DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU
राया-सूचानी(बागला),िजलासांबा-181143,जम्मू(जम्मूएवंकश्मीर)
Rahya-Suchani (Bagla), District Samba 181143, Jammu(J&K)

Dated: 28.02.2024

No. CUJ/EVS/2024/500

Minutes of the meeting of BOS (Board of Studies) of the Department of Environmental Sciences

The Meeting of the Board of Studies of the Department of Environmental Sciences was heldon Feb 8 2024***at 01:30 pm in the HOD chamber*** of the Department.The following memberswere present:

Prof. Richa Kothari	Chair Person
Prof. Kamal K. Kapoor	Expert Member
Prof. Piyush Malaviya	Expert Member
Prof. Deepak Pathania	Member
Prof. Sunil Dhar	Member
Dr. Dinesh Kumar	Member
Dr. Vinita Sharma	Member (VC Nominee)
Lt (Dr.) Pankaj Mehta	Special Invitee
Dr. Shweta Yadav	Special Invitee
Dr. Ankit Tandon	Special Invitee

The meeting started with a brief welcome address and the following agenda was discussed.

Agenda 1: To discuss the updation in the Syllabus of M.Sc. (Environmental Sciences).

Resolution1: The committee discussed the modification of the PG course and recommended the following modifications / changes as per the table below (Annexure –I)

:

(Dr. Vinita Sharma)

(Piyush Malaviya)

(Kamal K. Kapoor)

Annexure - I

DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU
राया-सूचानी(बागला),जिला सांबा-181143,जम्मू (जम्मू एवं कश्मीर)
Rahya-Suchani (Bagla), District Samba 181143, Jammu(J&K)

	Modifications	Remarks
	Sem-I	
S No	**Core Courses**	
1	The title of the core course entitled ***"Ecology and Environmental Sciences" changed to Fundamentals of Ecology***	Title modified
2	A new course titled ***"Indian Knowledge System (IKS)"*** of 2 credits has been introduced as a core course.	New course
3	***LAB-1 course (3 credits)*** has been split into ***Lab-1 and Lab-2 having 2 credits*** each.	Redistributing and increasingits credit to 4.
	Open elective course (OEC)	
4	OE Course content of ***"Introduction to Hydrology and Water Resource Management"*** has been modified.	Course content modified
5	A new OE course titled ***"Climatology" with 2 credits*** has been introduced.	New course
	Skill Enhancement / Value Additions Courses	
6	A new skill courseentitled ***"Solid Waste Management" with 2 credits*** has been introduced.	New course
	Compulsory Qualifying course from Swayam / NPTEL / E-PG Pathshala etc. of Ministry of Education, GoI recognized MOOCs platform related to Computers (Basics /Applications etc.)	
	Sem-II	
	Core courses	
8	The core course content ***of "Energy and Environment"*** has been modified.	Course content modified

9	A new course titled ***"Environmental Chemistry" of credit 3-credit*** has been introduced as a core course.	New Course
10	***LAB-2 course (3 credits)*** has been split into ***Lab-3 and Lab-4 having 2 credits each.***	Redistributing and increasing its credit to 4.
	OEC	
11	OE Course content of ***"Natural Hazards and Disaster Management in Himalayas"*** has been modified.	Course content modified
12	OE course titled ***"Waste as a Resource" has been changed to "Waste as Resource".***	Course title modified
13	The OE course titled ***"Alternate Energy Fuels"*** has been removed	Course removed
14	A new course titled ***"Hydrogen Energy"*** of credit 2-credit has been introduced as an OE course ***in-lieu of "Alternate Energy Fuels"***	New Course
15	A new course titled***"Environmental Engineering"*** of credit 2-credit has been introduced as an OE course.	New Course
16	A new course titled***"Environmental Nanotechnology" of credit 2***-credit has been introduced as an OE course.	New Course
	Sem-III	
	Core Courses (No Change)	
	OEC	
17	OE Course content ***of "Watershed Management"*** has been modified.	Course content modified
18	The OE course entitled ***"Environmental Statistics"*** has been removed	Course removed
19	OE course entitled ***"Instrumentation and Analytical Techniques"*** has been changed to ***"Environmental Instrumentation"*** and its course content was also modified.	Course title and course content modified

DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU
राया-सूचानी(बागला),जिला सांबा-181143,जम्मू (जम्मू एवं कश्मीर)
Rahya-Suchani (Bagla), District Samba 181143, Jammu(J&K)

20	OE course titled ***"Introduction to Meteorology"*** has been changed to "***Advances in Meteorology"*** and its course content was also modified.	Course title and course content modified
21	A new course titled ***"Environmental Data Analysis" of 2-credit*** has been introduced as an OE course in lieu of "***Environmental Statistics"*** *course*.	New Course

OEC offered in semesters I,II, and III are available to students of PG programs in Sciences Only.

	Sem-IV	
22	➢ The open elective will be selected of 12 credits from Swayam/NPTEL/IGNOU/CEC/E-PG Pathsala etc. of the Ministry of Education, GOI recognized MOOCs platform, one must be related to computers and its application in Sciences. ➢ ***A list of available open electives of Sem-IV will be provided by the Department at the time of semester commencement.***	
23	**Award of Post Graduate Degree (After 2 year) *** # 1 credit goes to outreach activity among anyone (15 hours minimum to contribute) ➢ Environmental Awareness ➢ Industrial visit ➢ Field visit ➢ Social Awareness ➢ Any other area deemed to be appropriate by the Department	
24	**Audit Course/ Qualifying Courses (QC) 2 Credits**	
	Commercialization Skills (Qualifying)	***In anticipationof PG coursematrix***
25	**Departmental initiative on NEP-2020 mandate for commercialization of skill courses:** The EVS Department had come up with the following skill courses in sem-II which had been resulted ineco-friendlyproducts. The outcomes of the courses are: ❖ ***Organic Waste to Compost***: The skill course resultedineco-friendly products. Exhibitions and workshops for the said products will be on the floor as per schedules. ❖ ***Organic Waste to Vermiwash***: The skill course had resultedineco-friendly products. Exhibitions and workshops for the said products will be on the floor as per schedules. ❖ ***Waste to Product "Ecogiri":*** The skill course hasresulted ineco-friendly products. Exhibitions and workshops for the said products had been floored and revenues were generated. The department had scheduled to continue the exhibition and workshops for	

	said ventures twice in a year.

Agenda 2: To approve the Course Codes of the courses taken by students of the ongoing academic session from the online platform

Resolution: The committee approved the list of Course Codes taken by students of the ongoing academic sessions from the online platform (Annexure –I)

Agenda 3: To approve the course matrix and content of the Ph.D. (Environmental Sciences) in anticipation.

Resolution 3: The committee discussed the course matrix and content Ph.D. (Environmental Sciences) and accorded approval in anticipation (Annexure-II)

Agenda 4: To consider the request of Ms. Kiran Kumari (R. No-0350818), Ph.D. scholar for conversion of regular mode Ph.D. to Part-time Ph.D. after joining as Assistant Professor in Higher Education Department, J&K w.e.f. 22.06.2022.

Resolution 4: The committeediscussed the case and referred the following documents (Annexure-III):

a) Office Order No. 176 of 2022 vide letter no. CUJ/Acad/VII-11/1/2022/650 dated 09.11.2022 issued by the Registrar, CU Jammu against her application dated 19.06.2022 regarding conversion of regular mode Ph.D. to Part-time Ph.D.
b) Minutes of Research Advisory Committee (RAC) held on 22.12.2022 vide letter no. CUJ/EVS/2023/04 dated 03.01.2023
c) No Objection Certificate (NOC) from the competent authority for converting regular mode Ph.D. to Part-time mode vide letter no. DC-HE/2022/1589 dated 16.11.2022 issued by Director Colleges, Higher Education Department, Govt. of J&K and letter no. DC-HE/J/2023/1373 dated 10.05.2023 issued by Director Colleges, Higher Education Department, Govt.of J&K.
d) Minutes of Research Advisory Committee (RAC) held on 23.11.2023 vide letter no. CUJ/EVS/2023/345 Dated 29.11.2023

e) Minutes of Research Advisory Committee (RAC) andMinutes of Departmental Research Committee (DRC) held on 30.11.2023 vide letter no. CUJ/EVS/2023/348-A dated 30.11.2023

The BoS committee approved the recommendations made by RAC andDRC regarding the progress of the scholar in terms of objective completion as per the approved synopsis and considered the No Objection Certificate (NOC) from the competent authority (copy attached). ***The committee approved the case of the conversion of regular mode Ph.D. to Part-time Ph.D. of Ms. Kiran Kumari (R. No-0350818).***

Agenda 5: To approve the Pre-Ph.D. Submission and a List of Examiners for Ph.D. thesis evaluation of Ms. Arti Devi (R. No.-0150818), Ms. Gagandeep Kaur (R. No.-0250818), and Ms. Kiran Kumari (R. No-0350818).

Resolution 5: The Committee approved the recommendations made by RAC and DRC regarding the progress of the scholars in terms of objective completion as per the approved synopsis (copy attached) and ***approved Pre-Ph.D. submission a List of Examiners for Ph.D. thesis evaluation of Ms. Arti Devi (R. No.-0150818), Ms. Gagandeep Kaur (R. No.-0250818), and Ms. Kiran Kumari (R. No-0350818)*** (Annexure-IV) - A, B, C)

Agenda 6: To discuss the case of Monika Kalsotra (Ph.D. Scholar)

Resolution 6: The Committee discussed and resolved that the Department may intimate and seek the response of the Candidate on her continuous absence and on not completing the Ph.D. course work. Further, the Department may communicate the responses received from the candidate to the Controller of Examination for further necessary action.

Agenda 7: To discuss the course matrix and content of the Integrated B.Sc.(Hons)-MSc in Environmental Sciences program.

Resolution 7: The committee discussed and approved the course matrix and content of the ***Integrated B.Sc. (Hons)-MSc in Environmental Sciences program*** (Annexure-V).

DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU
राया-सूचानी(बागला),जिला सांबा-181143,जम्मू (जम्मू एवं कश्मीर)
Rahya-Suchani (Bagla), District Samba 181143, Jammu(J&K)

The meeting ended with a vote of thanks to all.

Prof.Richa Kothari
(Chairperson)

Prof. Kamal K. Kapoor
(Expert Member)

Prof.Piyush Malaviya
(Expert Member)

Prof. Deepak Pathania
(Member)

Prof. Sunil Dhar
(Member)

Dr Dinesh Kumar
(Member)

Dr. Vinita Sharma
(Member-VC Nominee)

Lt (Dr.) Pankaj Mehta
(Special Invitee)

Dr. Shweta Yadav
(Special Invitee)

Dr. Ankit Tandon
(Special Invitee)

Annexure - I

Course Matrix and Syllabus of M.Sc. (Environmental Sciences) Programme

PREAMBLE

The Department of Environmental Sciences was established in the year 2012. The academic programme of the Department has been periodically reviewed, revised and updated, keeping in mind the need for sharper focusing, the available expertise at any given time, and the changes desired in curriculum of individual courses or specific programmes.

The school has started its M.Sc. degree programme firstly in 2012. In the light of the dynamic nature of the discipline besides its tremendous growth in many of its sub-disciplines, the programme is regularly being updated and revised as per the applicability and demand in the society.

The Ph.D. programme started since 2016 has also undergone periodic changes in the curriculum.

The School has diversified interest in various earth, atmospheric and biological processes. Linkages between Ecological and Social processes give an additional dimension to Department interest, making the work relevant. Therefore, the curriculum has components of disciplinary areas such as Earth and Atmospheric sciences, environmental biology, and environmental monitoring and management. With such a high level of diverse research interests, over 30 students have so far been registered in Ph.D. programme in different aspects of Environmental Sciences.

VISION

The Department of Environmental Sciences, with its focus on Natural Resource and Watershed Management, Glaciology, Environmental Geo-Science, Bio-Energy, Atmospheric Science, and Remote Sensing and GIS, has a very strong perception of developing knowledge, skill and technologies to understand the changing environment and associated challenges like climate change, over- and misuse of natural resources, increasing pollution levels, *etc*. This is aimed at producing skilled professionals in the discipline who are capable of stepping in academics, research and industry. The Department intends to lead environmental sciences education and research with a wish to create, integrate and transform fundamental understanding of environmental sciences and use it to help providing safe and clean energy, air, water, and land.

The vision of the Department for the next ten years is:

A. TEACHING:

- Developing interactive learner-oriented than teacher-oriented teaching methodologies
- Regular revision of course curricula for keeping pace with expanding knowledge to meet the national and global challenges in environmental sciences education, and to produce trained professionals who are equipped to deal with scientific, technological, legal, socio-economic and policy aspects related to environment and resource management
- Strengthening of hands-on-training of students by developing new practical modules (Hands-on-training)

- Provision for students' training in established industrial houses for skill development. (Skill Development through Public-Private Partnership)
- Imparting vocational training in job-oriented areas for Livelihood Security, Women Empowerment and Entrepreneurship Development) such as:
    a) Environmental Management, Disaster Mitigation, IPR & Environmental Auditing, Geo-Sciences.
    b) Applications of Remote Sensing and GIS in natural resource and watershed management, air pollution and NWP modeling of weather phenomenon
    c) Mushroom Production & Farming
    d) Bio-compositing, Bio-energy and Bio-fuels
    e) Reservior Health Assessment, Glaciology, water chemistry and Weathering Geochemistry

B. RESEARCH:

Assessment of reservoir health of important basin of the North West Himalayas in response to the climate change. Understanding the geological sensitivities of the Himalayan terrain in terms of seismology, landslides and development of mitigative measures for further dispensation amongst various stake holders.

