve environmental conservation issues

COURSE CONTENT:

Unit 1

Population and Environmental Conservation: Fitness and Viability of Population in Ecosystems, Concept of Minimum Viable Population, Heterozygosity and Fitness, Pattern of Diversity, Rarity, Endemism, Extinction Vortices. Reproductive Metrics: Breeding Habitats, Mating Systems, Inbreeding Depression, Genetic Bottleneck, Hardy-Weinberg's Principle, Genetic Constraints. Social Processes: Community Stability and Structure, Coadaptation, Coevolution, Keystone Species, Dominant Species, Indicator Species, Umbrella Species, Inbreeding Depression in Natural and Artificial Habitats, Outbreeding Depression. Conservation of species facing rarity and extinction threats.

Unit 2

Extinction: Global deforestation rates and extinction threats, Causes of Extinction: Habitat Destruction, Industrialization, Hunting, Spread of Invasive Species, Competition, Diseases. Extinction through Geological Time Scale, Mass Extinction. Current Extinction Trends.

Unit 3

Conservation Methods and Reserve Design: In-situ Conservation (Biosphere Reserves, National Parks, Sanctuaries, Sacred Groves, etc.), Ex-situ Conservation (Botanical Gardens, Zoological Gardens, Gene Banks, Seed Banks, Tissue Culture). Species-Environment Relationships, Island Biogeography, Habitat Fragmentation, Ecotones, Edge Effect, Faunal Relaxation Rates, Reserve Size, SLOSS Studies, Biological Dynamics of Forest Fragments Project (BDFFP) – Amazon.

Unit 4

Environmental Conservation Efforts: Restoration, Recovery, and Rehabilitation of Ecosystems (Actions and Stages in the Kerala Context). Overview of Global Protected Area Network, Protected Areas and Operations (UNESCO), Biodiversity Hotspots (IUCN) Conservation Categories (WCMC, CITES), Convention on Biological Diversity - National Biodiversity Targets, Role of Environmental Organizations in Conservation Efforts.

Unit 5

Biodiversity Assessment Methods in Aquatic Ecosystems: Identification and Collection Methods of Plant and Animal Assemblages in Aquatic Ecosystems: Plankton (Bottle Samples, Plankton Pumps, Plankton Nets). Fish (Various Nets, Traditional Methods). Modern Trends in Biodiversity Assessment. Classes and Discussions on Topics Suggested by Students Based on Environmental Conservation Knowledge.

References

Achuthan A., 2001, An Introduction to Environmental Studies, Kerala Science Literature Council.

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TAGGING:

CO	**COURSE OUTCOME**	**PO**	**PSO**	**CL**	**KC**	**THEORY HOURS**	**PRACTICAL / LAB/FIELD HOURS**	
CO1	Illustrate the basic principles of environmental conservation.	PO2, PO3	PSO 1, PSO3	Un	Co	10	--	
CO2	Explain the benefits of environmental conservation and the importance of ecosystem services	PO2, PO3	PSO 1, PSO 3, PSO 4	Un	Fa, Co	10	--	
CO3	Understand the process of species extinction and its causes	PO2	PSO 1, PSO5	Un	Fa, Co	12	--	
CO4	Evaluate different methods for species conservation and its	PO2, PO3	PSO 5, PSO 6	Ev	Co, Pr	14	--	

	management							
CO5	Illustrate the importance of global environmental conservation efforts	PO2, PO3	PSO 4, PSO 5, PSO 6	Un	Co, Pr	10	--	
CO6	Develop skills to explore and evolve ways to resolve environmental conservation issues	PO3, PO4	PSO 4, PSO 5, PSO 6	Cr	Co, Pr	18	--	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

CORE:
MUSES-C 6322 Environmental Geosciences
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO 1: Understand the concepts of geological process

CO 2: Explain the concepts of hydrology and hydrogeology

CO 3: Analyse the causes, effects and mitigation measures of natural hazards

CO 4: Discuss the principles and applications of remote sensing

CO 5: Explain the fundamental principles and concepts of mapping

CO 6: Describe the principles and applications of geographical information system

COURSE CONTENT:

Unit 1

Origin and Evolution of Earth: Internal structure of earth - core, mantle, crust, Plate tectonics– seafloor spreading and continental drift; forces acting on the surface of the earth - tectonic and diastrophic forces, ocean and ocean movements, geological time scale. Motions of the earth and seasons. Earth-sun relationship.Insolation and its latitudinal and seasonal variation. Earths' thermal environment and seasons, coriolis force, pressure gradient, meteorological factors-air temperature, humidity, clouds, precipitation, wind. Formation of Minerals and Rocks - igneous, sedimentary and metamorphic rocks. Weathering process, Mineral resources in India and Kerala, Environmental impacts of mining and quarrying.

Unit 2

Water resources: Distribution of water on earth - global, national and regional; hydrology and hydrogeology, water sources types – surface water, ground water; water availability and uses. Drainage basin–definition, characteristics, drainage pattern, stream classification and ordering. Groundwater: Source, occurrence and movement of groundwater, water table, Aquifer types (aquifer, aquitard, aquiclude), Groundwater recharging, Rainwater harvesting, Watershed management: Concepts, Socio-economic aspects of watershed management. Isotope hydrology: concepts and applications.

Unit 3

Natural hazards: Causes, effects, prevention, prediction and mitigation-Earthquakes, landslides, floods, volcanic eruption, cyclones, drought, forest fire, landslips, tsunami, cloud bursts, coastal erosion.

