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

No. CUJ/EVS/2022/223

Dated: 6th May, 2022

Minutes of Meeting

The meeting of Board of Studies of Department of Environmental Sciences was held in the committee room of the University on 6th May 2022. The following were present in the meeting:

1) Prof. Sunil Dhar	Chairman
2) Prof. Brijmohan Singh Bhau	VC Nominee
4) Prof. Rajesh Sharma	Subject Expert (joined through online mode)
5) Prof. R. Bhaskar	Subject Expert
6) Prof. N.K Arora	Subject Expert
7) Dr. Richa Kothari	Member
8) Dr. Shweta Yadav	Member (joined through online mode)
9) Dr. Anita Singh	Special Invitee
10) Dr. Pankaj Mehta	Special Invitee
11) Dr. Dinesh Kumar	Special Invitee

The meeting started with brief introduction by the Chairman. He also welcomed the members and introduced the agenda for the meeting which was then taken up for discussion.

Item I: Discussion and approval of the syllabus for M.Sc. Environmental Sciences as per NEP 2020:

Resolution: The Members approved the syllabus for M.Sc. Environmental Sciences as per NEP 2020. All the suggestions given by the members for different course titles were incorporated however, certain other suggestions made by the members are as under:

1) The course codes of the individual paper need to be incorporated as per the University norms. The list of the course code shall be prepared by the Department and submitted to the relevant branch for notification at later stage.

2) The members authorized the chairman BOS to make any modification in the evaluation scheme in accordance with the University guidelines

3) The BOS suggested that the CLO's in some courses need modifications for this members authorised the Chairman to incorporate the suggested changes and circulate the same to the members for their approval and if needed a virtual meeting will be conducted

4) The members also suggested to incorporate One Credit of Outreach programme in the semester four(4) along with Dissertation (Enclosed in the Credit –Matrix)

5) It was also suggested that skill enhancement course titled IPR, Env. Economics and Env. Audit should be split into two parts as a) Intellectual Property Rights (IPR); b) Environment: Economics & Auditing as two separate skill courses.

6) It was also suggested that keeping in view the importance of Computer Programming in the field of Environmental Science, one course each in Computer Programming language from MOOC platform should be incorporated in first and fourth semester.

Item II: Approval of the list of practical examiners for M.Sc. Environmental Sciences:

Resolution: The Members approved the list of the Examiners of M.Sc Practical Examination as enclosed herewith.

The meeting ended with vote of thanks to the chair.

Prof. Sunil Dhar 06/05/2022

Prof. Brijmohan Singh Bhau 06/5/2022

Prof. Rajesh Sharma

Prof. R. Baskar 6/5/22

Prof. N.K Arora 06/5/22

Dr. Richa Kothari 06/05/22

Dr. Shweta Yadav

Dr. Anita Singh 06/05/22

Dr. Pankaj Mehta 06/5/2022

Dr. Dinesh Kumar 6.5.22

DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU

SYLLABUS FOR MASTERS DEGREE

PROGRAMMEE IN ENVIRONMENTAL SCIENCES

SESSION 2022-2023 ONWARDS

Rahya-Suchani (Bagla), District Samba-181143

Jammu (J&K) India

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	MSE	ESE	Total Marks
	Core Courses 12 Credits (4x3)					
	Ecology and Environmental Sciences	3	18.75	18.75	37.5	75
	Environmental Pollution and Control	3	18.75	18.75	37.5	75
	Environmental Geosciences	3	18.75	18.75	37.5	75
	Lab-1	3	NA	NA	75	75
Open Elective (OE)8 Credit(4x2)						
	Introduction to Hydrology and Water Resource management	2	12.5	12.5	25	50
	Waste to Energy	2	12.5	12.5	25	50
	Environmental Issues and Awareness	2	12.5	12.5	25	50
	Soil and Water Quality analysis	2	12.5	12.5	25	50
	Atmosphere and its processes	2	12.5	12.5	25	50
	Geo-Spatial Sciences	2	12.5	12.5	25	50
Skill Enhancement / Value Additions Courses In alternate semesters (SE)/(VA) 2 Credits						
	Mushroom Farming and Production	2	12.5	12.5	25	50
	Intellectual Property Rights	2	12.5	12.5	25	50
Compulsory Qualifying course from MOOC/ Swayam platform on Computer Programming Language						
Credits (Total 22): Core Courses-12, Open elective- 08, SE/VA- 02						

06/05/2022

Rechakothari 06/05/22

6/5/22

06/5/22

06/5/2022

Semester-II

Course Code	Course Title	Credit	CIA	MSE	ESE	Total Marks
	Core Courses12 Credits (4x3)					
	Instrumentation and Analytical Techniques	3	18.75	18.75	37.5	75
	Risk Assessment and Disaster Management	3	18.75	18.75	37.5	75
	Energy and Environment	3	18.75	18.75	37.5	75
	Lab-2	3	NA	NA	75	75
Open Elective (OE)8 Credits (4x2)						
	Natural Hazards and Disaster Managements in Himalayas	2	12.5	12.5	25	50
	Alternate Energy Fuels	2	12.5	12.5	25	50
	Waste as a resource	2	12.5	12.5	25	50
	Sustainable Development	2	12.5	12.5	25	50
	Introduction to atmospheric aerosols	2	12.5	12.5	25	50
	Remote Sensing and Image Processing Techniques	2	12.5	12.5	25	50
Skill Enhancement / Value Additions Courses In alternate semesters (SE)/(VA) 2 Credits						
	Environment: Economics & Auditing	2	12.5	12.5	25	50
	Vermitechnology	2	12.5	12.5	25	50
Credits (Total 22): Core Courses-12, Open elective- 08, SE/VA- 02						