- Applying mesoscale to global scale NWP model over Himalayan region to understand atmospheric and metrological phenomenon. Further, using geospatial techniques in mapping and analyzing natural resources and air pollution
- Developing/refining low-cost, environment-friendly technologies for production of bio-energy including:
    a) Biodiesel from algae or other suitable bioresources (biomass production rates of algae are very high; they not only provide third generation biofuels but also capture carbon dioxide, thereby fighting climate change)
    b) Bio-ethanol from agricultural wastes and by-products
- Developing strategies for conservation of endangered plants and animals of India in general and Jammu and Kashmir in particular through genetic and habitat management strategies

C. OUTREACH ACTIVITY

- Establishing/strengthening of linkages with industry (for public-private partnership), national and international educational/research institutions for upgradation of course curricula, research and teaching methodologies and exchange of faculty and students
- Commercializing the technologies developed by the Department
- Strengthening of technology transfer mechanisms through training programmes, demonstrations, field days, campaigns, exhibitions, extension bulletins, magazines, awareness programmes, workshops, seminars, etc

MISSION

1. To generate, harness and effectively disseminate fundamental knowledge, and to integrate the use of newer technologies for addressing global and region-specific

problems about our planet, its resources, disaster mitigation and the environmental mechanisms for educating students, policy makers and other stake holders

2. To conduct interdisciplinary research for understanding the processes that model our environment
3. To assess and improve the quality of soil, air, water, and life with regional, national and international perspectives

Post Graduate Program Offered by School of Life Sciences
Syllabus for the Master's Degree Programme in Environmental Sciences

Semester-I

Course Code	Course Title	Credits	CIA	Mid Term	Major	Total Marks
Core Courses (CC) 15 Credits						
	Environmental Pollution and Control	3	15	22.5	37.5	75
	Environmental Geosciences	3	15	22.5	37.5	75
	Fundamentals of Ecology	3	15	22.5	37.5	75
	Lab-1	2	NA	NA	50	50
	Lab-2	2	NA	NA	50	50
	Indian Knowledge System (IKS)	2	10	15	25	50
Open Elective Courses (OE) 6 Credit						
	Environmental Issues and Awareness	2	10	15	25	50
	Introduction to Hydrology and Water Resource Management	2	10	15	25	50
	Waste to Energy	2	10	15	25	50
	Soil and Water Quality Analysis	2	10	15	25	50
	Atmosphere and its Processes	2	10	15	25	50
	Geo-Spatial Sciences	2	10	15	25	50
	Climatology	2	10	15	25	50
Skill Enhancement / Value Additions Courses In alternate semesters (SE)/(VA) 2 Credits						
	Solid Waste Management	2	10	15	25	50
	Mushroom Farming and Production	2	10	15	25	50
	Intellectual Property Rights	2	10	15	25	50
Compulsory Qualifying course from Swayam /NPTEL / E-PG Pathshalaetc of Ministry of Education, GoI recognized MOOCs platform related to Computers (Basics /Applications etc.)						
Credits (Total 23): Core Courses-15, Open elective- 06, SE/VA- 02						

Semester-II

Course Code	Course Title	Credit	CIA	Mid Term	Major	Total Marks
Core Courses (CC) 13 Credits						
	Risk Assessment and Disaster Management	3	15	22.5	37.5	75
	Environmental Chemistry	3	15	22.5	37.5	75
	Energy and Environment	3	15	22.5	37.5	75
	Lab-3	2	NA	NA	50	50
	Lab-4	2	NA	NA	50	50
Open Elective Courses (OE) 6 Credits						
	Environmental Nanotechnology	2	10	15	25	50

	Natural Hazards and Disaster Management in Himalayas	2	10	15	25	50
	Hydrogen Energy	2	10	15	25	50
	Waste as Resource	2	10	15	25	50
	Sustainable Development	2	10	15	25	50
	Introduction to Atmospheric Aerosols	2	10	15	25	50
	Remote Sensing and Image Processing Techniques	2	10	15	25	50
	Environmental Engineering	2	10	15	25	50
Skill Enhancement / Value Additions Courses In alternate semesters (SE)/(VA) 2 Credits						
	Vermitechnology	2	15	10	25	50
	Environment: Economics & Auditing	2	15	10	25	50
Credits (Total 21): Core Courses-13, Open elective- 06, SE/VA- 02						

Semester-III						
Course Code	**Course Title**	**Credit**	**CIA**	**Mid Term**	**Major**	**Total Marks**
Core Courses (CC) 8 Credits						
	Environment: Impact Assessment & Management Systems	2	15	10	25	50
	Atmospheric Sciences and Climate Change	2	15	10	25	50
	Natural Resources, Biodiversity and its Conservation	2	15	10	25	50
	Lab - 5	2	NA	NA	50	50
Open Elective Courses (OE)12 Credits						
	Water Shed Management	3	15	22.5	37.5	75
	Green Energy Sources	3	15	22.5	37.5	75
	Biofuels and Biorefinery	3	15	22.5	37.5	75
	Medicinal and Aromatic Plants of India	3	15	22.5	37.5	75
	Environmental Instrumentation	3	15	22.5	37.5	75
	Advances in Meteorology	3	15	22.5	37.5	75
	Environmental Data Analysis	3	15	22.5	37.5	75
Audit Course/ Qualifying Courses (QC) 2 Credits						
	Personality Development	2	10	15	25	50
Credits (Total 22): Core Courses-08, Open elective- 12, QC- 02						

Semester-IV

Course Code	CORE 8 Credits (Dissertation)	Credit	CIA	Mid Term	Major	Total Marks
	Dissertation	7+1#	NA	NA	200	200
Open Electives will be selected of 12 credits from the Swayam / NPTEL / E-PG Pathshalaetc. of the Ministry of Education, GoI recognized MOOCs platform, one must be related to Computers and its Application in Science						
Audit Course/ Qualifying Courses (QC) 2 Credits						
	Commercialization Skills (Qualifying)	2	10	15	25	50
Award of Post Graduate Degree (After 2 year) *						
# 1 credit goes to outreach activity among anyone (15 hours minimum to contribute) • **Environmental Awareness** • **Industrial visit** • **Field visit** • **Social Awareness**						
Any other area deemed to be appropriate by the department						
Credits (Total 22): Core Courses-08 (Dissertation + Outreach activity), Open elective- 12, QC- 2						

SEMESTER-I

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Course: Environmental Pollution and Control

Credits: 3 **Contact Hours / Week: 3**

Course Learning Outcomes (CLOs): At end of the course, the student will be able to understand the:

- Various environmental pollutions: water, Air, Soil, Noise, Thermal, Oil, E-waste and their impact on environment
- Conceptual knowledge on different technologies involved in control and management of environmental pollution
- Ability to analyse the water quality and water pollution monitoring
- Air pollution monitoring and impacting pollutants
- Deals with soil and radioactive pollution
- Impacts of the noise pollution, E-waste, urban waste and their sources
- Oil-spill and its monitoring with technologies to remediation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT I: AIR POLLUTION

1.1 Air Pollution: Types, sources and classification of air pollutants

1.2 Effect of air pollution on plants, animals and human health.

1.3 General methods of control of air pollutants from mobile and stationary sources.

1.4 Air quality standards, Air pollution control models

UNIT II: WATER AND SOIL POLLUTION

2.1 Water Pollution: Types, sources and classification

2.2 Industrial effluents characteristics of effluents from different industries (pulp and paper mills, oil exploration and refinery) water quality standards proposed by national and international agencies

2.3 Estuarine pollution, marine pollution, Eutrophication – causes, effects and control Measures, Waste water characteristics-Domestic waste water, Sewage treatment: preliminary, primary, secondary and tertiary treatment; process description of aerobic and anaerobic processes: aerobic fixed film bed reactor, anaerobic fluidized bed reactor, Upflow Anaerobic Sludge Bed reactor (UASB)

2.4 Sources, Impact and Control of soil pollution

UNIT III: NOISE AND RADIOACTIVE POLLUTION

3.1 Noise Pollution: types, sources, consequences; measurement of noise pollution, threshold hearing level and abatement measures

3.2 Radio-active Pollution: types, sources and consequences

3.3 Biological effects of ionizing radiation's: the interactions of radiation's with cells – various stages, somatic and genetic effect; maximum permissible dose

3.4 Parameters affecting the radiation monitoring - personal monitoring equipment's; Disposal and management of radioactive waste

UNIT IV: INDUSTRIAL AND URBAN POLLUTION

4.1 Sources, Impact and Control of thermal pollution and light pollution

4.2 Oil pollution: sources of oil spillage and impact, factors effecting fate of oil spillage

4.3 Solid-waste Pollution: types, sources and consequences, Management Practices

4.4 E-waste: sources, types and constituents; environmental consequences andmanagement, Bio-indicators of Pollution

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visit
- Industrial/Field Excursion to enhance the concepts

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment laboratory reports
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Introduction to Environmental Engineering and Science- Gilbert M Masters.
2. Environmental Engineering –Peavy and Rowe. McGraw Hill.
3. Environmental Engineering-Gerard Kiely (Tata McGraw-Hill Publishing Company
4. De, A. K. Environmental Chemistry. New age International (P) Ltd., New Delhi, India.2000
5. Baird, S.K. Environmental Chemistry. W. H. Freeman & Co.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Environmental Geosciences **Contact Hours / Week: 3**

Credits: 3

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Develop the crucial skills needed to address important challenges
- How can we predict and mitigate the effects of global climate change?
- What tools can we use to reduce greenhouse gas emissions to the atmosphere?
- Why is our planet able to sustain life?
- How can we reduce the effects of environmental pollution?
- Will changes in seawater properties affect the ocean's role as a food source?
- How does the increased CO2 concentration in seawater affect life in the ocean?

Gain experience in:

- acquiring, analyzing, assessing and presenting a wide range of data
- using a range of specialist laboratory techniques
- applying observational and sample collection techniques in the field

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT I: EARTH PROCESSES

1.1 Brief geological history of the planet, fundamental concepts.

1.2 Primary differentiation and magma. Constitution of Earth's Interior.

1.3 Earth movements, Endogenic and exogenic processes, Geological Time scale; Formation and classification of rocks.

1.4 Plate tectonics, sea floor spreading, Geosynclines, Mountain formation and evolution of continents.

UNIT -II: Geomorphology

2.1 Basic concept of Geomorphology and typical landforms.

2.2 Weathering, Soil Processes and Mass Movements.

2.3 Cycles of Erosion, Rejuvenation and Relief formation

2.4 Drainage basins, systems and Patterns. Important drainage basins of Himalayas.

UNIT III: GEOLOGICAL AGENTS

3.1 Fluvial system: factors affecting stream erosion, deposition, erosional and depositional land form

3.2 Underground water system-water table, land forms formed through ground water action

3.3 Aeolian system: mechanism of wind erosion, erosional and depositional land forms

3.4 Glacial system: mechanism of glacial erosion, erosional and depositional land forms

UNIT-IV: Geo-Environment

4.1 Spectrum of Environmental Geology, Resource Management and Conservation: Land, Water and Minerals.

4.2 Abundance of elements in the bulk earth, crust, hydrosphere, atmosphere and biosphere

4.3 Mineral stability diagrams and controls on the chemistry' of natural waters

4.4 Frontier areas in medical geology, geobiology, forensic geology

Teaching -Learning Process

Effective teaching and learning process for Environmental Geosciences involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

Assessment methods:

Specific assessment measure(s) Student will be assessed in a variety of ways.

- Written or practical exams, including multiple-choice exercises
- Laboratory reports and field project reports
- Practical evaluation in the field or field notebooks
- Coursework such as essays, posters
- Individual or group projects and presentations

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Press &Seiver, The Earth, Frank Press
2. Skinner & Porter, Dynamic Earth, Wiley
3. Krauskopf, Introduction to Geochemistry, Mc-Graw Hill
4. Parbin Singh, Engineering & General Geology, S.K. Kataria& Sons
5. K.S. Valdiya, Environmental Geology. Tata Mc-Graw Hill.
6. W.D. Thornbury, Pincipals of Geomorphology, CBS, Publication.
7. Savindra Singh, Geomophology, Prayag, Pustak Bhawan

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Fundamentals of Ecology **Contact Hours / Week: 3**

Credits: 3

Course Learning Outcomes (CLOs): On completion of this course, the students will be able to:

- Understand the basics of discipline of ecology and environmental sciences.
- Gain fundamental understanding of some important concepts of ecology at population and community level.
- Understand the basics of environment and important concepts of environmental physics and chemistry.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT-I: INTRODUCTION TO ECOLOGY

1.1 Four levels of ecological organization: Population, Community,Ecosystemand Biosphere.
1.2 Concept of food chain, food web, ecological pyramids, trophic structure,
1.3 Energy flow pathways; Concept of primary and secondary productivity
1.4 Shelford's law of tolerance, Liebig's law of minimum

UNIT-II: POPULATION AND COMMUNITY ECOLOGY

2.1 Characteristicsand attributes of population. Population growth vis-a-vis the concept of carrying capacity.
2.2 Population interactions, Predator-prey relationship, Lotka –voltera equation, 'r' and 'k' species.
2.3 Concept of communities, concept of niche, edge effect, ecotypes, ecotone.
2.4 Types of interactions, Succession and it's types, climax community.