Unit 4

Remote sensing: Basic concepts and processes in remote sensing, data acquisition - energy sources and radiation principles. Active and Passive Remote Sensing; Special features of remote sensing. Aerial Remote Sensing, Satellite Remote Sensing, Types of Sensors, Advantages and applications of Remote sensing.

Unit 5

Mapping and Geographical Information System (GIS): Theories and Principles of Mapping: Definition, history, Map projections, different types of map projections, scale of the map, different types of Maps. Geographical Information System (GIS): Introduction: definition, historical evolution, components, basic principles; Data models: vector and raster data; spatial and non-spatial data; Spatial Analysis: measurements; queries; buffering, map overlay; network analysis; spatial interpolation – TIN, DEM, DSM; Advances and Applications of GIS, Global Positioning System (GPS).

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand the concepts of geological process	PO2	PSO 1	Un	Co	15	
CO2	Explain the concepts of hydrology and hydrogeology	PO2	PSO 1	Un	Co	15	
CO3	Analyse the causes, effects and mitigation measures of natural hazards	PO2, PO3	PSO 1, PSO 3, PSO 6	An	Co	10	
CO4	Discuss the principles and applications of remote sensing	PO2, PO3	PSO 6	Un	Co	12	
CO5	Explain the fundamental principles and concepts of mapping	PO2, PO3	PSO1, PSO3, PSO 6	Ap	Co	10	
CO6	Describe the principles and applications of geographical information system	PO2, PO3	PSO1, PSO 6	Un	Co	10	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate

Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

CORE:
MUSES-C 6323 Environmental Pollution and Control
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Understand the types and science of environmental pollution.

CO2. Evaluate the effects of pollution on plants, animals and human health

CO3. Develop ability to link cause and effects of pollution.

CO4. Evaluate the controlling methods of environmental pollution.

CO5. Assess the role of government and NGOs in controlling environmental pollution

CO6. Develop skills to solve environmental pollution problems.

COURSE CONTENT:

Unit 1

Air Pollution: Definition, sources (natural and man-made) and different types of air pollution (indoor, outdoor and transboundary air pollution). Air Pollutants: Primary-Secondary Pollutants, Gaseous Pollutants, Organic Air Pollutants, Volatile Organic Pollutants Dispersion of Air Pollutants, Mixing Height/Depth, Lapse Rate), Effect of climatic factors on air pollution, size and structure of plume – Gaussian plume model. Impact of air pollutants on plants, animals, materials, climate and human health, air borne diseases, aeroallergnes. Control of gaseous

pollutants: adsorption. Adsorption, Absorption, Condensation, Combustion (including catalytic combustion) and particle removal devices-Centrifugal collectors, wet collectors, settling chamber, fabric filters, electrostatic precipitators. Controlling methods of indoor air pollution and industrial air pollution. Emissions from vehicles: pollutants, emission standards and methods of control.Urban air quality (with special reference to major cities in India). Biomonitoring of air pollution (biological indicators of air pollutants. Indian national ambient air quality standards, Air quality index, Air quality monitoring techniques. Air pollution related case studies-Kerala scenario.

Unit 2

Water Pollution: Definition, Sources (natural and man-made), Surface water pollution: Sources, Contaminants (physical, chemical, biological), Nutrients and eutrophication, Heavy metal pollution-biomagnification. Impact of water pollution on plants, animals and human health. Marine pollution and its consequences.

Oil pollution –sources and its effects on birds and fish. Water Quality monitoring techniques. Water quality standards (National and International), Water quality index. Biomonitoring of water pollution, isotopes in pollution monitoring. Water pollution control methods. Drinking water treatment methods. Water pollution related case studies- Kerala scenario.

Unit 3

Soil Pollution: Definition, Sources (natural and anthropogenic), Wastes and pollutants in soil, Pesticides and their effects on soil components, residual toxicity, and pollution. Different kinds of synthetic fertilizers and their interactions with soil components.Industrial effluents of different kinds, their interactions with soil components.Changes in characteristics of soil by waste disposal.Soil erosion and control methods. Control of soil pollution: sanitary and secured landfills. Remediation of contaminated soils.Soil microorganisms and their functions.Soil quality parameters, sampling, Physico-chemical analysis of soil quality, Trace element analysis in soil.

Unit 4

Noise Pollution: Sources (indoor and outdoor noise pollution, properties of sound, Effects of noise pollution. Noise measurement, Noise pollution standards, Noise pollution control and abatement measures. Case Studies.

Thermal Pollution: Definition and sources, chemical and biological effects of thermal pollution, effects on water quality. Case Studies.

Radioactive Pollution: sources, causes, consequences. Biological effects of ionizing radiations, radiation exposure and radiation standards. Case Studies

Unit 5

Environmental Pollution control policies and Plans: Role of state/central pollution control boards, local self-governments, NGOs to control the environmental pollution. National River conservation plan-Namami Gange and Yamuna Action Plan.Restoration of lakes. National water mission.Jal Jeevan Mission etc.

Additional classes and discussion on topics suggested by students based on Environmental pollution and control.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL / LAB/FIELD HOURS
CO1	Understand the types and science of environmental pollution.	PO3	PSO 1, PSO 3	Un	Co	10	**
CO2	Evaluate the effects of pollution on plants, animals and human health	PO3	PSO 1, PSO 3	An	Co	18	
CO3	Develop ability to link cause and effects of pollution.	PO3	PSO 3	Ap	Co	16	
CO4	Evaluate the controlling methods of environmental pollution.	PO3	PSO 3, PSO 6	Ev	Co	18	
CO5	Assess the role of government and NGOs in controlling environmental pollution	PO3	PSO 3	Ev	Co	10	
CO6	Develop skills to solve environmental pollution problems	PO3	PSO 5, PSO 6	Cr	Co	12	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural

Me	Metacognitive

SEMESTER III

CORE:
MUSES-C 6324 Practical
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Discuss various methods for environmental monitoring.