Semester-III

Course Code	4 Credits + 4 Credits (Project/Internship/OJT) 2 credit each	Credit	CIA	MSE	ESE	Total Marks
	Atmospheric Sciences and Climate Change	2	12.5	12.5	25	50
	Natural Resources, Biodiversity and its Conservation	2	12.5	12.5	25	50
	Environment: Impact Assessment & Management Systems	2	12.5	12.5	25	50
	Lab -3	2	NA	NA	50	50
Open Elective (OE)12 Credits 3 credit each						
	Water Shed Management	3	18.75	18.75	37.5	75
	Green Energy Sources	3	18.75	18.75	37.5	75
	Biofuels and Biorefinery	3	18.75	18.75	37.5	75
	Medicinal and Aromatic Plants of India	3	18.75	18.75	37.5	75
	Environmental Statistics	3	18.75	18.75	37.5	75
	Introduction to Meteorology	3	18.75	18.75	37.5	75
Audit Course/ Qualifying Courses (QC) 2 Credits						
	Personality Development (Qualifying)	2	12.5	12.5	25	50
Credits (Total 22): Core Courses-08, Open elective- 12, QC- 02						

06/5/2022

06/05/2022

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06/05/22

06/05/22

6-5-22

6/5/22

Semester-IV

Course Code	CORE 8 Credits (Dissertation/OJT)	Credit	CIA	MSE	ESE	Total Marks
	Dissertation	7+1#	25#	50	125	200
Open Electives will be selected of 12 credits from the Swayam platform, one must be on Computer Programming Language						
Audit Course/ Qualifying Courses (QC) 2 Credits						
	Commercialization Skills (Qualifying)	2	12.5	12.5	25	50
Award of Post Graduate Degree (After 2 year)*						
# 1 credit goes to outreach activity among any one (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						

जम्मू केंद्रीय विश्वविद्यालय
Central University of Jammu

राया–सूचानी; बागला, जिला सांबा–181143 जम्मू एवं कश्मीर
Rahya- Suchani (Bagla), District Samba – 181143, Jammu (J&K)

No. CUJ/Acad/II-14/12/2022/484

03 Aug, 2022

NOTIFICATION No. 124 / 2022

Sub: Course Scheme and Syllabus of M.Sc. in Environmental Sciences as per NEP 2020 w.e.f. Academic Session **2022-23** – Reg.

It is hereby notified for the information of all concerned that on the recommendation of the Board of Studies, Department of Environmental Sciences, and Dean, School of Life Sciences, the Competent Authority in anticipation of ratification of Academic Council has approved following **Course Scheme** and **Syllabus** of M.Sc. in Environmental Sciences w.e.f. Academic Session **2022-23**.

Semester – I

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
	Core Courses					
MEVS1C 001T	Ecology and Environmental Sciences	3	18.75	18.75	37.5	75
MEVS1C 002T	Environmental Pollution and Control	3	18.75	18.75	37.5	75
MEVS1C 003T	Environmental Geosciences	3	18.75	18.75	37.5	75
MEVS1C 001L	Lab-1	3	-	-	75	75
#	A course from MOOC/ Swayam Platform on Computer Programming Language	Qualifying only				
	Skill Enhancement Course / Value Addition Course (Any One)					
MEVS1C 004T	Mushroom Farming and Production	2	12.5	12.5	25	50
MEVS1C 005T	Intellectual Property Rights	2	12.5	12.5	25	50
	Open Elective Courses					
#	Open Elective Course - I	2	12.5	12.5	25	50
#	Open Elective Course - II	2	12.5	12.5	25	50
#	Open Elective Course – III	2	12.5	12.5	25	50
#	Open Elective Course - IV	2	12.5	12.5	25	50
	Total	**22**	-	-	-	**550**

List of Open Elective Courses offered by Department of Environmental Sciences

Sr. No.	Course Code	Course Name	Nature of Open Elective	Credit	CIA	MSE	ESE	Max. Marks
1.	MEVS1O 001T	Introduction to Hydrology and Water Resource Management	OEC	2	12.5	12.5	25	50
2.	MEVS1O 002T	Waste to Energy	OEC	2	12.5	12.5	25	50
3.	MEVS1O 003T	Environmental Issues and Awareness	OEC	2	12.5	12.5	25	50
4.	MEVS1O 004T	Soil and Water Quality analysis	OEC	2	12.5	12.5	25	50
5.	MEVS1O 005T	Atmosphere and its processes	OEC	2	12.5	12.5	25	50
6.	MEVS1O 006T	Geo-Spatial Sciences	OEC	2	12.5	12.5	25	50

Semester – II

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
	Core Courses					
MEVS1C 006T	Instrumentation and Analytical Techniques	3	18.75	18.75	37.5	75
MEVS1C 007T	Risk Assessment and Disaster Management	3	18.75	18.75	37.5	75
MEVS1C 008T	Energy and Environment	3	18.75	18.75	37.5	75
MEVS1C 002L	Lab-2	3	-	-	75	75
	Skill Enhancement Course / Value Addicon Course (Any One)					
MEVS1O 009T	Environment: Economics & Auditing	2	12.5	12.5	25	50
MEVS1O 010T	Vermitechnology	2	12.5	12.5	25	50
	Open Elective Courses					
#	Open Elective Course - I	2	12.5	12.5	25	50
#	Open Elective Course - II	2	12.5	12.5	25	50
#	Open Elective Course – III	2	12.5	12.5	25	50
#	Open Elective Course - IV	2	12.5	12.5	25	50
	Total	**22**	-	-	-	**550**