UNIT-III: INTRODUCTION TOENVIRONMENTAL SCIENCE

3.1 Definition, Principles and Scope of Environmental Science.
3.2 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere
3.3 Interaction between Earth, Man and Environment.
3.4 Biogeographic provinces of the world and agro-climatic zones of India.

UNIT-IV FUNDAMENTALS OF ENVIRONMENTAL PHYSICS AND CHEMISTRY

4.1 Basic concepts of light and matter, quantum mechanics (relation between energy, wavelength and frequency).
4.2 Basic concepts of pressure, force, work and energy; types of forces and their relation

4.3 Mole concept, solution chemistry, solubility product, solubility of gases, phase change
4.4 Laws of thermodynamic- first, second and third, Stereochemistry.

Teaching -Learning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Computer based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment on softwares
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. E.P. Odum and G.W. Barrett. 2005. Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
2. P.D.Sharma.2008. Ecology and Environment. Rastogi Publications
3. S.E. Mannahan, 2022. Environmental Chemistry. 9th Edition, CRC Press.
4. John L. Monteith and Mike H. Unsworth, 2013. Principles of Environmental Physics, Plants, Animals, and the Atmosphere Fourth Edition

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Knowledge System (Environment Protection Prospective and Indian Ethos) **Credits: 2**

Contact Hours / Week: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Conceptual knowledge on Bharatiya Civilization and Development of Indian Knowledge System
- Ability to analyse the role of Components of Environmental Science and Tradition in Ancient System
- Ability to analyse the role of Components of Environment coupled with Science and Tradition

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**37.5**	**75**

COURSE CONTENT

Unit-I: Indian Knowledge System: Introduction to *"Bharat"*

1.1 Definition, Scope, and Significance of Bharatiya Civilization and Development of IKS

1.2 Types of Indian Knowledge System: Indigenous, Traditional and Scientific

1.3 Saraswati-Sindhu Civilization, Traditional Knowledge System: Panchatantra ki Kahaniyan, Motivational Stories

Unit-II: Abiotic Components of Environmental Science and Tradition in Ancient System

2.1 Air; Water; Land; Fire; Atmosphere: Vedic system

2.2 Sustainable Solutions with Science and Technology for Environment

2.3 Successful Stories: Basholi Paintings, Rajasthani Paintings, Bihar Based Community Participation

Unit-III: Biotic Components of Environment: Science and Tradition

3.1 Plants and Agro-ecosystems: Conservation and Practices for Protection Prospectives

3.2 Wildlife and Biodiversity: Conservation and Practices for Protection Prospectives

3.3 Government of India Initiatives; AYUSH, YOGA etc., Cultural Heritages and Architectural Monuments of India

Teaching -Learning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Computer based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment on softwares
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

OPEN ELECTIVE COURSES FOR SEMESTER-I

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Environmental Issues and Awareness

Credits:2 Contact Hours / Week: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Know the role of media and NGO on environmental protection
- Understand the relationship between humans and their environment
- Articulate and apply the scientific methods along with regional knowledge in environmental protection
- Understand and evaluate the global scale of environmental problems
- Able to understand the requirement of water conservation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNITI: I: ENVIRONMENTAL AWARENESS

1.1 Environmental education: formal and in-formal methods;

1.2 Role of media in environmental awareness, role of NGOs, public participation in environmental movements

1.3 Current environmental issues, Environmental ethics, Ecotourism

1.4 Sustainable development goals, International Environmental Policies

UNIT-II GLOBAL ENVIRONMENTAL ISSUES

2.1 Biodiversity loss- factors affecting and consequences

2.2 Ozone layer depletion, Sea level rise,

2.3 Acid Rain, Forest fires

2.4 Carbon sequestration and carbon credits

UNIT-III: CURRENT ENVIRONMENTAL ISSUES IN INDIA

3.1 Environmental issues related to water resource projects

3.2 Water conservation-development of watersheds, Rain water harvesting and ground water recharge

3.3 National River conservation plan – NamamiGange and Yamuna Action Plan.

3.4 Eutrophication and restoration of lakes, Conservation of wetlands, Ramsar sites in India

4. Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- problem based assignments;
- oral presentations, including seminar presentation;
- viva voce interviews
- exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Steie, G. Economics and Environment
2. Srivastav, Sweta. Basics of Environmental Science, Anmol Publications Pvt Ltd.
3. Bhatt, S. Environment protection and sustainable development, APH Publishing Corporation
4. Vishwanathan Prasad. An introduction to Environment.Rawat Publications. 2012.
5. Vasudevan, Essentials of Environmental Science. Atlantic Publishers. 2011.
6. Tiwari, S.K. Environmental Science. Atlantic Publishers. 2011.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Course Title Introduction to Hydrology and Water Resource Management: **Contact Hours / Week: 2**

Credits: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- To study occurrence, movement and distribution of water that is one of the prime resource of human sustenance.
- To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
- To know the basic principles and movement of ground water and properties of ground water flow.
- Develop understanding of floods and drought
- To learn water harvesting and conservation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

Unit I: Water Resources

1.1 Hydrologic cycle, Global Water availability, Water budget, Precipitation and Water Resources.

1.2 Interrelation of water resources with other natural resources and Environment..

1.3 Water resources of the earth, Concept of Sustainable water resource development.

1.4 Need of Water resource development in India.

Unit II: Surface and Ground water

2.1 Surface water resources, River basins and water divide.

2.2. Cryosphere; its distribution and importance,

2.3 Occurrence and movement of groundwater, Darcy's law, Factors governing ground water flow.

2.4 Types of aquifers, porosity & permeability, specific yield, specific retention, storage coefficient.

Unit III Water Harvesting

3.1 Causes and Management of Floods.

3.2 Causes of drought, Water Harvesting:

3.3 Methods of rainwater collection and harvesting, runoff enhancement, runoff collection,

3.4 Artificial ground water recharge, needs and methods.

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visit
- Industrial/Field Excursion to enhance the concepts

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Text Books:

1. Garg S.K., Hydrology and Water Resources Engineering
2. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
3. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons..
4. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley
5. Dr. P.Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Waste to Energy **Contact Hours /**

Credits: 2

Course Learning Outcomes (CLOs): At end of the course, the student will be able to

- Explain about the energy from waste
- To understand the technologies for Waste to Energy options
- Able to gain knowledge on gasification, combustion, pyrolysis, anaerobic digestion processes
- the concept of recycling and recovery of resources from various solid/liquid wastes

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

Unit-I: Introduction to energy from waste

1.1: Characterization and classification of waste as fuel – agrobased, forest residues, industrial waste, Municipal solid waste.

1.2: Sources and types of wastes

1.3: Physical, chemical and biological properties of wastes

1.4: Global and Indian scenario on energy from waste,Success and Failures of Indian Waste to Energy plants, Role of the Government in promoting 'Waste to Energy'

Unit-II: Technologies for Waste to Energyoptions

2.1: Combustion (unprocessed and processed fuel), Factors affecting, environmental and health impacts

2.2: Gasification, Factors affecting, environmental and health impacts

2.3: Microbial conversion processes, Anaerobic digestion, fermentation, Factors affecting, environmental and health impacts

2.4: Pyrolysis, Factors affecting, environmental and health impacts

Unit-III: Conversion devices

3.1: Combustors (Spreader Stokes, Moving grate type, fluidized bed),

3.2: Gasifier, digesters. Briqueting technology: Production of RDF and briquetted fuel.

3.3: Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes.

3.4: Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers, Global Best Practices in Waste to energy production distribution and use.Circular economy

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab based practical's to enhance the concept
- Industrial/Field Excursion to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. SaeidMokhatab "Handbook of Liquefied Natural Gas", Gulf Professional Publishing 2016.
2. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies , JG Press, October 2005.
3. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.
4. Rogoff, M.J. and Screve, F., 2019. Waste-to-energy: technologies and project implementation. Academic Press.
5. Hussain, C.M., Singh, S. and Goswami, L. eds., 2021. Waste-to-Energy approaches towards zero waste: interdisciplinary methods of controlling waste. Elsevier.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Soil & water quality analysis

Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will learn throughout the course about:

- The concepts and principles of Soil Science
- Understand the role of soil forming factors and processes in soil formation
- Understand various soil physical, chemical and biological properties and their impact on plant growth.
- Working knowledge of water quality characteristics of water sources
- Working knowledge of drinking water regulations and standards required to protect public health and ensure compliance including: Safe Drinking Water
- Practical Knowledge in assessing the Soil & water quality through Lab experiments

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

Unit I:SOIL: AN OVERVIEW

1.1 Introduction: Definition of Soil, Properties of Soil, Soil water relationships

1.2 Chemical Properties; Acidity, Alkalinity, pH, Salinity, Reactions in Liming and Acidification

1.3 Biological Properties; Soil Organic Matter, C: N Relationships, N-Transformation Sulphurand phosphorus Transformation

1.4 Fertility Status of Soils, soil deficiency with respect to macro and micro nutrient components, brief study of micronutrient & macronutrient, organic agriculture

Unit II: WATER: AN OVERVIEW

2.1 Water availability; water stress index; Water Quality as a core thread

2.2 Water quality and health issues and policy interventions

2.3 Potable water quality criteria: desirable vs rejection, National River Action Programme

2.4 Wastewater discharge standards, Impairment of natural water bodies, role of national and international agencies in water health and sanitation

Unit III: SAMPLING & ANALYSIS (SOIL& WATER)

3.1 Soil Sample Collection and Processing, method of Soil Sample collection

3.2 To determine Soil Organic Carbon & Soil Organic Matter in given soil sample,

3.3 Collection and preservation of water samples from open well, tap, bore well, river, water treatment plants,

3.4 Determination of pH, Electrical Conductivity, Determination of Alkalinity, Determination of Hardness (Total, Permanent & Temporary),Determination of calciumin water

4. Teaching -Learning Process

Effective teaching and learning process for Soil and Water quality analysis involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods:

Specific assessment measure(s) Student will be assessed in a variety of ways

- Written or practical exams, including multiple-choice exercises
- Laboratory reports and field project reports
- Practical evaluation in the lab and field notebooks
- Individual or group projects and presentations

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Standard Methods for Examination of water & waste wate APHA- AWWA- WPCE
2. Manual of water & waste water analysis, NEERI, Nagpur.
3. Text book of water and waste water engineering by H. K. Hussen.
4. Water supply & sanitary engineering by Birdie.
5. Introduction to soil laboratory manual -J.J.Harsett stipes.
6. Introduction to soil science laboratory manual, Palmer and troch - Lowa state.
7. Soil Sampling, Preparation and analysis, Marcell Dekker, Inc, New York.
8. Soil Sampling and methods of analysis, carter M.R. and E.G.Gregorich, 2007, 2nd Ed..
9. Methods of soil analysis, Part, American society of Agronomy Inc., Kuete, A.Et.at., 198
10. Nature & Properties of Soils, Brady NC (2018)

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Atmosphere and its processes

Credits:2 **Contact Hours/Week: 2**

Course Learning outcomes (CLOs): After the completion of course, the students will able to:

- Understand fundamental design of Earth's atmosphere.
- Interpret thermodynamic structure of atmospheric processes
- Grasp the role and implications of atmospheric phenomena in governing earth's radiation budget,
- Understand atmospheric cycles in terms of pathways, burdens and reservoirs of major components like carbon, oxygen, sulfur and nitrogen across different spheres.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-I: Overview

1.1 History and evolution of the earth's atmosphere

1.2 Understanding the atmospheric strata

1.3 Measures of atmospheric composition: absolute concentration, fractional abundance and number density

1.4 Concept of meteorology, meteorological parameters: pressure, temperature, wind direction and wind speed, humidity and solar radiation

UNIT-II: Atmospheric Thermodynamics and Radiative transfer

2.1 Understanding the laws of thermodynamics in atmosphere, the concept of air parcel, the dry adiabatic lapse rate

2.2 Moisture parameters: mixing ratio and specific humidity, saturation mixing ratios and vapor pressures, relative humidity; dew point and frost point

2.3 Lifting condensation level and normand's rule.

2.4 The spectrum of radiation and blackbody radiation laws

UNIT - III: Atmospheric Cycles

3.1 The atmospheric sulphur cycle: natural and anthropogenic emission of SO_2, major pathways of sulphur compounds.

3.2 The atmospheric nitrogen cycle: natural and anthropogenic processes for nitrogen fixation, Inter conversion sources and implication of nitrogen containing compounds.