CO2. Illustrate the working principle of analytical instruments.

CO3. Apply various environmental monitoring techniques in the field.

CO4. Assess the water, soil and air quality using different laboratory techniques.

CO5. Develop skill for data analysis using softwares.

CO6. Design and execute experiments independently.

COURSE CONTENT:

Unit 1

Ecology: Identification of plant and animal flora and fauna and cell count counting. Estimating primary productivity: Light and dark bottle. Water Transparency - Secchi Disk method. Estimation of chlorophyll content, estimation of species area curve method, line transect, Identification and numbering of flora and fauna in aqueous and land ecosystems by quadrate methods (Diversity, Density, Abundance).

Unit 2

Environmental pollution

Water quality assessment: sampling methods, sampling equipment, sample collection, sample storage. Physical factors - color, taste, smell, temperature, turbidity and conductivity. Chemical constituents - acidity, alkalinity, dissolved oxygen, biochemicall oxygen demand, chemical oxygen demand, Oil and grease, total solids, total dissolved solids, total suspended solids, calcium, magnesium, sodium, potassium, sulphate, nitrate, nitrite, phosphate, chloride, fluoride, salinity, iron and heavy metals.

Soil/sediment quality assessment: Sampling methods, sampling tools, sample collection, sample storage. Physical factors in soil:- Soil composition (Texture), macro density (Bulk Density), moisture content, and water holding capacity.

Chemical components in soil: - pH, conductivity, total nitrogen, total phosphorous, organic carbon, organic matter, sodium, potassium, calcium, magnesium, nitrates, phosphate, chloride and sulphate.

Air Quality Assessment: Sampling methods, sampling tools, sample collection, sample storage. Estimation of the amount of particles-gas pollutants in the air., Estimation of noise levels in different regions (Residential, Commercial, Industrial and Silent Zone) using Sound Level meter.

Unit 3

Environmental microbiology: Sampling methods, sampling tools, sample collection, sample storage. Preparation of culture media (Nutrient Agar, Nutrient Broth), isolation techniques, Serial Dilution, Plating, Purification of Mixed Culture – Streak Plate Technique, Pour plate Technique, Preparation of Slants, Gram staining, quantification of the amount of coliforms in the water - Most Probable Number (MPN).

Unit 4

Environmental Geology: Familiarizing with different types of soils, familiarizing with different types of rocks: igneous rocks, sedimentary rock, metamorphic rock, global positioning system (GPS) working principle, familiarization with topographic maps: scale, latitude, longitude, legend. Calculation of the amount of rainfall - rain gauge. Calculation of the amount of humidity - hygrometer and psychrometer. Wind Rose Diagram, Climatogram. Map creation using various softwares in GIS technology.

Unit5

Data analysis: Software-assisted data analysis methods (MS Excel, SPSS, etc.)

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL / LAB/FIELD HOURS
CO1	Discuss various methods for environmental monitoring	PO 2	PSO 1, PSO 5, PSO 6	Un	Co	5	10
CO2	Illustrate the working principle of analytical instruments	PO 3	PSO 3, PSO 5, PSO 6	Ap	Pr	5	10
CO3	Apply various environmental monitoring techniques in the field	PO 3	PSO 5, PSO 6	Ap	Pr		15
CO4	Assess the water, soil and air quality using different laboratory techniques	PO 3	PSO 6	Ev	Pr		15
CO5	Develop skill for data analysis using softwares	PO 3	PSO 5, PSO 6	Ap	Co, Pr	4	4
CO6	Design and execute experiments independently	PO 3	PSO 5	Cr	Pr		4

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual

Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

OPEN ELECTIVE:
MUEVS-OE 6301 Environmental Health and Education
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the student will be able to

CO1. Discuss the basic concepts of environmental health and environmental education.

CO2. Explain communicable, contagious and occupational health hazards.

CO3. Explain urbanization and climate change related health hazards.

CO4. Examine Environmental Health Impact Assessment.

CO5. Analyze the role of NGOs in environmental education.

CO6. Discuss the concepts of environmental ethics.

COURSE CONTENT:

Unit 1

Environmental Health: Health - concept, definition (WHO), basic principles, types (physical, mental, spiritual health), sustainable development goals and health, factors influencing health, major health issues (global, national, regional level)

Unit 2

Environmental changes and epidemiological issues – Air borne diseases, Vector borne diseases. Prevalence of zoonotic diseases (NIPAH, KFD, Leptospirosis, Kala Azar, etc), Water-borne diseases, Soil-borne diseases, Food-borne diseases, Food additives, Fluorosis, Arsenicosis. Climate Change and Health, Disasters and Health Issues, Urbanization and Health, Sanitation and Health, ECOSAN – Concept, Objectives and Achievements. Water borne diseases, Soil borne diseases, Food borne diseases, fluorosis, Arsenocosis. Ecological change and diseases,

Climate change and Human health: Climate and chronic Respiratory Disease (CRD), Direct and Indirect impacts of climate. Disasters and health effects, Sanitation and health, Urbanisation and health. Eco San –: concept, goals and advantages.

Unit 3

Occupational Health: Occupational health problems: asbestosis, silicosis, byssinosis, pneumoconiosis, asthma, allergies, anthracosis, siderosis. Occupational Safety and Health Administration (OSHA). Farmers and health problems.

Environmental Health Impact Assessment (EHIA) – Definition and Significance of EHIA, Steps in EHIA, National and State level plans and policies on environmental health.