List of Open Elective Courses offered by Department of Environmental Sciences								
Sr. No.	Course Code	Course Name	Nature of Open Elective	Credit	CIA	MSE	ESE	Max. Marks
1.	MEVS1O 007T	Natural Hazards and Disaster Managements In Himalayas	OEC	2	12.5	12.5	25	50
2.	MEVS1O 008T	Alternate Energy Fuels	OEC	2	12.5	12.5	25	50
3.	MEVS1O 009T	Waste as a Resource	OEC	2	12.5	12.5	25	50
4.	MEVS1O 010T	Sustainable Development	OEC	2	12.5	12.5	25	50
5.	MEVS1O 011T	Introduction to Atmospheric Aerosols	OEC	2	12.5	12.5	25	50
6.	MEVS1O 012T	Remote Sensing and Image Processing Techniques	OEC	2	12.5	12.5	25	50

Semester – III

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
Core Courses						
MEVS2C 001T	Atmospheric Sciences and Climate Change	2	12.5	12.5	25	50
MEVS2C 002T	Natural Resources, Biodiversity and its Conservation	2	12.5	12.5	25	50
MEVS2C 003T	Environment: Impact Assessment & Management Systems	2	12.5	12.5	25	50
MEVS2C 001L	Lab -3	2	-	-	50	50
Compulsory Audit Course / Qualifying Course						
MEVS2C 004T	Personality Development	2	12.5	12.5	25	50
Open Elective Courses						
#	Open Elective Course - I	3	18.75	18.75	37.5	75
#	Open Elective Course - II	3	18.75	18.75	37.5	75
#	Open Elective Course – III	3	18.75	18.75	37.5	75
#	Open Elective Course - IV	3	18.75	18.75	37.5	75
Total		**22**	-	-	-	550

List of Open Elective Courses offered by Department of Environmental Sciences								
Sr. No.	Course Code	Course Name	Nature of Open Elective	Credit	CIA	MSE	ESE	Max. Marks
1.	MEVS2O 001T	Water Shed Management	OEC	3	18.75	18.75	37.5	75
2.	MEVS2O 002T	Green Energy Sources	OEC	3	18.75	18.75	37.5	75
3.	MEVS2O 003T	Biofuels and Biorefinery	OEC	3	18.75	18.75	37.5	75
4.	MEVS2O 004T	Medicinal and Aromatic Plants of India	OEC	3	18.75	18.75	37.5	75
5.	MEVS2O 005T	Environmental Statistics	OEC	3	18.75	18.75	37.5	75
6.	MEVS2O 006T	Introduction to Meteorology	OEC	3	18.75	18.75	37.5	75

03/08/2022

(Dr. Yashwant Singh)
Registrar (I/c)
registrar@cujammu.ac.in
01923 – 249658

Encl: Syllabus of Semester I, II, III of M.Sc. in Environmental Sciences

To: Head, Department of Environmental Sciences

Copy to: Controller of Examinations

जम्मू केंद्रीय विश्वविद्यालय

Central University of Jammu

राया-सुचानी, बगला, जिला सांबा-181143 जम्मू एवं कश्मीर
Rahya- Suchani (Bagla), District Samba – 181143, Jammu (J&K)

No: CUJ/Acad/II-14/12/2022/618

14th October 2022

NOTIFICATION No. 160 / 2022

Sub: Course Scheme and Syllabus of M.Sc. in Environmental Sciences w.e.f. Academic Session **2022-23** – Reg.
Ref: Notification No. 124 of 2022 dated 03.08.2022

In continuation to University Notification under reference, it is hereby notified for the information of all concerned that on the recommendation of the Board of Studies, Department of Environmental Sciences and Dean School of Life Sciences, the Competent Authority in anticipation of Academic Council has approved following Course **Scheme** and **Syllabus** of IV semester of M.Sc. in Environmental Sciences w.e.f. Academic Session **2022-23** :-

Semester – IV

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
	Core Courses					
MEVS2C 001D	Dissertation	7				
MEVS2C 001F	Outreach Activities (Any One):- • Environmental Awareness • Industrial visit • Field visit • Social Awareness • Any other area deemed to be appropriate by the department	1*	25	50	125	200
	Compulsory Audit Course / Qualifying Course					
MEVS2C 005T	Commercialization Skills	2	12.5	12.5	25	50
	Open Elective Courses					
#	Courses to be selected from the Swayam platform, including one course on Computer Programming Language	12	-	-	-	300
	Total	**22**	-	-	-	**550**

** Outreach Activity*
 # as provided by concerned department / SWAYAM portal

14/10/2022

(Dr. Yashwant Singh)
Registrar
registrar@cujammu.ac.in
01923 – 249658

Encl: Syllabus of IV Semester of M.Sc. in Environmental Sciences

Head,
Department of Environmental Sciences

Copy to:
Controller of Examinations

जम्मू केंद्रीय विश्वविद्यालय
Central University of Jammu
राया-सूचानी (बागला), जिला सांबा -181143, जम्मू (जम्मू एवं कश्मीर)
Rahya-Suchani (Bagla), District Samba - 181143, Jammu (J&K)

No: CUJ/Exam/2022/[illegible] Dated: [illegible]

NOTICE

The Hon'ble Vice Chancellor is pleased to appoint following external expert(s) for the Practical/Lab/Dissertation/Project Work/Viva Voce etc. for End Semester Examinations to be held on [illegible] of January 2023.