3.3 The global carbon cycle: the global mean atmospheric CO2 level, the flux of carbon between various reservoirs, the six compartment carbon model of carbon cycle.

3.4 The atmospheric oxygen cycle: odd oxygen chemistry, formation and destruction of ozone and OH radical.

4. Teaching -Learning Process: Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer-based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Finlayson-Pitts, B.J., Pitts J.N., J., (2000): Chemistry of the upper and lower atmosphere-Theory experiments and applications. Academic Press, US.
2. Seinfeld, J.H., Pandis, S.N., (2006): Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. A wiley inter-science publication.
3. Wallace John M. Jr., Peter V. Hobbs (2006): Atmospheric Science: An Introductory Survey, 2nd Edition, Academic Press, ISBN: 978-0127329512
4. Gilbert, M. Masters & Ela, W. P. (2007):Introduction to Environmental Engineering and Science. PHI learning Pvt Ltd.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Geo-Spatial Sciences **Credits: 2 Course**

Code: **Maximum Marks: 50**

1. **Course Learning Outcomes (CLOs):** On completion of this course the students will able to:
   - Understand the fundamental concept and practice of GIS and its advancement
   - Design creative application of geospatial technology
   - Demonstrate the use of GIS to create interactive map for user's choice
   - Understand the skill required for professional level

2. Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

3. COURSE CONTENT

UNIT II: FUNDAMENTALS OF REMOTE SENSING AND GPS

1.1 Fundaments of Remote sensing, spectral signature, basic characteristics of satellite

1.2 Satellite data characteristics, details of satellite of Indian and global origin

1.3 Basic principles of global positioning system (GPS), Concept of positioning in GPS, GPS receiver basic functioning

1.4 Application of GPS in Defense, avian industry, surveying, DGPS

UNIT I: FUNDAMENTALS OF GIS

2.1 GIS concepts, Coordinate system and projections, GIS data modeling

2.2, Data structures- vector and raster data, pros and cons of data

2.3 Data inputting, data storage, data editing, Hardware and Software requirement for GIS.

2.4 Data base management system (DBMS), online GIS data publishing

UNIT III:APPLICATION OF GIS

3.1 GIS application natural resource management.

3.2 GIS application in hazard zonation mapping.

3.3 GIS application in generation of Digital elevation model.

3.4 GIS application in Atmospheric pollution.

Dingle

4. TEACHING -LEANING PROCESS:

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- problem based assignments;
- practical assignment laboratory reports;
- oral presentations, including seminar presentation;
- viva voce interviews
- exams in regular intervals

5. Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Lillesand Kiefer Chipman: Remote sensing and Inmage interpretation, Willey
2. Stephen Wise: GIS Fundamentals (Second Edition), CRC Press
3. Robert A. Schowengerdt: Remote Sensing, Elsevier

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Climatology

Credits: 2 **Contact Hours / Week: 2**

Course Learning outcomes (CLOs): After the completion of course, the students will able to:

- Understand fundamentals of Earth's Climate System and Climate Types.
- Comprehend the structure and role of weather systems on different scales
- Recognize the effects of jet-streams and atmospheric rivers in causing variability in Indian summer monsoon
- Indentify the tele-connections of Indian Summer Monsoon with various atmospheric-oceanic coupled oscillations

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-I: Climate Variables and Climate Types:

1.1 Weather vs Climate, Climate Variables and Component of Climate System

1.2 Latitudinal and seasonal variation in insolation, atmospheric pressure, and air temperature

1.3 Pressure belts and Global & Local Winds

1.4 Classification of Climates: Koppen's and Thornthwaite's Scheme of classification

Unit- II: Weather Systems, Clouds and Precipitation:

2.1 Weather Systems on different scales

2.2 Extra-tropical Cyclones: Air masses, fronts and jet streams

2.3 Tropical Cyclones: Structure, thermodynamics and dynamics, Genesis and life cycle

2.4 Condensation Nuclei, Growth of Cloud droplets and ice-crystals, Cloud classification

Unit III: Indian Summer Monsoon and its Variability:

3.1 Onset, course and Reversal of Indian Summer Monsoon

3.2 Variability in Monsson, Beaks in Monsoon and factors affecting brakes

3.3 Factors affecting Indian Summer Monsoon: Tropical Easterly Jet Streams, Atmospheric Rivers, Atmospheric Lakes

3.4 Tele-connections of Indian Summer Monsoon with various atmospheric-oceanic coupled oscillations viz. Indian Ocean Dipole and El-Nino Southern Oscillation etc.

Teaching -Learning Process: Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer-based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Singh S., (2023): Climatology, Pravalika Publications, Prayagraj, India
2. Lal D.S. (2023): Climatology, Sharda Pustak Bhawan, Prayagraj, India
3. Strahler A., (2016): Introducing Physical Geography, Wiley, USA

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – I

Subject Course Code No.

Subject Course Title: Solid Waste Management

Course Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): By the end of the course, students are expected to be able to:

- Demonstrate a thorough understanding of the waste management sector, issues at global, regional and local scales.
- Illustrate all the steps involved in waste management, and technologies and strategies involved thereof.
- Discriminate the various waste categories and their respective potential for treatment.
- Analyze and integrate various technological options, and conceptualize a management solution for particular waste characteristics.

Examination Schedule			
CIA	Mid-Term	Major	Total
10	15	25	50

COURSE CONTENT

Unit - I: Sources and Composition of Municipal Solid Waste

1.1 Sources and Composition of Municipal Solid Waste Introduction

1.2 Sources of solid waste, Types of solid waste, Composition of solid waste and its determination

1.3 Physical properties of Municipal Solid Waste, Chemical properties of Municipal Solid Waste

1.4 Biological properties of Municipal Solid Waste, Transformation of Municipal Solid Waste

Unit – II: Solid Waste Generation and Collection

2.1 Handling and segregation of wastes at source

2.2 Quantities of Solid Waste, Measurements and methods to measure solid waste quantities

2.3 Solid waste generation and collection

2.4 Factors affecting solid waste generation rate

Unit III: Methods of Solid Waste Treatment and Disposal

3.1 Pyrolysis, Recycling and Reuse of Solid Waste and Management

3.2 Solid Waste Handling Methods, Segregation and Salvage,

3.3 Recovery of the Bio Products, Public Health and economic Aspects of open storage related to Solid Waste.

Teaching -Learning Process

Effective teaching and learning process for IPR, involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

Assessment methods

Specific assessment measure(s):

- Oral Communications: The student will learn how to give oral presentation in context of course learned to corporate houses, over various communication tools, such as radios or telephones. The student will also learn how to communicate clearly and effectively
- Reading: Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Students will be given various scenarios to practice during the course of the program. These scenarios will help the student to develop their critical thinking skills.

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Reference Books:

1. Kumar, S. (2016). Municipal Solid Waste Management in Developing Countries, 1st Edition.
2. Epstein, E. (2015).Disposal and Management of Solid Waste: Pathogens and Diseases, 1st Edition.
3. Andrén, M. (2015). Nuclear Waste Management and Legitimacy: Nihilism and Responsibility 1st Edition.
4. Pitchel, J. (2005). Waste Management Practices: Municipal, Hazardous, and Industrial 1st Edition. CRC Press.
5. Saling, J., Fentimen, A, W. (2001). Radioactive Waste Management, 2nd Edition. CRC Press.
6. Juhasz, A. L., Magesan, G., & Naidu, R. (Eds.). (2004). Waste Management, 1st Edition. Science publishers, US.
7. Solid Waste Management CPCB. New Delhi

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Mushroom Farming & Production

Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will be able to do :

- Start a small business enterprise by liaising with different stake holders
- Effectively manage small business enterprise
- Take up Mushroom Cultivation and run it profitably
- Selection of important types of Mushroom and their cultivation
- Maintain Mushroom farm in a hygienic and scientific way
- Work out the economics of Mushroom Cultivation

Examination Schedule			
CIA	Mid Term	Major	Total
10	15	25	50

Unit 1: MUSHROOM CULTIVATION: AN OVERVIEW

1.1 Commercial Mushroom Cultivation, Present scenario and prospects for Mushroom Cultivation.

1.2 Description of edible types, natural growth aspects and climatic requirements

1.3 Selection of types of Mushroom and Sites Selection of important types of Mushroom, Design and construction of Mushroom farm.

1.4 Composting in Mushroom cultivation, Role of composting in Mushroom cultivation, Appropriate materials to prepare different types of compost.

Unit II : BIOLOGY, DISEASE CONTROL & HARVESTING OF MUSHROOM

2.1 Biology of Mushrooms: Button, Straw& Oyster- General morphology, distinguishing characteristics, spore germination and life cycle,

2.2 Nutrient Profile of Mushroom: protein, aminoacids, calorific values, carbohydrates, fats, vitamins &minerals, Different types of Mushroom growing facilities and fixtures.

2.3 Disease control and pest Management Inspection of Mushroom bags or beds for early detection of pests and diseases

2.4 Harvesting of Mushroom, Identification of right stage of Mushroom. Methods of harvesting using approved cutting techniques for harvesting

Unit III: CULTIVATION, DESIGNING& FARMING OF MUSHROOM

3.1 Cultivation System & Farm design: Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipments& facilities

3.2 Casting materials & Case running: Importance of casing mixture, Quality parameters of casing soil, different types of casing mixtures, commonly used materials.

3.3 Cultivation of Button, Oyster and Straw Mushrooms: Collection of raw materials, compost & composting,

3.4 Spawn & spawning, casing & case run, cropping & crop management, picking & packing, Visit to relevant Labs/Field Visits

4. Teaching -Learning Process

Effective teaching and learning process for Mushroom Farming & Production involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods: Specific assessment measure(s) Student will be assessed in a variety of ways.

- written or practical exams, including multiple-choice exercises
- Field project reports on Mushroom Cultivation
- Practical evaluation in the field or field notebooks, carried for Mushroom Production, Design and construction of Mushroom farm (Lab Simulation) through project and case studies
- individual or group projects and presentations

6. Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1.Mushroom Cultivation, Tripathi, D.P.(2005) Oxford & IBH Publishing Co. PVT.LTD, New Delhi. Reference

2. A hand book of edible mushroom, S.Kannaiyan&K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi

3.Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co.

42
43

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – I

Subject Course Code No.

Subject Course Title: Intellectual Property Rights (IPR)

Course Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Identify different types of Intellectual Properties (IPs),
- Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development
- Be familiar with the processes of Intellectual Property Management (IPM) and various approaches for conducting IP awareness session.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-1: IPR (Intellectual Property Rights), Innovation & Knowledge

1.1 Knowledge – characteristics and role in economic growth,Tacit and codified knowledge, Knowledge as public good and 'market failure'

1.2 Pre-IPR system of protection: Secrecy/Trade guilds/Cartels

1.3 IPR: Consequentialist, right based justification and economic justification

1.4 Basic forms of IPRs: — Patent, copyright, trademark, industrial design,

UNIT-II: IPR in India

2.1 The Patent Act of India 1911 and the Indian Patent Act of 1970

2.2 IP rights in India and progressive harmonization with international standards; Patent Amendment Act (2005)

2.3 Case studies giving examples of patents and technology transfer, access and affordability of medicines in India

2.4 International organizations and Treaties (pre- TRIPs era): Paris Convention, Berne Convention, Rome convention, WIPO, GATT, FAO, UNCTAD

UNIT–III: Debates on IPR and Development

3.1 IPRs and technology transfer

3.2 Traditional knowledge, IPR and Benefit sharing, Biopiracy, Breeders vis-à-vis Farmers rights, IPR & Traditional Medicine, Private vis-à-vis community-based ownership,

3.3 IPRs vis-à-vis access & affordability of medicines

3.4 Bayh-Dole Act and issues of academic entrepreneurship, advancement of science and commercialization of university research.

4. Teaching -Learning Process

Effective teaching and learning process for IPR, involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods

Specific assessment measure(s):

- Oral Communications: The student will learn how to give oral presentation in context of course learned to corporate houses, over various communication tools, such as radios or telephones. The student will also learn how to communicate clearly and effectively
- Reading: Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Students will be given various scenarios to practice during the course of the program. These scenarios will help the student to develop their critical thinking skills.

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. L.W. Canter (2002). Environmental Impact Analysis, McGraw Hill Book Co., New York.
2. International Chamber of Commerce (1986) ICC Guide to Effective Environmental Auditing, ICC, New York.
3. A.D. Little (1990) Principles for conducting Environmental Health, and Safety Audits, Centre for Environmental Assurance.
4. Ministry of Environment & Forests (1992) Policy Statement for Abatement of Pollution, Govt. of India, New Delhi.
5. Swaminathan, M.S (2002). The Protection of Plant Varieties and Farmers' Rights Act: From Legislation to Implementation. Journal of Intellectual Property Rights. 7, pp. 324- 329.
6. Vivien Irish (2000). How to Read a Patent Specification. Engineering Management Journal. April, pp. 71-73.
7. Vasudeva, P.K. (2000). Patenting biotech products: Complex issues. Economic and Political Weekly. 3726- 3729.
8. Wesley, M. Cohen and Stephen, A. Merrill (2004). Patents in the Knowledge Based Economy. The National Academic Press, Washington, DC.
9. Watal, Jayshree (2001). Intellectual Property Rights in the WTO and Developing Countries. Oxford University Press: New Delhi.