Unit 4

Environmental Education (EE): History (Bell Grade Agreement, Tbilisi Conference), goals, objectives, principles, environmental awareness strategies: formal and informal education, action plans, environmental organizations and working groups, lifestyle changes and consumerism, Ecomark, ecolabelling, Role of NGOs in environmental education. Environmental education in India, Environmental Information System (ENVIS)

Unit 5

Environmental Ethics: Gaia Concept, disciplines of environmental ethics-Anthropocentrism, biocentrism and ecocentrism, application of ethics to environmental issues, Environmental equity and justice.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Discuss the basic concepts of environmental health and environmental education	PO 2	PSO 1	Un	Co	8	
CO2	Explain communicable, contagious and occupational health hazards	PO 2	PSO 1	Un	Co	10	
CO3	Explain urbanisation and climate change related health hazards	PO 2	PSO 1	Un	Co	10	
CO4	Examine Environmental	PO 3	PSO 3	Ap	Pr	15	

	Health Impact Assessment						
CO5	Analyze the role of NGOs in environmental education	PO 3	PSO 6	An	Co	15	
CO6	Discuss the concepts of environmental ethics	PO 3	PSO 4	Un	Co	14	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER III

OPEN ELECTIVE:
MU EVS-OE 6302 Environment and Society
(4 CREDITS)

COURSE CONTENT:

Unit 1

An Introduction to Ecology: Environment, Components, Interactions, Laws and Limiting Factors, Inter and Intraspecific Relationships, Population Ecology, Natural Resources, Types of Ecosystems.

Unit 2

Cultural Ecology Concept of Culture, Cultural Ecology, Role of Culture in Human Adaptation. Basic Forms of Human Adaptation to the Environment: Hunting and Gathering; Pastoralism; Shifting

Cultivation; Agriculture; Commercial/Industrial Societies. Society, Culture, Environment; Environmental Awareness and Conflicts, Environmental Ethics, Ecophilosophy, Case Studies.

Unit 3

Ethnoecology and Conservation Science Introduction to Ethnoecology: Traditional Ecological Knowledge, Traditional Technical Knowledge, Traditional Resource Management, Ethnobotany, Ethnozoology, Ethnotaxonomy. Case Studies.

Unit 4

Traditional Ecological Knowledge and Sustainable Development Traditional Ecological Knowledge and Sustainable Development (Water and Soil Conservation Methods), Traditional Ecological Knowledge and Agriculture (Traditional Varieties, Cultivation, Conservation, Cultivation Methods, Pest and Weed Management, Food Security), Traditional Ecological Knowledge and Traditional Medicine Systems, Biodiversity Conservation, Climate Change, Disaster Management, Case Studies.

Unit 5

Conservation of Traditional Ecological Knowledge Convention on Biological Diversity 1992, National Biodiversity Authority, People's Biodiversity Register, CSIR - Traditional Knowledge Digital Library (TKDL), Protection and Sustainable Use of Medicinal Plants 1999 (Planning Board, Government of India), United Nations Conference on Trade and Development (2004), World Intellectual Property Organization (WIPO). Policies and Laws: Environmental Protection Act 1986, Biodiversity Act 2002, Wildlife Protection Act 1972, National Forest Policy 1988, Intellectual Property Rights Act.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understands the concepts and objectives of Environmental Sociology.	PO2	PSO 1	Un	Co	*2	
CO2	Describes the thoughts of prominent Environmental Sociologists on the social construction of nature.	PO2	PSO 4	Un	Co	8	
CO3	Discusses development and environmental issues and their socio-political concerns.	PO3	PSO 3	Un	Co	16	
CO4	Critically reviews environmental struggles and movements in India and Kerala.	PO3	PSO 5	An	Co	18	
CO5	Discusses creating	PO3	PSO 3	Ev	Co	20	

	environmentally and socially responsible citizens.						

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

MODEL QUESTION PAPER

UNIVERSITY EMBLEM

THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

NAME OF EXAMINATION

MONTH – YEAR

COURSE CODE

PROGRAMME TITLE

COURSE TITLE

TIME: 3HRS **MAXIMUM MARKS: 70**

I.Answer all questions (5X2=10)

(Cognitive Level: Remember/ Understand)

1.

2.

3.

4.

5.

II.Answer any six questions not exceeding two pages (6X6=36)

(Cognitive Level: Analyse/ Apply)

6.

7.

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11.

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13.

III.Answer any two questions not exceeding five pages (2X12=24)

(Cognitive Level: Apply/ Analyse/ Evaluate/ Create)

14.

15.

16.

SEMESTER IV

ELECTIVE:
MUSES-E 6424 Environmental Economics
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the student will be able to:

CO 1: Understand the key concepts of environmental economics and their application to analyze environmental issues.

CO 2: Develop skills in valuing environmental goods and services and applying different valuation methods to real-world cases.

CO 3: Apply the principles of cost-benefit analysis of development projects into environmental decision-making.

CO 4: Evaluate the effectiveness of various environmental policy instruments and their implications for sustainable management.

CO 5: Explore the economic principles and challenges related to natural resource economics and conservation.