Department: Environmental Science
Course: M.Sc. Environmental Science

S.no.	Particular	Semester	External Expert(s)
1.	Course Code : PGEVS3C007L Course Title : Lab Course-I	III	Prof. Sanjay Khajuria, SKAUST, Jammu
2.	Course Code : PGEVS3C008L Course Title : Lab Course -II	III	Prof. Avtar Singh, Department of Remote Sensing, [illegible]

Note: Remuneration and T.A/D.A for External Expert as per university norms.

Controller of Examinations

To:

The Head,
Department of Environmental Science

Copy to: Finance Officer, Central University of Jammu

जम्मू केंद्रीय विश्वविद्यालय

Central University of Jammu

राया-सूचानी (बागला), जिला **सांबा** -181143, **जम्मू** (जम्मू एवं कश्मीर)

Rahya-Suchani (Bagla), District **Samba** – 181143, **Jammu** (J&K)

No: CUJ/Exam/2023/3255 Dated: 01/03/2023

NOTICE

The Hon'ble Vice Chancellor is pleased to appoint following external expert(s) for the Practical/Lab/Dissertation/Project Work/Viva Voce etc for End Semester Examinations to be held in the month of **Feb-March 2023**.

Department: **Department of Environmental Sciences**

Course: **M.Sc. Environmental Sciences**

S.No	Particular	Sem	External Expert(s)
1.	**Course Code : MEVS1C001L** **Course Title**: LAB - I	Ist	**Dr. Prashant,** Department of Geology, IGNOU, New Delhi

Note: Remuneration and T.A/D.A for External Expert as per university norms.

Controller of Examinations (I/c)

To,
The Head, Department of **Environmental Sciences**

Copy to: Finance Officer, Central University of Jammu

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-I

Course Title: Ecology and Environmental Sciences

Credits: 3 **Contact Hours / Week: 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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**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

4.1Basic 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.

5. 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

6. 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

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. 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: Course: Environmental Pollution and Control

Credits: 3 **Contact Hours /**

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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**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

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 visit
- Industrial/Field Excursion to enhance the concepts

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. 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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**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

5. 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.

6. 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

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. 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

Open Electives for Semester-I

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Course Title Introdu tion to Hydrology and Water Resource Management:

Credits: 2

Contact Hours / Week: 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 a prime resource for development of a civilization.
- 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	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

Unit I: Hydrology

1.1 Hydrologic cycle, Climate and water availability, Water balances, Precipitation: Forms, Classification, Measurement,

1.2 The significance of water in different fields of anthropogenic human activities and its role in the development of civilization.

1.3 Water resources of the earth, Global water budget

1.4 Interrelation between hydrological processes and atmosphere, hydrosphere and lithosphere, Hydrologic cycle.

Unit II: Surface and Ground water (merge both units)

2.1 Formation of surface water resources. River basins and water divide

2.2. Fluvial landforms. Causes and Management of Floods.

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

2.4 Types of aquifers, porosity, specific yield, specific retention, storage coefficient, permeability, hydraulic conductivity, hydraulic transmissibility

Unit III Water Harvesting

3.1 Drought Management and Water Harvesting: Causes of drought,

3.2 Measures for water conservation an augmentation, drought contingency planning.

3.3 Methods of rainwater collection and harvesting, Dams: runoff enhancement, runoff collection.

3.4 Artificial ground water recharge and needs and methods.

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 visit
- Industrial/Field Excursion to enhance the concepts

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

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.

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**

Credits: 2

Contact Hours /

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	MSE	ESE	Total
12.5	12.5	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 Energy options

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

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 based practical's to enhance the concept
- Industrial/Field Excursion 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

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. 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: Environmental Issues and Awareness

Credits:2Contact 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	MSE	ESE	Total
12.5	12.5	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

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	**MSE**	**ESE**	**Total**
12.5	**12.5**	**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	MSE	ESE	Total
12.5	12.5	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	MSE	ESE	Total
12.5	12.5	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.

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

Syllabus for MSc

Semester-I

Course Title: Mushroom Farming & Pr

Credits: 2

Course Learning Outcomes (CLOs): On

do :

- Start a small business enter
- Effectively manage small b
- Take up Mushroom Cultiva
- Selection of important type
- Maintain Mushroom farm
- Work out the economics o

	Ex
CIA	MSE
12.5	12.5

Unit 1: MUSHROOM CULTIVAT

1.1 Commercial Mushroom Cult Cultivation.

1.2 Description of edible types, n

1.3 Selection of types of Mushro Design and construction of M

1.4 Composting in Mushroom Appropriate materials to prep

Unit II : BIOLOGY, DISEASE C

2.1 Biology of Mushrooms: But characteristics, spore germinati

2.2 Nutrient Profile of Mushroo vitamins &minerals. Different

2.3 Disease control and pest M detection of pests and disease

2.4 Harvesting of Mushroom. Ide using approved cutting techni

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	**MSE**	**ESE**	**Total**
12.5	12.5	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.

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	MSE	ESE	Total
12.5	12.5	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-II

DEPARTMENT OF ENVIRONMENTAL SCIENCES
CENTRAL UNIVERSITY OF JAMMU

Course Title: Instrumentation and analytical techniquesCredits: 3

Course Code: 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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**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 andSound level meter.