SEMESTER-I

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Course: Environmental Pollution and Control

Credits: 3 **Contact Hours / Week: 3**

Course Learning Outcomes (CLOs): At end of the course, the student will be able to understand the:

- Various environmental pollutions: water, Air, Soil, Noise, Thermal, Oil, E-waste and their impact on environment
- Conceptual knowledge on different technologies involved in control and management of environmental pollution
- Ability to analyse the water quality and water pollution monitoring
- Air pollution monitoring and impacting pollutants
- Deals with soil and radioactive pollution
- Impacts of the noise pollution, E-waste, urban waste and their sources
- Oil-spill and its monitoring with technologies to remediation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT I: AIR POLLUTION

1.1 Air Pollution: Types, sources and classification of air pollutants

1.2 Effect of air pollution on plants, animals and human health.

1.3 General methods of control of air pollutants from mobile and stationary sources.

1.4 Air quality standards, Air pollution control models

UNIT II: WATER AND SOIL POLLUTION

2.1 Water Pollution: Types, sources and classification

2.2 Industrial effluents characteristics of effluents from different industries (pulp and paper mills, oil exploration and refinery) water quality standards proposed by national and international agencies

2.3 Estuarine pollution, marine pollution, Eutrophication – causes, effects and control Measures, Waste water characteristics-Domestic waste water, Sewage treatment: preliminary, primary, secondary and tertiary treatment; process description of aerobic and anaerobic processes: aerobic fixed film bed reactor, anaerobic fluidized bed reactor, Upflow Anaerobic Sludge Bed reactor (UASB)

2.4 Sources, Impact and Control of soil pollution

UNIT III: NOISE AND RADIOACTIVE POLLUTION

3.1 Noise Pollution: types, sources, consequences; measurement of noise pollution, threshold hearing level and abatement measures

3.2 Radio-active Pollution: types, sources and consequences

3.3 Biological effects of ionizing radiation's: the interactions of radiation's with cells – various stages, somatic and genetic effect; maximum permissible dose

3.4 Parameters affecting the radiation monitoring - personal monitoring equipment's; Disposal and management of radioactive waste

UNIT IV: INDUSTRIAL AND URBAN POLLUTION

4.1 Sources, Impact and Control of thermal pollution and light pollution

4.2 Oil pollution: sources of oil spillage and impact, factors effecting fate of oil spillage

4.3 Solid-waste Pollution: types, sources and consequences, Management Practices

4.4 E-waste: sources, types and constituents; environmental consequences andmanagement, Bio-indicators of Pollution

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visit
- Industrial/Field Excursion to enhance the concepts

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment laboratory reports
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Introduction to Environmental Engineering and Science- Gilbert M Masters.
2. Environmental Engineering –Peavy and Rowe. McGraw Hill.
3. Environmental Engineering-Gerard Kiely (Tata McGraw-Hill Publishing Company
4. De, A. K. Environmental Chemistry. New age International (P) Ltd., New Delhi, India.2000
5. Baird, S.K. Environmental Chemistry. W. H. Freeman & Co.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Environmental Geosciences **Contact Hours / Week: 3**

Credits: 3

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Develop the crucial skills needed to address important challenges
- How can we predict and mitigate the effects of global climate change?
- What tools can we use to reduce greenhouse gas emissions to the atmosphere?
- Why is our planet able to sustain life?
- How can we reduce the effects of environmental pollution?
- Will changes in seawater properties affect the ocean's role as a food source?
- How does the increased CO2 concentration in seawater affect life in the ocean?

Gain experience in:

- acquiring, analyzing, assessing and presenting a wide range of data
- using a range of specialist laboratory techniques
- applying observational and sample collection techniques in the field

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT I: EARTH PROCESSES

1.1 Brief geological history of the planet, fundamental concepts.

1.2 Primary differentiation and magma. Constitution of Earth's Interior.

1.3 Earth movements, Endogenic and exogenic processes, Geological Time scale; Formation and classification of rocks.

1.4 Plate tectonics, sea floor spreading, Geosynclines, Mountain formation and evolution of continents.

UNIT -II: Geomorphology

2.1 Basic concept of Geomorphology and typical landforms.

2.2 Weathering, Soil Processes and Mass Movements.

2.3 Cycles of Erosion, Rejuvenation and Relief formation

2.4 Drainage basins, systems and Patterns. Important drainage basins of Himalayas.

UNIT III: GEOLOGICAL AGENTS

3.1 Fluvial system: factors affecting stream erosion, deposition, erosional and depositional land form

3.2 Underground water system-water table, land forms formed through ground water action

3.3 Aeolian system: mechanism of wind erosion, erosional and depositional land forms

3.4 Glacial system: mechanism of glacial erosion, erosional and depositional land forms

UNIT-IV: Geo-Environment

4.1 Spectrum of Environmental Geology, Resource Management and Conservation: Land, Water and Minerals.

4.2 Abundance of elements in the bulk earth, crust, hydrosphere, atmosphere and biosphere

4.3 Mineral stability diagrams and controls on the chemistry' of natural waters

4.4 Frontier areas in medical geology, geobiology, forensic geology

Teaching -Learning Process

Effective teaching and learning process for Environmental Geosciences involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

Assessment methods:

Specific assessment measure(s) Student will be assessed in a variety of ways.

- Written or practical exams, including multiple-choice exercises
- Laboratory reports and field project reports
- Practical evaluation in the field or field notebooks
- Coursework such as essays, posters
- Individual or group projects and presentations

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Press &Seiver, The Earth, Frank Press
2. Skinner & Porter, Dynamic Earth, Wiley
3. Krauskopf, Introduction to Geochemistry, Mc-Graw Hill
4. Parbin Singh, Engineering & General Geology, S.K. Kataria& Sons
5. K.S. Valdiya, Environmental Geology. Tata Mc-Graw Hill.
6. W.D. Thornbury, Pincipals of Geomorphology, CBS, Publication.
7. Savindra Singh, Geomophology, Prayag, Pustak Bhawan

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Fundamentals of Ecology **Contact Hours / Week: 3**

Credits: 3

Course Learning Outcomes (CLOs): On completion of this course, the students will be able to:

- Understand the basics of discipline of ecology and environmental sciences.
- Gain fundamental understanding of some important concepts of ecology at population and community level.
- Understand the basics of environment and important concepts of environmental physics and chemistry.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNIT-I: INTRODUCTION TO ECOLOGY

1.1 Four levels of ecological organization: Population, Community,Ecosystemand Biosphere.
1.2 Concept of food chain, food web, ecological pyramids, trophic structure,
1.3 Energy flow pathways; Concept of primary and secondary productivity
1.4 Shelford's law of tolerance, Liebig's law of minimum

UNIT-II: POPULATION AND COMMUNITY ECOLOGY

2.1 Characteristicsand attributes of population. Population growth vis-a-vis the concept of carrying capacity.
2.2 Population interactions, Predator-prey relationship, Lotka –voltera equation, 'r' and 'k' species.
2.3 Concept of communities, concept of niche, edge effect, ecotypes, ecotone.
2.4 Types of interactions, Succession and it's types, climax community.

UNIT-III: INTRODUCTION TOENVIRONMENTAL SCIENCE

3.1 Definition, Principles and Scope of Environmental Science.
3.2 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere
3.3 Interaction between Earth, Man and Environment.
3.4 Biogeographic provinces of the world and agro-climatic zones of India.

UNIT-IV FUNDAMENTALS OF ENVIRONMENTAL PHYSICS AND CHEMISTRY

4.1 Basic concepts of light and matter, quantum mechanics (relation between energy, wavelength and frequency).
4.2 Basic concepts of pressure, force, work and energy; types of forces and their relation

4.3 Mole concept, solution chemistry, solubility product, solubility of gases, phase change
4.4 Laws of thermodynamic- first, second and third, Stereochemistry.

Teaching -Learning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Computer based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment on softwares
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. E.P. Odum and G.W. Barrett. 2005. Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
2. P.D.Sharma.2008. Ecology and Environment. Rastogi Publications
3. S.E. Mannahan, 2022. Environmental Chemistry. 9th Edition, CRC Press.
4. John L. Monteith and Mike H. Unsworth, 2013. Principles of Environmental Physics, Plants, Animals, and the Atmosphere Fourth Edition

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Knowledge System (Environment Protection Prospective and Indian Ethos) **Credits: 2**

Contact Hours / Week: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Conceptual knowledge on Bharatiya Civilization and Development of Indian Knowledge System
- Ability to analyse the role of Components of Environmental Science and Tradition in Ancient System
- Ability to analyse the role of Components of Environment coupled with Science and Tradition

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**37.5**	**75**

COURSE CONTENT

Unit-I: Indian Knowledge System: Introduction to *"Bharat"*

1.1 Definition, Scope, and Significance of Bharatiya Civilization and Development of IKS

1.2 Types of Indian Knowledge System: Indigenous, Traditional and Scientific

1.3 Saraswati-Sindhu Civilization, Traditional Knowledge System: Panchatantra ki Kahaniyan, Motivational Stories

Unit-II: Abiotic Components of Environmental Science and Tradition in Ancient System

2.1 Air; Water; Land; Fire; Atmosphere: Vedic system

2.2 Sustainable Solutions with Science and Technology for Environment

2.3 Successful Stories: Basholi Paintings, Rajasthani Paintings, Bihar Based Community Participation

Unit-III: Biotic Components of Environment: Science and Tradition

3.1 Plants and Agro-ecosystems: Conservation and Practices for Protection Prospectives

3.2 Wildlife and Biodiversity: Conservation and Practices for Protection Prospectives

3.3 Government of India Initiatives; AYUSH, YOGA etc., Cultural Heritages and Architectural Monuments of India

Teaching -Learning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Computer based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments
- Practical assignment on softwares
- Oral presentations, including seminar presentation
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

OPEN ELECTIVE COURSES FOR SEMESTER-I

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Environmental Issues and Awareness

Credits:2 Contact Hours / Week: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Know the role of media and NGO on environmental protection
- Understand the relationship between humans and their environment
- Articulate and apply the scientific methods along with regional knowledge in environmental protection
- Understand and evaluate the global scale of environmental problems
- Able to understand the requirement of water conservation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNITI: I: ENVIRONMENTAL AWARENESS

1.1 Environmental education: formal and in-formal methods;

1.2 Role of media in environmental awareness, role of NGOs, public participation in environmental movements

1.3 Current environmental issues, Environmental ethics, Ecotourism

1.4 Sustainable development goals, International Environmental Policies

UNIT-II GLOBAL ENVIRONMENTAL ISSUES

2.1 Biodiversity loss- factors affecting and consequences

2.2 Ozone layer depletion, Sea level rise,

2.3 Acid Rain, Forest fires

2.4 Carbon sequestration and carbon credits

UNIT-III: CURRENT ENVIRONMENTAL ISSUES IN INDIA

3.1 Environmental issues related to water resource projects

3.2 Water conservation-development of watersheds, Rain water harvesting and ground water recharge

3.3 National River conservation plan – NamamiGange and Yamuna Action Plan.

3.4 Eutrophication and restoration of lakes, Conservation of wetlands, Ramsar sites in India

4. Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- problem based assignments;
- oral presentations, including seminar presentation;
- viva voce interviews
- exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Steie, G. Economics and Environment
2. Srivastav, Sweta. Basics of Environmental Science, Anmol Publications Pvt Ltd.
3. Bhatt, S. Environment protection and sustainable development, APH Publishing Corporation
4. Vishwanathan Prasad. An introduction to Environment.Rawat Publications. 2012.
5. Vasudevan, Essentials of Environmental Science. Atlantic Publishers. 2011.
6. Tiwari, S.K. Environmental Science. Atlantic Publishers. 2011.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Course Title Introduction to Hydrology and Water Resource Management: **Contact Hours / Week: 2**

Credits: 2

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- To study occurrence, movement and distribution of water that is one of the prime resource of human sustenance.
- To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
- To know the basic principles and movement of ground water and properties of ground water flow.
- Develop understanding of floods and drought
- To learn water harvesting and conservation

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

Unit I: Water Resources

1.1 Hydrologic cycle, Global Water availability, Water budget, Precipitation and Water Resources.

1.2 Interrelation of water resources with other natural resources and Environment..

1.3 Water resources of the earth, Concept of Sustainable water resource development.

1.4 Need of Water resource development in India.

Unit II: Surface and Ground water

2.1 Surface water resources, River basins and water divide.

2.2. Cryosphere; its distribution and importance,

2.3 Occurrence and movement of groundwater, Darcy's law, Factors governing ground water flow.

2.4 Types of aquifers, porosity & permeability, specific yield, specific retention, storage coefficient.

Unit III Water Harvesting

3.1 Causes and Management of Floods.

3.2 Causes of drought, Water Harvesting:

3.3 Methods of rainwater collection and harvesting, runoff enhancement, runoff collection,

3.4 Artificial ground water recharge, needs and methods.

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visit
- Industrial/Field Excursion to enhance the concepts

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Text Books:

1. Garg S.K., Hydrology and Water Resources Engineering
2. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
3. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons..
4. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley
5. Dr. P.Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Waste to Energy **Contact Hours /**

Credits: 2

Course Learning Outcomes (CLOs): At end of the course, the student will be able to

- Explain about the energy from waste
- To understand the technologies for Waste to Energy options
- Able to gain knowledge on gasification, combustion, pyrolysis, anaerobic digestion processes
- the concept of recycling and recovery of resources from various solid/liquid wastes

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

Unit-I: Introduction to energy from waste

1.1: Characterization and classification of waste as fuel – agrobased, forest residues, industrial waste, Municipal solid waste.