COURSE CONTENT:

Unit 1: Introduction to Environmental Economics

- Definition and scope of environmental economics, Environmental Economics and Ecological Economics.
- Key economic concepts in environmental analysis (supply and demand, market equilibrium, elasticity of demand and supply)
- Market failures and environmental externalities (negative and positive externalities), Public goods, Freeriding problem, Property rights and Coase Theorem.
- Welfare aspects of Environmental Economics (maximum social welfare, pareto criterion)

Unit 2: Valuation of Environmental Resources

- Need for environmental valuation
- Methods for valuing environmental goods and services (market price approach, revealed preference methods – Hedonic pricing, Travel cost method, property value method, stated preference methods – Contingent Valuation Method)
- Challenges and limitations of valuation methods
- Application of valuation techniques to real-world case studies

Unit 3: Cost-Benefit Analysis and Environmental Policy Instruments

- Principles and applications of cost-benefit analysis (net present value, benefit-cost ratio, sensitivity analysis)
- Discounting and intertemporal decision-making (discount rates, intergenerational equity)
- Incorporating environmental impacts into cost-benefit analysis (valuation of environmental impacts, monetization of non-market goods, environmental impact assessment)
- Environmental policy instruments:

- Command-and-control regulations: Standards and emission limits, Technology mandates, Liability and enforcement
- Market-based instruments: Cap and trade system, Pollution taxes (Pigouvian taxes), subsidies and grants
- Tradable permits and offsets: Offsetting and carbon neutrality
- Voluntary approaches: Eco-labeling and certification

Unit 4: Natural Resource Economics and Sustainable Development

- Economics of non-renewable resources (exhaustible resource extraction models, Kuznets curve, Hotelling's rule, resource rent and taxation)
- Economics of renewable resources (renewable resource management models, optimal harvesting and conservation, common pool resources and tragedy of the commons)
- Fisheries and forestry economics (sustainable fisheries management, timber harvesting and sustainable forestry)
- Concepts of sustainable development (social, economic, and environmental dimensions, interlinkages between sustainability pillars, Weak sustainability and Strong sustainability notions)

Unit 5: Green Growth and Case Studies

- Economic indicators of sustainability (Genuine Progress Indicator, Ecological Footprint, Human Development Index, Planetary Pressure Adjusted Human Development Index, Environmental Performance Index)
- Green growth strategies and policies (decoupling economic growth from environmental degradation, circular economy, renewable energy transition and low - carbon development)
- Green national accounting
- Case studies and applications (climate change mitigation and adaptation, pollution control and environmental regulation, natural resource management and conservation, policy effectiveness and cost-effectiveness, trade-offs and unintended consequences)
- Energy Audit
- Classes and discussions based on topics suggested by students on the subject of Environmental Economics

References

Kunhikannan TP, 2013, Wealth and Poverty: The Semantics of People's Lives, Kerala Sastra Sahitya Parishad

Boero G and Silberston A, 1995, Environmental Economics. St. Martins Press,Inc., New York.

Carton, W., (2018), Environmental Economics, In: Companion to Environmental Studies, Castree, N., Hulme, M. & Proctor, J. (eds.) Routledge, Oxon - New York, pp. 281-285.

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Michael Jacobs, 2012, Green Growth: Economic Theory and Political Discourse. Working Paper No. 108, Centre for Climate Change Economics and Policy

Tom Tietenberg and Lynne Lewis, 2018, Environmental and Natural Resource Economics, 11th Edition. Routledge, New York.

Timothy C Haab and Kenneth E McConnell, 2002, Valuing Environmental and Natural Resources. Edward Elgar, Northampton, USA.

Tim Jackson, 2009, Prosperity without Growth: Economics for a Finite Planet. Earthscan, London.

Nicholas Stern, 2008, The Economics of Climate Change, American Economic Reivew.

Jennifer Rietbergen McCracken and Hussein Abaza, 2000, Environmental Valuation: A Worldwide Compendium of Case Studies. Earthsacn, London.

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Daniel C Esty and Andrew S Winston, 2006, Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value and Buiild Competitive Advantage, Yale University Press, London.

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Nick Hanley, Jason F Shogren and Ben White, 1997. Environmental Economics: In Theory and Practice. Macmillan Press, London.

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL / LAB/FIELD HOURS
CO1	Understand the key concepts of environmental economics and their application to analyze environmental issues.	PO2	PSO 1, PSO 3	Un	Co	12	
CO2	Develop skills in valuing environmental goods and services and applying different valuation methods to real-world cases.	PO2	PSO 2, PSO 3	Ap	Co	15	
CO3	Apply the principles of cost-benefit analysis of development projects into environmental decision-making	PO3	PSO 2, PSO 5	Ap	Pr	15	
CO4	Evaluate the effectiveness of various environmental policy instruments and their implications for sustainable management	PO3	PSO 1, PSO 2	Ev	Pr	15	
CO5	Evaluate the economic principles and challenges related to natural resource economics and conservation	PO3	PSO 5	Ev	Pr	15	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER IV

ELECTIVE:
MUSES-E 6425 Environmental Biotechnology and Ecotoxicology
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Understand evolution of life, concepts of human ecology.

CO2. Describe concepts and basic principles of eco-informatics

CO3. Discuss scope and importance of microbial ecology.

CO4. Analyze the role of biotechnology in environmental conservation

CO5. Appraise the applications of environmental microbiology

CO6. Understand the basic concept of ecotoxicology

CO7. Evaluate the effects of toxic chemicals and their potential health risks.

COURSE CONTENT:

Unit 1

Environmental biology: Basic concepts - Origin of Life and speciation, human ecology and settlement. Ecoinformatics: concepts and basic principles.

Unit 2

Microbial ecology: Scope and importance of microorganisms; Major groups of microorganisms, microbiology of soil, air, water and sediments. Microbes in extreme environments, Space microbiology, Geomicrobiology - role of microorganisms in biogeochemical cycling of elements – carbon, nitrogen, sulphur, phosphorus and iron cycles.