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

UNIT II: Chromatography techniques

2.1 Basic terminologies and laws of chromatography.

2.2 Principle, instrumentation and working of paper chromatography, thinlayer chromatography and columnchromatography.

2.3 Principle, instrumentation and working of Gas chromatography (GC) andGas 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

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).

4.4 Principle, instrumentation and working of X-ray fluorescence: Energy dispersiveX-ray fluorescence and wavelength dispersive X-ray fluorescence.

1. 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

2. 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

3. 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.

CENTRAL UNIVERSITY OF JAMMU
Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Risk Assessment & Disaster Management

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

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

- Integrate knowledge analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, will develop the skills to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
- Will develop the skills on the knowledge and understanding of the International Strategy for Disaster Reduction (UN-ISDR) along with the implementation of Disaster Risk Reduction (DRR) Strategy.

a) Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
18.75	**18.75**	**37.5**	**75**

COURSE CONTENT

UNIT – I: RISK ASSESSMENT &MANAGEMENT

1.1 Concepts of Environmental Risks Definitions for Environmental Risk.

1.2 Concepts of Hazard, exposure, dose and response with special reference to Risk – Public perception of Environmental Risk – Communication of Risk.

1.3 Developmental activities/projects/programmes required to carry out Risk assessments

1.4 Contingency Plans for Risk Management.

UNIT – II:RISK Vs DISASTERS

2.1. Risk Exposure Assessment – Risk Characterization.

2.2 Hazard Operability study: Hazard Assessment, Hazard Survey, Risk Analysis. New developments in quantifying risks and Risk Reducing measures.

2.3 Environmental Concepts of Disasters - Natural and Human-made.

2.4 Understanding the causative factors vulnerability, their analysis and evaluation. Environmental implications of Earthquakes, Avalanches, Volcanic eruptions, landslides, floods and tsunamis, cyclones, hurricanes, typhoons, tornadoes.

UNIT –III: DISASTER& IT'S MANAGEMENT CYCLE

3.1 Disasters due to nuclear chemical and biological disaster

3.2 Earthquakes in the areas of larger dams, forest fires and wild life destruction.

3.3 Disasters Mitigation and Disaster Management Cycles

3.4 Identification of Disaster prone areas and high risk groups

UNIT-IV: DISASTER WARNING &IT'S MITIGATION PLAN

4.1 Disaster warning programmes, Disaster preparedness and prevention of loss to life.

4.2 Disaster in context with Livestock, property, natural resources and ecology management – 4.3 Development of Disaster Mitigation Plans – Awareness programmes

4.4 Capacity building among the Risk Groups, Post disaster environmental problems and their management.

5. Teaching -Learning Process

Effective teaching and learning process for Risk Assessment & Disaster Managementinvolves 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.

6. Assessment methods

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

- Written or practical exams, including multiple-choice exercises
- Participation and organizing a mock-disaster drill
- Individual or group projects and presentations
- Preparation of Disaster Management Plan & Emergency Response Plan of Organizations

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. Gilbert, M. Masters (2000) Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt. Ltd., New Delhi.

2. Khitoliya, R.K. (2004) Environmental Pollution: Management and Control for Sustainable Development

3. Santra, S. (2001) Environmental Science. New Central Book Agency (Pvt) Ltd., Kolkotta.

4. Susan, L.C. (Ed)(1999) Environmental Risks and Hazards. Prentice Hall of India Pvt. Ltd., New Delhi.

5. Gopal Bhargava 1992. Environmental Challenges and Ecological Disasters, Mittal Publication, New Delhi.

6. UNCHS (1983) Planning for Human Settlements in Disaster Prone Areas, UNCHS-Habitat.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Energy & Environment

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

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

- How the energy sources affecting on the surrounding environment
- know about advantages of renewable energy sources
- Able to understand the energy, environment and climate change concerns
- Know about the various climate changes agreements and policies at national and international level
- Understand the routes for energy conversion and management

4. Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
18.75	**18.75**	**37.5**	**75**

COURSE CONTENT

Unit-I: Basic Introduction to Energy

1.1: Energy and power, forms of energy, primary and secondary energy sources, renewable energy potential.

1.2: World energy production and consumption. Impact of Energy on Development

1.3: Energy prices and affordability, Social and environmental aspects

1.4: Factors affecting India's energy development: Economy and demographics Policy and institution framework

Unit-II: Renewable& Non Renewable Energy Sources

2.1: Solar radiation Availability, Instruments for measurement for Solar Radiation, Indian Solar Energy Mission,

2.2: Wind Energy, Indian Wind Energy Potential, factors influencing wind, wind shear, turbulence, wind speed monitoring, impact on Environment

2.3: Hydropower Energy, Present status of Hydro Power, Ocean energy resources, ocean wave energy conversion and tidal energy conversion. Geothermal Energy, types of geothermal energy sites, geothermal power plants; Nuclear Energy, impact on Environment

2.4: Bio-Energy Scenario, Biomass generated energy resources (Biogas, Biofuel, Biohydrogen etc.), Conversion Process and Its impact on Environment, Coal & Petroleum

Unit-III: Energy, Environment and Climate Change Concerns

3.1: Overview of global environmental problems. Elementary ideas of renewable energy sources, Fossil fuels, Environmental pollution sources and classification

3.2: Environmental degradation due to Energy production and utilization, Pollution due to thermal power stations, Environmental aspects of Wind Energy Farms, Environmental aspects of Nuclear power generation, Nuclear waste disposal, Impact of Hydro power generation on Ecology and Environment

3.3: Global Warming, Climate Change Concerns, Climate Change in India, Kyoto protocol, Clean Development Mechanism [CDM], Carbon Fund Concept of Carbon credit; Impact of Climate Change on Glaciers, Rivers and Water Resources, Climate Change Policy Issues in Himalayas

3.4: International Status of Climate Change Policies, Indian Action Plan on Climate Change.