1.2: Sources and types of wastes

1.3: Physical, chemical and biological properties of wastes

1.4: Global and Indian scenario on energy from waste,Success and Failures of Indian Waste to Energy plants, Role of the Government in promoting 'Waste to Energy'

Unit-II: Technologies for Waste to Energyoptions

2.1: Combustion (unprocessed and processed fuel), Factors affecting, environmental and health impacts

2.2: Gasification, Factors affecting, environmental and health impacts

2.3: Microbial conversion processes, Anaerobic digestion, fermentation, Factors affecting, environmental and health impacts

2.4: Pyrolysis, Factors affecting, environmental and health impacts

Unit-III: Conversion devices

3.1: Combustors (Spreader Stokes, Moving grate type, fluidized bed),

3.2: Gasifier, digesters. Briqueting technology: Production of RDF and briquetted fuel.

3.3: Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes.

3.4: Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers, Global Best Practices in Waste to energy production distribution and use.Circular economy

Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab based practical's to enhance the concept
- Industrial/Field Excursion to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. SaeidMokhatab "Handbook of Liquefied Natural Gas", Gulf Professional Publishing 2016.
2. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies , JG Press, October 2005.
3. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.
4. Rogoff, M.J. and Screve, F., 2019. Waste-to-energy: technologies and project implementation. Academic Press.
5. Hussain, C.M., Singh, S. and Goswami, L. eds., 2021. Waste-to-Energy approaches towards zero waste: interdisciplinary methods of controlling waste. Elsevier.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Soil & water quality analysis

Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will learn throughout the course about:

- The concepts and principles of Soil Science
- Understand the role of soil forming factors and processes in soil formation
- Understand various soil physical, chemical and biological properties and their impact on plant growth.
- Working knowledge of water quality characteristics of water sources
- Working knowledge of drinking water regulations and standards required to protect public health and ensure compliance including: Safe Drinking Water
- Practical Knowledge in assessing the Soil & water quality through Lab experiments

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

Unit I:SOIL: AN OVERVIEW

1.1 Introduction: Definition of Soil, Properties of Soil, Soil water relationships

1.2 Chemical Properties; Acidity, Alkalinity, pH, Salinity, Reactions in Liming and Acidification

1.3 Biological Properties; Soil Organic Matter, C: N Relationships, N-Transformation Sulphurand phosphorus Transformation

1.4 Fertility Status of Soils, soil deficiency with respect to macro and micro nutrient components, brief study of micronutrient & macronutrient, organic agriculture

Unit II: WATER: AN OVERVIEW

2.1 Water availability; water stress index; Water Quality as a core thread

2.2 Water quality and health issues and policy interventions

2.3 Potable water quality criteria: desirable vs rejection, National River Action Programme

2.4 Wastewater discharge standards, Impairment of natural water bodies, role of national and international agencies in water health and sanitation

Unit III: SAMPLING & ANALYSIS (SOIL& WATER)

3.1 Soil Sample Collection and Processing, method of Soil Sample collection

3.2 To determine Soil Organic Carbon & Soil Organic Matter in given soil sample,

3.3 Collection and preservation of water samples from open well, tap, bore well, river, water treatment plants,

3.4 Determination of pH, Electrical Conductivity, Determination of Alkalinity, Determination of Hardness (Total, Permanent & Temporary),Determination of calciumin water

4. Teaching -Learning Process

Effective teaching and learning process for Soil and Water quality analysis involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods:

Specific assessment measure(s) Student will be assessed in a variety of ways

- Written or practical exams, including multiple-choice exercises
- Laboratory reports and field project reports
- Practical evaluation in the lab and field notebooks
- Individual or group projects and presentations

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Standard Methods for Examination of water & waste wate APHA- AWWA- WPCE
2. Manual of water & waste water analysis, NEERI, Nagpur.
3. Text book of water and waste water engineering by H. K. Hussen.
4. Water supply & sanitary engineering by Birdie.
5. Introduction to soil laboratory manual -J.J.Harsett stipes.
6. Introduction to soil science laboratory manual, Palmer and troch - Lowa state.
7. Soil Sampling, Preparation and analysis, Marcell Dekker, Inc, New York.
8. Soil Sampling and methods of analysis, carter M.R. and E.G.Gregorich, 2007, 2nd Ed..
9. Methods of soil analysis, Part, American society of Agronomy Inc., Kuete, A.Et.at., 198
10. Nature & Properties of Soils, Brady NC (2018)

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Atmosphere and its processes

Credits:2 **Contact Hours/Week: 2**

Course Learning outcomes (CLOs): After the completion of course, the students will able to:

- Understand fundamental design of Earth's atmosphere.
- Interpret thermodynamic structure of atmospheric processes
- Grasp the role and implications of atmospheric phenomena in governing earth's radiation budget,
- Understand atmospheric cycles in terms of pathways, burdens and reservoirs of major components like carbon, oxygen, sulfur and nitrogen across different spheres.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-I: Overview

1.1 History and evolution of the earth's atmosphere

1.2 Understanding the atmospheric strata

1.3 Measures of atmospheric composition: absolute concentration, fractional abundance and number density

1.4 Concept of meteorology, meteorological parameters: pressure, temperature, wind direction and wind speed, humidity and solar radiation

UNIT-II: Atmospheric Thermodynamics and Radiative transfer

2.1 Understanding the laws of thermodynamics in atmosphere, the concept of air parcel, the dry adiabatic lapse rate

2.2 Moisture parameters: mixing ratio and specific humidity, saturation mixing ratios and vapor pressures, relative humidity; dew point and frost point

2.3 Lifting condensation level and normand's rule.

2.4 The spectrum of radiation and blackbody radiation laws

UNIT - III: Atmospheric Cycles

3.1 The atmospheric sulphur cycle: natural and anthropogenic emission of SO_2, major pathways of sulphur compounds.

3.2 The atmospheric nitrogen cycle: natural and anthropogenic processes for nitrogen fixation, Inter conversion sources and implication of nitrogen containing compounds.

3.3 The global carbon cycle: the global mean atmospheric CO2 level, the flux of carbon between various reservoirs, the six compartment carbon model of carbon cycle.

3.4 The atmospheric oxygen cycle: odd oxygen chemistry, formation and destruction of ozone and OH radical.

4. Teaching -Learning Process: Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer-based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Finlayson-Pitts, B.J., Pitts J.N., J., (2000): Chemistry of the upper and lower atmosphere-Theory experiments and applications. Academic Press, US.
2. Seinfeld, J.H., Pandis, S.N., (2006): Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. A wiley inter-science publication.
3. Wallace John M. Jr., Peter V. Hobbs (2006): Atmospheric Science: An Introductory Survey, 2nd Edition, Academic Press, ISBN: 978-0127329512
4. Gilbert, M. Masters & Ela, W. P. (2007):Introduction to Environmental Engineering and Science. PHI learning Pvt Ltd.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Geo-Spatial Sciences **Credits: 2 Course**

Code: **Maximum Marks: 50**

1. **Course Learning Outcomes (CLOs):** On completion of this course the students will able to:
   - Understand the fundamental concept and practice of GIS and its advancement
   - Design creative application of geospatial technology
   - Demonstrate the use of GIS to create interactive map for user's choice
   - Understand the skill required for professional level

2. Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

3. COURSE CONTENT

UNIT II: FUNDAMENTALS OF REMOTE SENSING AND GPS

1.1 Fundaments of Remote sensing, spectral signature, basic characteristics of satellite

1.2 Satellite data characteristics, details of satellite of Indian and global origin

1.3 Basic principles of global positioning system (GPS), Concept of positioning in GPS, GPS receiver basic functioning

1.4 Application of GPS in Defense, avian industry, surveying, DGPS

UNIT I: FUNDAMENTALS OF GIS

2.1 GIS concepts, Coordinate system and projections, GIS data modeling

2.2, Data structures- vector and raster data, pros and cons of data

2.3 Data inputting, data storage, data editing, Hardware and Software requirement for GIS.

2.4 Data base management system (DBMS), online GIS data publishing

UNIT III:APPLICATION OF GIS

3.1 GIS application natural resource management.

3.2 GIS application in hazard zonation mapping.

3.3 GIS application in generation of Digital elevation model.

3.4 GIS application in Atmospheric pollution.

Dingle

4. TEACHING -LEANING PROCESS:

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- problem based assignments;
- practical assignment laboratory reports;
- oral presentations, including seminar presentation;
- viva voce interviews
- exams in regular intervals

5. Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Lillesand Kiefer Chipman: Remote sensing and Inmage interpretation, Willey
2. Stephen Wise: GIS Fundamentals (Second Edition), CRC Press
3. Robert A. Schowengerdt: Remote Sensing, Elsevier

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Climatology

Credits: 2 **Contact Hours / Week: 2**

Course Learning outcomes (CLOs): After the completion of course, the students will able to:

- Understand fundamentals of Earth's Climate System and Climate Types.
- Comprehend the structure and role of weather systems on different scales
- Recognize the effects of jet-streams and atmospheric rivers in causing variability in Indian summer monsoon
- Indentify the tele-connections of Indian Summer Monsoon with various atmospheric-oceanic coupled oscillations

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-I: Climate Variables and Climate Types:

1.1 Weather vs Climate, Climate Variables and Component of Climate System

1.2 Latitudinal and seasonal variation in insolation, atmospheric pressure, and air temperature

1.3 Pressure belts and Global & Local Winds

1.4 Classification of Climates: Koppen's and Thornthwaite's Scheme of classification

Unit- II: Weather Systems, Clouds and Precipitation:

2.1 Weather Systems on different scales

2.2 Extra-tropical Cyclones: Air masses, fronts and jet streams

2.3 Tropical Cyclones: Structure, thermodynamics and dynamics, Genesis and life cycle

2.4 Condensation Nuclei, Growth of Cloud droplets and ice-crystals, Cloud classification

Unit III: Indian Summer Monsoon and its Variability:

3.1 Onset, course and Reversal of Indian Summer Monsoon

3.2 Variability in Monsson, Beaks in Monsoon and factors affecting brakes

3.3 Factors affecting Indian Summer Monsoon: Tropical Easterly Jet Streams, Atmospheric Rivers, Atmospheric Lakes

3.4 Tele-connections of Indian Summer Monsoon with various atmospheric-oceanic coupled oscillations viz. Indian Ocean Dipole and El-Nino Southern Oscillation etc.

Teaching -Learning Process: Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer-based practical's to enhance the concept

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings:

1. Singh S., (2023): Climatology, Pravalika Publications, Prayagraj, India
2. Lal D.S. (2023): Climatology, Sharda Pustak Bhawan, Prayagraj, India
3. Strahler A., (2016): Introducing Physical Geography, Wiley, USA

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – I

Subject Course Code No.

Subject Course Title: Solid Waste Management

Course Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): By the end of the course, students are expected to be able to:

- Demonstrate a thorough understanding of the waste management sector, issues at global, regional and local scales.
- Illustrate all the steps involved in waste management, and technologies and strategies involved thereof.
- Discriminate the various waste categories and their respective potential for treatment.
- Analyze and integrate various technological options, and conceptualize a management solution for particular waste characteristics.

Examination Schedule			
CIA	Mid-Term	Major	Total
10	15	25	50

COURSE CONTENT

Unit - I: Sources and Composition of Municipal Solid Waste

1.1 Sources and Composition of Municipal Solid Waste Introduction

1.2 Sources of solid waste, Types of solid waste, Composition of solid waste and its determination

1.3 Physical properties of Municipal Solid Waste, Chemical properties of Municipal Solid Waste

1.4 Biological properties of Municipal Solid Waste, Transformation of Municipal Solid Waste

Unit – II: Solid Waste Generation and Collection

2.1 Handling and segregation of wastes at source

2.2 Quantities of Solid Waste, Measurements and methods to measure solid waste quantities

2.3 Solid waste generation and collection

2.4 Factors affecting solid waste generation rate

Unit III: Methods of Solid Waste Treatment and Disposal

3.1 Pyrolysis, Recycling and Reuse of Solid Waste and Management

3.2 Solid Waste Handling Methods, Segregation and Salvage,

3.3 Recovery of the Bio Products, Public Health and economic Aspects of open storage related to Solid Waste.

Teaching -Learning Process

Effective teaching and learning process for IPR, involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

Assessment methods

Specific assessment measure(s):

- Oral Communications: The student will learn how to give oral presentation in context of course learned to corporate houses, over various communication tools, such as radios or telephones. The student will also learn how to communicate clearly and effectively
- Reading: Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Students will be given various scenarios to practice during the course of the program. These scenarios will help the student to develop their critical thinking skills.