Unit 3

Environmental Biotechnology: Definition, principles, scope, role of biotechnology in environmental conservation; Biotechnology and biodiversity conservation - ex-situ & in-situ methods. Bioremediation – concept, principles and applications; types – in-situ, ex-situ; rhizoremediation, phycoremediation, zoo – phytoremediation. Role of microorganisms in the degradation of natural and manmade compounds– pesticides, recalcitrant chemicals, Persistent Organic Pollutants (POPs). Microbial transformation of heavy metals: heavy metal tolerance; metal-microbe interactions; immobilization and transformation of metals; genetic aspects of resistance; applications in metal removal.

Unit 4

Applied microbiology: Biomining, Bioleaching, Biosensors, Bioindicators, Biochips, Biosurfactants, Biofertilizers and Biopesticides, genetically engineered organisms – Bt toxin gene, microbes in industries.

Unit 5

Eco-toxicology: Introduction, influence of ecosystem on fate and transport of toxicants, Transport of toxicants by air, water and food chains; biotransformation and bio-magnification; Influence of ecological factors on ecotoxicology. Acute and chronic toxicity; Lethal and sub-lethal doses: LD50 and LC50; concept of bioassay, threshold limit value, margin of safety, Therapeutic index, Dose-response relationship, Carcinogens, Mutagens and Teratogens.

Classes and Discussions Based on Topics Suggested by Students on Environmental biotechnology and Ecotoxicology

References

Agarwal,S.K.,1998, Environmental Biotechnology, APH Publishing Corporation, New Delhi.

Baker.K.H. and Herson, D.S., 1994, Bioremediation, McGraw Hill Inc., New York.

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Pery, G., 1980, Introduction to Environmental Toxicology, Elsevier, Amsterdam.

Walker, C.H., R.M.Sibly, S.P.Hopkin and Peakall, D.B. 2012, Principles of Ecotoxicology, CRC Press, New York.

Wright, D.A. and Welbourn, P., 2002, Environmental Toxicology, Cambridge University Press, London.

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TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand evolution of life, concepts of human ecology.	PO2	PSO 1	Un	Co	15	–
CO2	Describe concepts and basic principles of eco-informatics	PO2	PSO 1	Un	Co	5	–
CO3	Discuss scope and importance of microbial ecology	PO2	PSO 1	Un	Co	15	–
CO4	Analyse the role of biotechnology in environmental conservation	PO2, PO3	PSO 1, PSO 2, PSO 6	An	Co	10	–
CO5	Appraise the applications of environmental microbiology	PO2, PO3	PSO 6	Ev	Co	10	–
CO6	Understand the basic concept of ecotoxicology	PO2	PSO 1	Un	Co	10	–
CO7	Evaluate the effects of toxic chemicals and their potential health risks	PO2	PSO 3	Ev	Co	10	–

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**

Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER IV

ELECTIVE:
MUSES-E 6426 Environmental Health and Education
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the student will be able to

CO1. Discuss the basic concepts of environmental health and environmental education.

CO2. Explain communicable, contagious and occupational health hazards.

CO3. Explain urbanization and climate change related health hazards.

CO4. Examine Environmental Health Impact Assessment.

CO5. Analyze the role of NGOs in environmental education.

CO6. Discuss the concepts of environmental ethics.

COURSE CONTENT:

Unit 1

Environmental Health: Health - concept, definition (WHO), basic principles, types (physical, mental, spiritual health), sustainable development goals and health, factors influencing health, major health issues (global, national, regional level)

Environmental changes and epidemiological issues – Air borne diseases, Vector borne diseases. Prevalence of zoonotic diseases (NIPAH, KFD, Leptospirosis, Kala Azar, etc), Water-borne diseases, Soil-borne diseases, Food-borne diseases, Food additives, Fluorosis, Arsenicosis. Climate Change and Health, Disasters and Health Issues, Urbanization and Health, Sanitation and Health, ECOSAN – Concept, Objectives and Achievements. Water borne diseases, Soil borne diseases, Food borne diseases, fluorosis, Arsenocosis. Ecological change and diseases, Climate change and Human health: Climate and chronic Respiratory Disease (CRD), Direct and Indirect impacts of climate. Disasters and health effects, Sanitation and health, Urbanization and health. Eco San –: concept, goals and advantages**.**

Unit 3

Occupational Health: Occupational health problems: asbestosis, silicosis, byssinosis, pneumoconiosis, asthma, allergies, anthracosis, siderosis. Occupational Safety and Health Administration (OSHA). Farmers and health problems.

Environmental Health Impact Assessment (EHIA) – Definition and Significance of EHIA, Steps in EHIA, National and State level plans and policies on environmental health.

Unit 4

Environmental Education (EE): History (Bell Grade Agreement, Tbilisi Conference), goals, objectives, principles, environmental awareness strategies: formal and informal education, action plans, environmental organizations and working groups, lifestyle changes and consumerism, Ecomark, ecolabelling, Role of NGOs in environmental education. Environmental education in India, Environmental Information System (ENVIS)

Unit 5

Environmental Ethics: Gaia Concept, disciplines of environmental ethics-Anthropocentrism, biocentrism and ecocentrism, application of ethics to environmental issues, Environmental equity and justice.

References

A group of writers, 2001, Ecological Perspective, Kerala Language Institute, Thiruvananthapuram.

Dr. B. Padmakumar, 2014, Green Health, Kerala Language Institute Thiruvananthapuram.

Dr Shobha 2018, Climate Change and Health, Kerala Language Institute, Thiruvananthapuram

Hanif M. 2014 Insect-Borne Diseases and Infectious Diseases, , Kerala Language Institute, Thiruvananthapuram.