Unit-IV: CONSERVATION AND MANAGEMENT OF ENERGY

4.1 Environmental degradation due to energy production and utilization

4.2 Principles of energy conservation

4.3 Objectives and principles of energy management

4.4 Energy Audit: need, types, and methodology; BEE: objectives and implementation strategies

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
- Field come lab visits 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., 2021. Renewable energy resources. Routledge.
2. Da Rosa, A.V. and Ordoñez, J.C., 2021. Fundamentals of renewable energy processes. Academic Press.
3. Patel, M.R. and Beik, O., 2021. Wind and solar power systems: design, analysis, and operation. CRC press.
4. Roorda, N., 2020. Fundamentals of sustainable development. Routledge.
5. Ehrlich, R. and Geller, H.A., 2017. Renewable energy: a first course. CRC press.

OPEN ELECTIVES FOR SEM-II

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester: II

Course Title: Natural Hazards and Disaster Managements in Himalayas Course Credits: 2

Course Code: Contact Hours / Week: 2 Course Learning Outcomes (CLOs):

- To provide basic conceptual understanding of disasters.
- To understand approaches of Disaster Management
- To build skills to disaster response.
- To have knowledge about past events of disasters in the Himalayan region and future preparedness.

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

Unit I: Introduction to Disaster

1.1 Understanding Disasters: Meaning, nature, characteristics and types of Disasters.

1.2 Causes and effects, Hazards and Disasters, Risk, Vulnerability Analysis.

1.3 Geological and Mountain Area Disasters: Earthquakes, Landslides, Snow Avalanches, GLOF's.

1.4 Other Mountain Disasters: Floods, Flash Floods and Cloud bursts.

Unit II: Disaster Sensitivity of Himalayas

2.1 Reasons of vulnerabilities of Himalayas to Disasters

2.2 Geology and Tectonic of Himalaya.

2.3 Main disasters of Himalayas: Causes, and Assessment, Landslides in Himalayas, Seismicity associated with Himalayan terrain.

2.4 Anthropogenic threats and Geo-environmental vulnerability of Himalayan.

Unit III: Case Studies of Important Himalayan Disaster

3.1 Kangra Earthquake (1905), Uttarkashi Earthquake (1991), Bhuj Earthquake 2001,

3.2 Chamoli Earthquake (1999), Kashmir Earthquake 2005

3.3 Kedarnath Disaster (2013) Kaahmir floods 2014,

3.4 Ronti Gad Landslide Chamoli (2021), Cyclone and Tsunami 1999, 2004

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.

Learning Outcome:-

- Support the basic understanding of the Disaster and Its management for the Himalayan region.
- Student will be able to learn about the Disaster management and response plan.
- Develop understanding about the past events that occurred in the Himalayan region and disaster vulnerabilities and sensitivities.

Suggested Readings:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster. APH Publishing Corporation, New Delhi.
4. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi
5. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
6. Valdiya, K.S. (1998) Environmental Geology, Tata McGraw-Hill, New Delhi.

CENTRAL UNIVERSITY OF JAMMU
Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Alternate Energy Fuels

Contact Hours / Week: 2

Credits: 2

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

- Basics of the need of alternative fuels
- Understand about alcohol fuels
- Applications of biodiesel and synthetic fuels
- Use of gaseous fuels in Internal Combustion engines
- Applications of future green fuel for the sake of environment

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

Unit I: Need for Alternative Fuels

1.1: Sources for constituents of Exhaust gas emission on environmental condition of earth (, COx, NOx, SOx, O2).

1.2: Effects of Pollution created by Exhaust gas emission in atmosphere-Greenhouse effect,

1.3: Factors affecting greenhouse effect. Impact on Flora and Fauna

1.4: Study of Global Carbon Budget. Carbon foot print and Carbon credit calculations-Emission norms as per Bharat. Standard up to BS – VI and procedures for confirmation on production.

Unit II: Bio Diesel and Synthetic Fuels

2.1: Base materials used for production of Bio Diesel (Karanji oil, Neem oil, Sunflower oil, Soyabean oil, Mustard oil, Palm oil, Jatropha seeds)

2.2: Process of separation of Bio Diesel. Properties-Diesel blended with vegetable oil,

2.3: Various Vegetable oils for Engines – Esterification, performance and emission characteristics of Engine.

2.4: Algae Biodiesel. Di-Methyl Ether (DME). P-Series, and Eco Friendly Plastic fuels (EPF).

Unit III: Hydrogen and Biogas

3.1: Introduction to Hydrogen and Biogas system.