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Reference Books:

1. Kumar, S. (2016). Municipal Solid Waste Management in Developing Countries, 1st Edition.
2. Epstein, E. (2015).Disposal and Management of Solid Waste: Pathogens and Diseases, 1st Edition.
3. Andrén, M. (2015). Nuclear Waste Management and Legitimacy: Nihilism and Responsibility 1st Edition.
4. Pitchel, J. (2005). Waste Management Practices: Municipal, Hazardous, and Industrial 1st Edition. CRC Press.
5. Saling, J., Fentimen, A, W. (2001). Radioactive Waste Management, 2nd Edition. CRC Press.
6. Juhasz, A. L., Magesan, G., & Naidu, R. (Eds.). (2004). Waste Management, 1st Edition. Science publishers, US.
7. Solid Waste Management CPCB. New Delhi

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Mushroom Farming & Production

Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will be able to do :

- Start a small business enterprise by liaising with different stake holders
- Effectively manage small business enterprise
- Take up Mushroom Cultivation and run it profitably
- Selection of important types of Mushroom and their cultivation
- Maintain Mushroom farm in a hygienic and scientific way
- Work out the economics of Mushroom Cultivation

Examination Schedule			
CIA	Mid Term	Major	Total
10	15	25	50

Unit 1: MUSHROOM CULTIVATION: AN OVERVIEW

1.1 Commercial Mushroom Cultivation, Present scenario and prospects for Mushroom Cultivation.

1.2 Description of edible types, natural growth aspects and climatic requirements

1.3 Selection of types of Mushroom and Sites Selection of important types of Mushroom, Design and construction of Mushroom farm.

1.4 Composting in Mushroom cultivation, Role of composting in Mushroom cultivation, Appropriate materials to prepare different types of compost.

Unit II : BIOLOGY, DISEASE CONTROL & HARVESTING OF MUSHROOM

2.1 Biology of Mushrooms: Button, Straw& Oyster- General morphology, distinguishing characteristics, spore germination and life cycle,

2.2 Nutrient Profile of Mushroom: protein, aminoacids, calorific values, carbohydrates, fats, vitamins &minerals, Different types of Mushroom growing facilities and fixtures.

2.3 Disease control and pest Management Inspection of Mushroom bags or beds for early detection of pests and diseases

2.4 Harvesting of Mushroom, Identification of right stage of Mushroom. Methods of harvesting using approved cutting techniques for harvesting

Unit III: CULTIVATION, DESIGNING& FARMING OF MUSHROOM

3.1 Cultivation System & Farm design: Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipments& facilities

3.2 Casting materials & Case running: Importance of casing mixture, Quality parameters of casing soil, different types of casing mixtures, commonly used materials.

3.3 Cultivation of Button, Oyster and Straw Mushrooms: Collection of raw materials, compost & composting,

3.4 Spawn & spawning, casing & case run, cropping & crop management, picking & packing, Visit to relevant Labs/Field Visits

4. Teaching -Learning Process

Effective teaching and learning process for Mushroom Farming & Production involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods: Specific assessment measure(s) Student will be assessed in a variety of ways.

- written or practical exams, including multiple-choice exercises
- Field project reports on Mushroom Cultivation
- Practical evaluation in the field or field notebooks, carried for Mushroom Production, Design and construction of Mushroom farm (Lab Simulation) through project and case studies
- individual or group projects and presentations

6. Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1.Mushroom Cultivation, Tripathi, D.P.(2005) Oxford & IBH Publishing Co. PVT.LTD, New Delhi. Reference

2. A hand book of edible mushroom, S.Kannaiyan&K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi

3.Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co.

42
43

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – I

Subject Course Code No.

Subject Course Title: Intellectual Property Rights (IPR)

Course Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Identify different types of Intellectual Properties (IPs),
- Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development
- Be familiar with the processes of Intellectual Property Management (IPM) and various approaches for conducting IP awareness session.

Examination Schedule			
CIA	**Mid Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT-1: IPR (Intellectual Property Rights), Innovation & Knowledge

1.1 Knowledge – characteristics and role in economic growth,Tacit and codified knowledge, Knowledge as public good and 'market failure'

1.2 Pre-IPR system of protection: Secrecy/Trade guilds/Cartels

1.3 IPR: Consequentialist, right based justification and economic justification

1.4 Basic forms of IPRs: — Patent, copyright, trademark, industrial design,

UNIT-II: IPR in India

2.1 The Patent Act of India 1911 and the Indian Patent Act of 1970

2.2 IP rights in India and progressive harmonization with international standards; Patent Amendment Act (2005)

2.3 Case studies giving examples of patents and technology transfer, access and affordability of medicines in India

2.4 International organizations and Treaties (pre- TRIPs era): Paris Convention, Berne Convention, Rome convention, WIPO, GATT, FAO, UNCTAD

UNIT–III: Debates on IPR and Development

3.1 IPRs and technology transfer

3.2 Traditional knowledge, IPR and Benefit sharing, Biopiracy, Breeders vis-à-vis Farmers rights, IPR & Traditional Medicine, Private vis-à-vis community-based ownership,

3.3 IPRs vis-à-vis access & affordability of medicines

3.4 Bayh-Dole Act and issues of academic entrepreneurship, advancement of science and commercialization of university research.

4. Teaching -Learning Process

Effective teaching and learning process for IPR, involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

5. Assessment methods

Specific assessment measure(s):

- Oral Communications: The student will learn how to give oral presentation in context of course learned to corporate houses, over various communication tools, such as radios or telephones. The student will also learn how to communicate clearly and effectively
- Reading: Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Students will be given various scenarios to practice during the course of the program. These scenarios will help the student to develop their critical thinking skills.

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. L.W. Canter (2002). Environmental Impact Analysis, McGraw Hill Book Co., New York.
2. International Chamber of Commerce (1986) ICC Guide to Effective Environmental Auditing, ICC, New York.
3. A.D. Little (1990) Principles for conducting Environmental Health, and Safety Audits, Centre for Environmental Assurance.
4. Ministry of Environment & Forests (1992) Policy Statement for Abatement of Pollution, Govt. of India, New Delhi.
5. Swaminathan, M.S (2002). The Protection of Plant Varieties and Farmers' Rights Act: From Legislation to Implementation. Journal of Intellectual Property Rights. 7, pp. 324- 329.
6. Vivien Irish (2000). How to Read a Patent Specification. Engineering Management Journal. April, pp. 71-73.
7. Vasudeva, P.K. (2000). Patenting biotech products: Complex issues. Economic and Political Weekly. 3726- 3729.
8. Wesley, M. Cohen and Stephen, A. Merrill (2004). Patents in the Knowledge Based Economy. The National Academic Press, Washington, DC.
9. Watal, Jayshree (2001). Intellectual Property Rights in the WTO and Developing Countries. Oxford University Press: New Delhi.

Semester III

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – III

Subject Course Title: EnvironmentImpact Assessment & Management System

Course Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Describe organizations as systems and their role in environmental management
- Explain how environmental management can be used as environmental protection and how
- Organizations can define and manage risk.

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

UNIT 1: EIA OVERVIEW AND PROCESSES

1.1 Objectives of EIA, linkage between development and environment, Relationship of EIA to sustainable development

1.2 Environmental policy and regulatory guidelines regarding EIA in India, EIA notification

1.3 EIA processes, components and techniques, EIA of major projects case studies(thermal power (Thermal power plant, River valley project)

1.4 Overview of Biodiversity, social, health, Impact Assessment.

UNIT 2: OVERVIEW OF EMS

2.1. Environmental management system structure

2.2.Context of environmental management, overview of the state of the global environment

2.3. Introduction to EMS evaluation tool

2.4.Element and extent of application

UNIT 3: ISO-14000 & RECENT CONCEPTS OF CORPORATE EMS

3.1 Background of ISO, ISO-14000 series, ISO-14062 – corporate EM,

3.2 ISO in developing World, Principles of clean production, packaging, sustainable procurement

3.3 Social responsibility and function of corporate houses

3.4 Eco-labeling, ecological and carbon footprints (ISO 14064-65) and A Case study

Teaching -Learning Process

Effective teaching and learning process for EMS involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And

lastly students are involved practically to use new knowledge and skills learned.

Assessment methods

Specific assessment measure(s)

- Writing: The student will learn to write reports in a legible manner, using appropriate terms and grammar.
- Oral Communications: The student will learn how to give oral presentation in context of course learned to corporate houses, over various communication tools, such as radios or telephones. The student will also learn how to communicate clearly and effectively
- Reading: Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Students will be given various scenarios to practice during the course of the program. These scenarios will help the student to develop their critical thinking skills.

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Christopher S. and Mark Y. (2007) Environmental Management Systems, (third edition), Earthscan Publications
2. David L.G. and Stanley B.D. (2001) ISO 14000 Environmental Management, Prentice Hall.
3. Madu C.N. (2007) Environmental Planning and Management, Imperial College Press.
4. Kenneth M.M. (1999). Basic concepts in Environmental Management System, Boca Raton FL, Lewis

- Lab visits, computer-based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- problem based assignments;
- practical assignment laboratory reports;
- oral presentations, including seminar presentation;
- viva voce interviews
- exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Frederick K. Lutgens, Edward J. Tarbuck (2010): The Atmosphere: An Introduction To Meteorology, Phi (Prentice-hall New Arrivals), ISBN: 978-8120344150
2. Wallace John M. Jr., Peter V. Hobbs (2006): Atmospheric Science: An Introductory Survey, 2nd Edition, Academic Press, ISBN: 978-0127329512
3. John H. Seinfeld, Spyros N. Pandis (2006): Atmospheric Chemistry and Physics, John Wiley & Sons Inc., ISBN: 978-0-471-72018-8

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: Natural resources, Biodiversity and its conservation

Credits: 2 **Contact Hours / Week: 2**

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Understand the fundamental concept of resources and its types
- Able to grasp the importance of renewable energy and its potential to save environment
- Understand zero waste technology to reduce wastes and management
- Understand the skill required for professional level

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
10	**15**	**25**	**50**

COURSE CONTENT

Unit I: NATURAL RESOURCES

1.1. Concept and types of natural resources, current status of major resources

1.2. Sustainable resource utilization and tribal communities, Recreational and Ecotourism

1.3. Renewal energy resources and fissile fuels, future of sustainable energy resource

1.4. Biofuel, solar energy collector, Wind energy and wind mills.

Unit II: INTRODUCTION TO BIODIVERSITY

2.1 Introduction: Definition, History, Levels of Biodiversity, Threats to biodiversity

2.2 Biodiversity Climatic Zones, resources of India

2.3Protected areas: biospheres, national parks, Wildlife sanctuaries, marine protected areas

2.4 Biodiversity hotspots and their characteristic, threatened plants andanimals of India

Unit III: BIODIVERSITYAND CONSERVATION

3.1. In-situ and ex-situ conservation, Methods and programmes, CBD

3.2. Red data book, Environment conservation organizations

3.3. Bioprospecting, IPR and Indigenous and traditional knowledge, Biopiracy

3.4.Project elephant, project tiger, GAP

TEACHING -LEANING PROCESS:

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer-basedpractical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Botkin, Daniel B .and Keller, Edward A . Environmental Science *: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007
2. Enger, E.D. and Smith, B.F Environmental Science: *A Study of Interrelationships*. 11thed . McGraw Hill Inc, USA. 2006
3. Frankel, O.H. Brown A.H.D. and Burdon, J.J. *Conservation of Plant Diversity.* Cambridge University Press, UK. 1995.
4. Gadgil, Madhav and Rao, P.R.S. *Nurturing Biodiversity* : An Indian Agenda. Centre for Environment Education, Ahmadabad, India.
5. MeffeG.k. and C.RonalsCorrol(1994) Principles of Conservation Biology, Sinaur Associates, Inc. Sunderland. Massachusetts.