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Chatterji,M., M.Munasinghe and R. Ganguly. 1998, Environment and Health in Developing Countries. A.P.H.Publishing House, New Delhi.

Kemm, J; Parry, J; Palmer, S. 2004, Health Impact Assessment: Concepts, theory, techniques and applications, Oxford University Press, New York.

Landon, M. 2006, Environment, Health and Sustainable Development. Tata McGraw Hill Publishing Company Limited, New Delhi, 221 p.

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Sharma, P.D. 2001, Ecology and Environment, Rastogi Publications, Meerut.

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Srivastava, D.C. 2005, Readings in Environmental Ethics: Multidisciplinary Perspectives, Rawat Publications, Jaipur.

Velma I. Grover (Ed.), 2013, Impact of climate change on water and health, CRC Press, New York.

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL / LAB/FIELD HOURS
CO1	Discuss the basic concepts of	PO2	PSO 1, PSO 3	Un	Co	8	

	environmental health and environmental education						
CO2	Explain communicable, contagious and occupational health hazards	PO2	PSO 1	Un	Co	10	
CO3	Explain urbanisation and climate change related health hazards	PO2	PSO 1, PSO 3	Un	Co	10	
CO4	Examine Environmental Health Impact Assessment	PO3	PSO 3	Ap	Pr	15	
CO5	Analyze the role of NGOs in environmental education	PO3	PSO 3	An	Co	15	
CO6	Discuss the concepts of environmental ethics	PO3	PSO 4	Un	Co	14	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
PSO	Programme Specific Outcome
CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
KC	**Knowledge Category**
Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER IV

ELECTIVE:
MUSES-E 6427 Waste Management and Techniques
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Understand the concepts, types and characteristics of wastes.

CO2. Describe the types and treatment methods of solid wastes.

CO3. Explain the sources, characteristics and treatment methods of hazardous wastes.

CO4. Explain the sources, characteristics and treatment methods of liquid wastes.

CO5. Distinguish the treatment methods of sludge and industrial effluents.

CO6. Analyze the different waste management policies and frameworks.

COURSE CONTENT:

Unit 1

Wastes: Concept, definition, different types of waste, sources and characteristics (solid waste, biomedical waste, nuclear-radioactive waste, electronic waste, plastic waste, liquid waste). Waste Management - Concepts of separation, segregation and Material Recovery Facility (MRF).

Unit 2

Treatment methods of Solid wastes: Land filling-sanitary and secured landfill, composting, vermicomposting, biomethanation, incineration, pyrolysis, Refuse Derived Fuel (RDF), SRF (Solid Recovered Fuel), CBG (Compressed BioGas). Microplastic, biopolymer, bioplastics, resource from waste – compost, single cell protein. Energy from waste.

Unit 3

Hazardous waste treatment methods: Neutralization, Oxidation - Deoxidation, Precipitation, Solidification, Stabilisation, Incineration and Disposal. Management of biomedical waste and

nuclear radioactive waste - classification, sources, disposal, electronic waste and disposal. IMAGE, Clean Kerala Company.

Unit 4

Liquid waste management: The characteristics and difference between Sewage and Effluent, Primary Treatment Methods (Screening, Skimming, Grit Chamber, Coagulation and Flocculation), Filtration, Sedimentation, Secondary Treatment Methods - Activated Sludge Process (Activated Sludge Process), trickling filters, oxidation ponds,Tertiary/advanced treatment methods - removal of dissolved inorganic substances, ion exchange methods, electrodialysis, water softening - reverse osmosis, removal of nitrogen and phosphorus, disinfection. Sludge disposal methods, Greywater treatment, Effluent standards, Effluent treatment methods with special reference to distilleries, tanneries textile, fertilizer and electroplating industries. Difference between STP (Sewage Treatment Plants) and CETP (Common Effluent Treatment Plants).

Unit 5

Waste Management Policies: Zero waste, 7Rs concept, Basel Convention, Extended Producer Responsibility (EPR), Role of Local Self-Governments - Non-Governmental Organizations in waste management, National State level projects (Swachh Bharat Abhiyan, Haritha Kerala, Sanitation Mission). Polluter Pays Principle.

Classes and discussion on topics suggested by the students based on the topic of waste management and techniques.

References

Achuthan, A. 2016, Paristhithipadanthinu Oramugham, Kerala Sasthra Sahitya Parishad

Ramachandran, K. and Sahadevan K, 2011Waste Management- Solid Waste Problems and Solutions, Currentbooks, Thrissur.

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Abbasi, S.A., Ramasamy, E.V., 2001, Solid Waste Management with Earthworms.Discovery Publishing house, New Delhi.

Agarwal,S.K. 1998, Environmental Biotechnology, APH Publishing corporation, New Delhi.

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Agarwal,S.K. 2005., Wealth from waste, APH Publishing corporation, New Delhi

Baker K.H. and D.S.Herson, 1994, Bioremediation, McGraw Hill Inc. New York.

Bhatia,S.C. 2007, Solid and Hazardous Waste Management. Atlantic Publishers and Distributors, New Delhi

Bide A.D. and R.R.Sundaresan, 2001, Solid Waste Management Collection, processing and disposal, INSDOC, New Delhi

Khan, M.K. 2004, Hospital waste Management: Principles and Guidelines, Kanishka Publishers, New Delhi

Liu,D.H.F. and R.GLiptak. 2000, Hazardous waste and solid waste.Lewis Publishers, New York.

Ram Kumar 2000, Environmental Biodegradation. Sarup and Sons, New Delhi.