3.2: Properties, sources and methods of production of Hydrogen and biogas, Factors affecting the process

3.3: Storage and Transportation of hydrogen and biogas. Usage in SI engine & CI engine

3.4: Economics of Application and Advantages of hydrogen (Liquid hydrogen) as fuel for IC engine/ hydrogen car. Visit to relevant Labs Field Visits

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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 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

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. Ganesan V, "Internal Combustion Engines ". McGraw Hill HED Publications. 4th ed 2017
2. John Heywood, "Internal Combustion Engine Fundamentals". McGraw Hill Education. 1st edition. 2017.
3. Viswanathan, "Fuel Cells: Principles and Applications". Universities Press: 1st edition. 2006.
4. Lee, S., Speight, J.G. and Loyalka, S.K. eds., 2014. Handbook of alternative fuel technologies. crc Press.
5. Christian, D.G., 2000. Biomass for Renewable Energy, Fuels, and Chemicals: Donald L. Klass, Academic Press Ltd., 525 B Street, Suite 1900, San Diego, CA 92101-4495. ISBN 0-12-410950-0.

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CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Waste as a Resource

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

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

- Gain knowledge on strategies and solutions for solid and liquid waste management
- Suggest and describe the suitable technical aspects for management and recovery from particular waste
- Able to describe various thermal, thermo-chemical, biochemical and biological conversion techniques of waste into resources
- Understand the concepts of recycling, resource recovery and integrated resource recovery
- Able to understand the process of resource and value-added products recovery from waste

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

UNITI: I: INTRODUCTION TO WASTE

1.1 Waste- sources, types, characteristics

1.2 Solid waste and its management practices

1.2 Liquid waste and its management practices

1.4 Integrated resource recovery, Environmental impacts of waste recycling

UNIT-II CONVERSION TECHNIQUES

2.1 Thermal and Thermochemical conversion of waste- pyrolysis, gasification, incineration

2.2 Biochemical conversion of waste- methane generation, anaerobic digestion

2.3 Biofuels from waste: Methods and processes for utilization of waste for production of fuels

2.4 Environmental impacts of conversion techniques for resource recovery

UNIT-III: RESOURCE RECOVERY

3.1 Electronic waste generation, recycling and resource recovery

3.2 Hazardous waste- recycling and environmental benefits

3.3 Resource recovery from flue gases

3.4 Case studies and commercial success stories related to resource recovery

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Syllabus for the Master's Degree Programme in Environmental Sciences

Semester-II

Course Title: Sustainable Development **Credits: 2**

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

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

- The Skills for critically analysing the social, environmental and economic dimensions of sustainability
- The capacity for integrative thinking and practice will be enhanced
- The Integration of theoretical knowledge with practical application in the pursuit of the current market trends

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

Unit 1: SUSTAINABLE DEVELOPMENT: MEANING, POLICIES & PROGRAMS

1.1 Understanding sustainable development. Definition and dimensions of sustainability. The ecological footprint and carrying capacity

1.2 Global challenges of sustainable development:Our common future report, Agenda 21 and Millenium Development Goals, Earth Charter, domains of sustainability-Economics, ecology, politics and culture.

1.3 National Action Plan on Climate Change, National sustainable development strategies in India: Twenty point program of Govt. of India, Key programs introduced to increase agricultural productivity and profitability

1.4 Policies and programs relevant to sustainable development in India key legislations relative to sustainable development.

Unit-II: SUSTAINABLE DEVELOPMENT: PLANNING, STRATEGIES & MANAGEMENT

2.1 Strategies for promoting sustainable development-International Trade-TRIPS,IPR; Important current issues and areas of debate in relation to sustainable development.

2.2 Business strategies and sustainability . Business and sustainability-Concept of responsible business,

2.3 Principles of sustainable development in business planning and management.

2.4 Indicators for sustainability: Introduction to Nature s Living Planet Index developed by WWF.

Unit III: SUSTAINABLE DEVELOPMENT: CHALLENGES, INDICATORS& REPORTING

3.1 Happy Planet Index, Gross domestic product, Human development index, Sustainability reporting.

3.2 Corporate social responsibility –Sustainable urban development, Urbanization and its impact on Environment.

3.3 Rural and Urban planning for sustainable development , Green Building-LEED certification

3.4 Smart cities (Case Study: Jammu) -Ecological footprint, , Architecture- Eco industrial parks, Urban farming..

4. Teaching -Learning Process

Effective teaching and learning process for Sustainable Developmentinvolves five sequential steps. First, organizing the course`s disciplinary content as per demand of the Industry. Second, effectiv 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
- Case studies and field project reports
- Practical evaluation in the field/ industry
- Coursework such as essays, posters, models
- 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. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF,2011.
2. World Resources Institute (1995) "Environmental Indicators: A Systematic Approach to Measuring & Reporting on Environmental Policy Performance in the Context of Sustainable Development". World Resources Institute, Washington, DC.
3. Adger, W.N., Brown, K., Fairbrass, J., Jordan, A., Paavola, J., Rosendo, S., Seyfang, G. (2003) Governance for sustainability: towards a 'thick' analysis of environmental decisionmaking. Environment and Planning A 35, 1095 –1110.
4. Connelly, J. and Smith, G. (2003). Politics and the Environment: from theory to practice. Routledge, London.
5. Carter, N. (2001) The politics of the environment. Cambridge University Press: Cambridge
6. Leach, M., Scoones, I., Wynne, B. (2005) Science and Citizens: Globalization and the Challenge of Engagement.Zed books, London.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Introduction to Atmospheric Aerosols

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

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

- Gain fundamental understanding of role, importance and direct as well as indirect implications of particles in the lower atmosphere.
- Understand the aerosols-climate change connection.
- Understand the physical, chemical and biological attributes of aerosols.