OPEN ELECTIVE COURSES FOR SEMESTER-III

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Course Title: Watershed Management **Course Code:**

Semester:III **Duration: 3 Hours**

Maximum Marks: 75 **Course Credits:3**

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- To understandbehavior of different watershed
- Interpret runoff data and quantify erosion by using various modeling methods
- Land use classification and impact of land use changes on hydrological parameters.
- To understand the watershed management practices, planning and identification of watershed problems
- To impart knowledge about erosion process and its mitigation methods
- Aware about the watershed management practices in India

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

Unit I: Introduction to Watershed

1.1 Watershed; Introduction and Characteristics.

1.2 Soil Characteristic and soil forming processes.

1.3 Land capability classification, Characteristic of various land capability classes,

1.4 Principal Factors Influencing Watershed Operations.

Unit II: Watershed Management

2.1 Watershed Management and Objectives,

2.2 Reasons of Watershed deterioration

2.3 Water conservation practices in irrigated and dry lands, water conservation structures,

2.4 Runoff, Factors affecting runoff

Unit III: Erosion and its control

3.1 Erosion process, types of erosion and control.

3.2 Factors affecting erosion and Assessment of erosion,

3.3Gully and Ravine Reclamation

3.4 Control measures of soil erosion foe agricultural and non agricultural land.

Unit IV: Watershed Management in India

4.1 Watershed development in India, Common Guidelines,

4.2 Wetland management- types, Ramsar convention,

4.3. Water conservation practices for deserts.

4.4 Crop water management and crop planning with special reference to different agro-ecological zones in India.

4. TEACHING -LEANING PROCESS: Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment

5. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

6. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Books:-

1. Sharda V.N., Sikka A.K. and Juyal G.P. (2006) Participatory Integrated Watershed Management: A Field Manual, Central Soil and Water Conservation Research and Training Institute, 218, Kaulagarh Road, Dehradun.
2. Tideman E.M. (1999) Watershed Management–Guidelines for Indian Conditions, Omega Scientific Publishers, New Delhi.
3. Dhruva N.V.V. (2002) Soil and Water Conservation Research in India, Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi- 110012.
4. Dhruva N.V.V., Sastry G. and Patnaik U.S. (1990) Watershed Management, Indian Council of Agricultural Research, New Delhi.

80

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: GREEN ENERGY SOURCES **Course Code:**

Course Credits: 3 **Contact Hours / Week: 3**

Course Learning Outcomes (CLOs): At the end of the course, the students will be able to

- know about advantages of renewable energy sources
- understand the environment impact of using fossil fuels
- Explain about harvesting of solar energy and solar collectors' applications
- Deal the basics of wind energy, geothermal energy and hydro-energy conversion systems and their impact on environment

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

Unit I: Introduction to Solar Energy

1.1: Renewable energy scenario in India – importance of renewable energy sources.

1.2: Environmental aspects of energy utilization- CO_2 Emission Potentials – Achievements and Applications

1.3: Photovoltaic cell-characteristics- Equivalent circuit-Photovoltaic modules and arrays-Applications.

1.4: Solar Room Heating and cooling, Solar Pond – Solar Desalination, Maximum Power Point Tracking (MPPT) systems

Unit II: Geo-thermal and Hydro energy

2.1: Introduction to Geothermal energy

2.2: National status of Geothermal and environmental impacts

2.3: Introduction to Hydro energy

2.4: National status of Geothermal and environmental impacts

Unit III: Wind Energy

3.1: Wind resource assessment -site selection

3.2: Wind energy conversion devices – classification

3.3: Types of wind energy systems – Performance of wind turbine generator

3.4: Applications - Safety and Environmental Aspects.

Unit IV: Other and Hybrid Renewable Energy Sources

4.1: Hydrogen and Fuel cell – principle of working- various types - construction and applications. Biogas - generation - types of biogas Plants

4.2: Small hydro - Geothermal energy- site selection, construction, environmental issues.

4.3: Wave Energy - Tidal energy - site selection, construction, environmental issues
4.4: Need for Hybrid Systems- Range and type of Hybrid systems-Quantitative study of Diesel-PV and Wind-PV systems

5. Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab based practical's to enhance the concept
- Industrial/Field Excursion to enhance the concept

6. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

7. Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 2005.
2. B.H.Khan, "Non Conventional energy resources", Tata McGraw-Hill Education, 2nd Edition, 2009.
3. Sukhatme S P, Nayak J K, "Solar Energy: Principles of Solar Thermal Collection and Storage", Tata McGraw Hill, 2008.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press , Third edition, 2012
6. Kothari D. P &Singal K. C & Ranjan, Rakesh, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, New Delhi, 2013.
7. Bhatia, S.C. and Gupta, R.K., 2019. Textbook of renewable energy. Woodhead Publishing India PVT. Limited.

82

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: Biofuels and Biorefinery

Credits: 3

Contact Hours / Week: 3

Course Learning Outcomes (CLOs): On completion of this course the students will able to:

- Understand the importance of biofuels
- Importance about the various feedstocks for production of biofuels
- Gain the knowledge on production processes of biofuels
- How the various types of biorefineries and their commercial feasibility
- Knowledge on biofuel generation and associated environmental impacts

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

UNITI: I: INTRODUCTION TO BIOFUELS

1.1.World energy scenario, consumption pattern, environmental impacts of fossil fuel burning

1.2:Biofuel- types, Generations of biofuel- 1G, 2G, 3G, 4G

1.3:International policies and status of biofuel production

1.4:National status of biofuel production, National Biofuel Policy-2018

UNIT-II LIQUID BIOFUELS

2.1 Bioethanol- feedstocks and production process

2.2 Biodiesel- feedstocks and production process

2.3 Biobutanol- feedstocks and production process

2.4 Methanol- feedstocks and production process

UNIT-III: Gaseous AND SOLID BIOFUELS

3.1Biogas- feedstocks and production process

3.2 Biohydrogen - feedstocks and production process

3.3 Bio-char- feedstocks and production process

3.4 Environmental impacts of biofuel production

UNIT-IV: BIOREFINERY

4.1 Basic concept, types of biorefineries, biorefinery feedstocks

4.2 lignocellulosic biorefinery, algal biorefinery, waste biorefinery

4.3 Integrated biorefinery and life cycle assessment

4.4 Commercial success stories of biorefineries worldwide

5. Teaching -Leaning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer based practical's to enhance the concept

6. Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

5. Attendance Requirements:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Donald L. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, Elsevier, 2006.
2. PrabirBasu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.
3. A.A. Vertes, N. Qureshi, H.P. Blaschek, H. Yukawa (Eds.), Biomass to Biofuels : Strategies for Global Industries, Wiley, 2010.
4. S. Yang, H.A. El-Enshasy, N. Thongchul (Eds.), Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuels, Chemicals and Polymers, Wiley, 2013.

84

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: Medicinal & Aromatic Plants of India

Credits: 3 **Contact Hours / Week: 3**

Course Learning Outcomes (CLOs): On completion of this course the students will be able to do:

- Sample collection of the selected species as per the course content
- Will be in a position to give theme specific Presentation
- Will be able to do the Practical work on selected MAP species as per the course contents,includingField surveys for familiarization with local plants.

Examination Schedule			
CIA	**Mid-Term**	**Major**	**Total**
15	**22.5**	**37.5**	**75**

COURSE CONTENT

Unit 1: MAP (Medicinal & Aromatic Plant): AN OVERVIEW

1.1 MAPs: definition, history, importance and future prospects. Medicinal Plants – past and present status in world and India.

1.2 MAPs as industrial crops - constraints and remedial measures. Medicinal plant diversity & local healthcare. Medicinal plant conservation – issues and approaches.

1.3 Medicinal plant conservation areas (MPCA), Non-timber forest products (NTFP), Good Agriculture Practices (GAP

1.4 National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions.

Unit II: IMPORTANCE OF MAP (Medicinal & Aromatic Plant)

2.1 Important medicinal plants of India with their systematics, geographical distribution and uses.

2.2 Introduction and historical background of aromatic plants. Aromatic and cosmetic products. Raw material for perfumes etc.

2.3 Cosmetic Industries. Major, minor and less known aromatic plants of India. Taxonomic descriptions and uses of important aromatic plants – citronella, davana, damask rose, geranium, khus grass.

2.4 Taxonomic descriptions and uses of important aromatic plants - large cardamom, lavender, lemon grass, mentha, holy basil,.

Unit III:Indian Himalayan region (IHR) &MAP(Medicinal & Aromatic Plant)

3.1. Taxonomic descriptions and uses of important aromatic plants patchouli, rosemary Palmarosa, vetiver, artemisia, eucalyptus, thyme, marjoram and oreganum.

3.2 Aromatic spices - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron.

3.3 Other organizational initiatives for promotion of MAPs at National and International levels. Demand and supply of medicinal plants. Herbal industries.

3.4 Indian Himalayan region (IHR), Promotion of medicinal plant sector at national level.

Unit IV: Traditional System of Medicine (TSM) in India & Quality Control Practices

4.1 Traditional System of Medicine (TSM) in India;introduction, Concept and Principles of Ayurveda, Siddha, Unani and, Homeopathy;

4.2 Importance of TSM; Concept and Principles of Naturopathy and Tibetan Medicine;

4.3 Concept of herbalism and its significance. Introduction to phyto-medicines, Herbal raw materials, Local health traditions, ethano-medicines.

4.4 Adulteration and deterioration- Quality Control, Quality Assurance and Stability testing, Good Manufacturing Practices; Good Laboratory Practices,

Teaching -Learning Process

Effective teaching and learning process for Medicinal & Aromatic Plants (MAP) involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Industry. Second, effective communication leading to transforming information and knowledge clearly and specifically to convince students how and why listening will personally benefit them. Third, involving interactive classes utilizing a variety of instructional approaches interspersed with engaging learning activities through case studies and hands on training/demonstration, Fourth, through learning assessments, reinforce learning. And lastly students are involved practically to use new knowledge and skills learned.

Assessment methods: Specific assessment measure(s) Student will be assessed in a variety of ways.

- written or practical exams, including multiple-choice exercises
- laboratory reports and field project reports MAP (Medicinal and Aromatic Plant)
- practical evaluation in the field or field notebooks, carried for local plants, preparation of herbarium specimens and Field visits.
- individual or group projects and presentations

4 Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination

Suggested Readings

1. Medicinal Plants of Uttarakhand by C.P. Kala (2010).
2. Indian Medicinal Plants by P.C. Trivedi (2009).
3. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
4. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
5. Handbook of MAPs by S.K. Bhattacharjee (2009)

CENTRAL UNIVERSITY OF JAMMU

Course Title: Environmental Instrumentation

Course Code:

Credits: 3 **Contact Hours / Week: 3**

Course Learning Outcomes (CLOs):

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

- Understand fundamentals of environmental sampling and analysis.
- Gain understanding of principle, instrumentation and working of analytical techniques based on three important fields viz. Chromatography, spectrometry and microscopy.
- Understand the basic laws governing the techniques along with the working knowledge of the instruments, which will lead to skill development.

Examination Schedule			
CIA	Mid-Term	Major	Total
15	22.5	37.5	75

COURSE CONTENT

UNIT I: Fundamentals of sampling and analysis

1.1 Standard protocol for sampling of air, water and soil.

1.2 Gravimetric analysis and Volumetric analysis.

1.3 Principle, structure and working of pH meter; Conductivity meter and Sound level meter.

1.4 Standard extraction and sample preparation techniques: ultrasonication, soxhlet extraction and microwave digestion system.

UNIT II: Chromatography techniques

2.1 Basic terminologies and laws of chromatography.

2.2 Principle, instrumentation and working of paper chromatography, thin layer chromatography and column chromatography.

2.3 Principle, instrumentation and working of Gas chromatography (GC) and Gas chromatography–mass spectrometry (GC-MS).

2.4 Principle, instrumentation and working of High Pressure Liquid Chromatography (HPLC) and Ion chromatography.

UNIT III: Spectrometric techniques

3.1 Basic terminologies and laws of spectrometry.

3.2 Principle, instrumentation and working of UV-Visible spectrophotometer.

3.3 Principle, instrumentation and working of Flame photometer and Atomic absorption spectroscopy (AAS)

3.4 Principle, instrumentation and working of Inductively coupled plasma atomic emission spectroscopy (ICP-AES) andInductively coupled plasma mass spectrometry (ICP-MS), XRD
3.5 Principle, instrumentation and working of X-ray fluorescence: Energy dispersive X-ray fluorescence and wavelength dispersive X-ray fluorescence.

UNIT IV: Microscopy techniques

4.1 Basic terminologies and laws of microscopy.
4.2 Principle, instrumentation and working of Phase contrast and Fluorescence microscopy
4.3 Principle, instrumentation and working of Electron microscopy: Scanning electron microscope (SEM) and Transmission electron microscope (TEM).

Teaching -Learning Process

Teaching process includes

- Class teaching in physical mode
- Recommending and using standard books
- Power point and animation video
- Periodic interaction and discussion on previous completed concepts
- Problem solving assignment
- Lab visits, computer based practical's to enhance the concept

Assessment methods

Progress towards achievement of learning outcomes may be assessed using the following:

- Problem based assignments;
- Practical assignment laboratory reports;
- Oral presentations, including seminar presentation;
- Viva voce interviews
- Exams in regular intervals

Attendance Requirements

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Suggested Readings

1. Text book of quantitative chemical analysis by Vogel, I & Mendham, J. Vogel's.
2. Practical Handbook of spectroscopy by James W. Robinson.
3. Quantifying Uncertainity in Analytical Measurement by Ellison and William.
4. The Fitness for purpose of Analytical methods by EurachemGuid.
5. Spectrometric Identification of Organic Compounds, John Wiley and Sons Inc, New York, 2008 by R.M. Silverstein, F.X. Webster.