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Understand the concepts, types and characteristics of wastes.	PO3	PSO 3	Un	Fa, Co	2	**
CO2	Describe the types and treatment methods of solid wastes	PO3	PSO 3, PSO 6	Un	Co	16	
CO3	Explain the sources, characteristics and treatment methods of hazardous wastes	PO3	PSO 6, PSO 3	Un	Co	16	
CO4	Explain the sources, characteristics and treatment methods of liquid wastes	PO3	PSO 6, PSO 3, PSO 2	Un	Co	16	
CO5	Distinguish the treatment methods of sludge and industrial effluents	PO3	PSO 6, PSO 3, PSO 2	Un	Co	16	
CO6	Analyze the different waste management policies and frameworks	PO3	PSO5, PSO6	An	Co	10	

TERMINOLOGIES USED	
CO	Course Outcome
PO	Programme Outcome
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CL	**Cognitive Level**
Re	Remember
Un	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
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Fa	Factual
Co	Conceptual
Pr	Procedural
Me	Metacognitive

SEMESTER IV

CORE:
MUSES-C 6428 Dissertation
(4 CREDITS)

COURSE OUTCOME:

On successful completion of this course the students will be able to

CO1. Create independent research skills on a focal theme

CO2. Develop skills for critical evaluation and evolving solutions to various environmental problems.

CO3. Develop professional capacity to address environmental issues.

CO4. Develop skills in data collection, synthesis, analysis and interpretation.

CO5. Develop research aptitude in identifying and resolving environmental problems**.**

COURSE CONTENT:

Students shall conduct research oriented project work emphasizing any environmental issues in Kerala scenario and submit a thesis (up to 70 pages with pictures).

Short report - 80 marks

Viva - 20 marks

Total - 100 marks

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Create independent research skills on a focal theme	PO2, PO3	PSO5, PSO6	Cr	Pr	5	10
CO2	Develop skills for critical evaluation and evolving solutions to various environmental problems.	PO2, PO3	PSO4, PSO5	Cr	Pr	5	10
CO3	Develop professional capacity to address environmental issues.	PO2, PO3	PSO4, PSO5	Cr	Pr	5	10
CO4	Develop skills in data collection, synthesis, analysis and interpretation.	PO2, PO3	PSO4, PSO5	Cr	Pr	5	10
CO5	Develop research aptitude in identifying and resolving environmental problems.	PO2, PO3, PO4	PSO4, PSO5	Cr	Pr	5	10

TERMINOLOGIES USED	
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SEMESTER IV

CORE:
MUSES-C 6429 Internship
(2 Credits)

COURSE OBJECTIVE: On successful completion of this course the students will be able to

CO1:Develop research interests / skills.

CO2: Identify and propose solutions to regional environmental issues.

CO3: Training in describing and interpreting extensive environmental issues.

CO4: Develop skills in conducting data analysis and writing reports.

CO5: Develop a plan to solve environmental problems.

COURSE CONTENT

The students are required to visit locations providing exposure to environmental conservation and related subjects and complete an internship for a duration of fifteen days related to environmental studies. (Up to 30 pages, including photographs).

Short Report - 80 marks

Viva - 20 marks

Total - 100 marks

TAGGING:

CO	COURSE OUTCOME	PO	PSO	CL	KC	THEORY HOURS	PRACTICAL/ LAB/FIELD HOURS
CO1	Develop research interests / skills.	**PO 3**	**PSO 5**	Ap	Pr	1	15

CO2	Identify and propose solutions to regional environmental issues.	**PO 3**	**PSO 5**	Ap	Pr	2	18
CO3	Training in describing and interpreting extensive environmental issues.	**PO 3**	**PSO 3, PSO 5**	Ap	Pr	2	14
CO4	Develop skills in conducting data analysis and writing reports.	**PO 3**	**PSO 7**	Cr	Pr	2	14
CO5	Develop a plan to solve environmental problems.	**PO 3**	**PSO 5**	Cr	Pr	1	15

TERMINOLOGIES USED	
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MODEL QUESTION PAPER

UNIVERSITY EMBLEM

THUNCHATH EZHUTHACHAN MALAYALAM UNIVERSITY

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COURSE CODE

PROGRAMME TITLE

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I.Answer all questions (5X2=10)

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II.Answer any six questions not exceeding two pages (6X6=36)

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III.Answer any two questions not exceeding five pages (2X12=24)

(Cognitive Level: Apply/ Analyse/ Evaluate/ Create)

14.

15.

16.

DISSERTATION MODEL

COVER PAGE

Title (Unicode Font: Meera font size 18, Bold, Center Aligned)

University Emblem (Center Aligned)

Name of the Student (Font size 16, Bold, Center Aligned)

Register Number (Font size 14, Center Aligned)

Name of the Programme (Font size 16, Center Aligned)

School (Font size 16, Center Aligned)

Faculty (Font size 16, Center Aligned)

University Address (Font size 16, Bold, Center Aligned)

Month, Year (Font size 14, Center Aligned)

DECLARATION

I (Name of Student), do hereby declare that this dissertation entitled (……) is a genuine record of the research work done by me under the guidance of (Name and Designation of the Guide) and that no part of the dissertation has been presented earlier for the award of any other degree or recognition in any other university.

Place: Signature,

Date: Name of the Student.

CERTIFICATE

This is to certify that the dissertation entitled …… is an authentic record of research work carried out by (Name of the student) for the degree of (Name of the Programme) of Thunchath Ezhuthachan Malayalam University under my guidance and that no part thereof has been presented before for any degree or recognition in any other university.

Signature,

Name of the Supervisor

Place:

Date:

Signature, Signature,

School Director External Examiner

ACKNOWLEDGEMENT

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