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

UNIT - I: Particles in the lower atmosphere

1.1 Basic terminologies and properties of atmospheric particles.
1.2 Spatial and temporal variations in aerosols.
1.3 Reactions involved in particle formation and growth: nucleation, condensation and coagulation.
1.4 Aerosols-cloud interactions.

UNIT II: Understanding the aerosol - climate change connection

2.1 Optical properties of aerosols.Aerosol scattering and colors in the atmosphere.
2.2 Hygroscopic properties of aerosols, homogeneous and heterogeneous nucleation.
2.3 Direct implications of aerosols on the climate system.
2.4 Indirect implications of aerosols on the climate system.

UNIT III:Physico-chemical and biological attributes of aerosols

3.1 Size distribution and chemical composition of aerosols.
3.2 Major compound classes and atmospheric tracers used in source apportionment.
3.3 Definition, nature, sources and types of bioaerosols.
3.4 Traditional and modern methods of analysis.

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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-basedpracticals 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. Gelencsér, A. (2004) Carbonaceous Aerosol. Springer. The Netherlands.
2. Seinfeld, J.H., Pandis, S.N., (2006) Atmospheric Chemistry and Physics: From Air Pollution to Climate Change.Awileyinterscience publication.
3. Gilbert, M. Masters & Ela, W. P. (2007): Introduction to Environmental Engineering and Science. PHI learning Pvt Ltd
4. Andrews, D. G. (2010): An introduction to atmospheric physics. 2nd Edition. Cambridge university press.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-II

Course Title: Remote Sensing &Image Processing Techniques

Credits: 2

Contact Hours / Week: 2

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

- Understand the fundamental concept and practice of remote sensing and its advancement
- Design creative application of remote sensing technology
- Demonstrate the use of image processing software to create interactive map of satellite data
- Understand the skill required for professional level

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

UNIT I: FUNDAMENTALS OF REMOTE SENSING

1.1 Components of remote sensing, satellite orbits, Characteristics of satellite data

1.2 Processes involved in atmosphere-energy and land surface-energy interaction,

1.3 Stephen Bolzman law, Weins displacement law, atmospheric absorption spectra.

1.4 concept of atmospheric windows, spectral signature curve, radiometric quantities

UNIT II:DIGITAL IMAGE PROCESSING

2.1 Structure of digital image, concept of band, Pan, multispectral and hyperspectral data

2.2 Linear stretching, Histogram equalization, binary and grey level slicing

2.3 Concept of spatial frequencies, low pass filter, high pass filter and edge enhancement

2.4 Spectral biasness and band ratioing, supervised and unsupervised classification, indices

UNIT III:APPLICATION OF GIS

3.1Remote sensing application for vegetation mapping.

3.2 SAR data characteristics and its application.

3.3 Remote sensing application in cryosphere and oceanic studies.

3.4 remote sensing platforms, scope of RS as profession, remote sensing satellites.

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

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. 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-II

Course Title: Vermitechnology

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

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

- Understand the importance of vermi-technology and their socio-economic benefits
- How to produce good quality of Vermicompost and Vermiculture
- Acquire skills for entrepreneurship.

Examination Schedule			
CIA	MSE	ESE	Total
12.5	12.5	25	50

COURSE CONTENT

Unit-I: Introduction

1.1: Vermitechnology: definition, economic importance, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore.

1.2: Role in bio transformation, residues generated by human activity and production of organic fertilizers. How does nature works. Matter and humus cycle (product, qualities).

1.3: Ground population, transformation process in organic matter. Selection of the right worm. Useful species of earthworms. Local species of earthworms.

1.4: Exotic species of earthworms. Key to identify the species of earthworms, Complementary activities of auto-evaluation.

Unit-II: Vermiculture

2.1: Common species for culture: Environmental parameters

2.2: Culture methods – wormery – breeding techniques: indoor and outdoor cultures - monoculture and polyculture – merits and demerits.

2.3: Earthworm biology and Rearing: limit factors (gases, diet, humidity, temperature, pH , light, and climatic factors)

2.4: Physio- chemical parameters of vermicompost

Unit-III: Wastes and Vermicpompost

3.1: Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage,

3.2: Vermiwash-Preparation and application. Pest and ciseases of earthworms. Frequent problems

3.3: Applications of vermiculture: Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming horticulture.

3.4: Earthworms for management of municipal/selected biomedical solid wastes: as feed bait for capture/culture fisheries: forest regeneration. Potentials and constraints for vermiculture in India. Visit to relevant Labs/Field Visits

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
- Field Visits

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. Munroe, G., 2007. Manual of on-farm vermicomposting and vermiculture. organic agriculture centre of Canada.
2. Nagavallemma, K.P., Wani, S.P., Lacroix, S., Padmaja, V.V., Vineela, C., Rao, M.B. and Sahrawat, K.L., 2004. Vermicomposting: Recycling wastes into valuable organic fertilizer. Global Theme on Agroecosystems Report no. 8.
3. Jason Johns, 2015. Worm Farming - Creating Compost at Home with Vermiculture. ISBN-13: 9781508687429
4. Panda, H., 2013. Integrated organic farming handbook. ASIA PACIFIC BUSINESS PRESS Inc..

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Syllabus for the Masters Degree Programme in Environmental Sciences

Semester – II

Subject Course Title: Environment: Auditing & Economics **Course Code No.**

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

Course Learning Outcomes (CLOs): By the end of this unit, students should be able to:

- Explain what environmental auditing is and how it originated
- Describe the benefits of environmental auditing
- Understanding on the environmental management responsibilities of an organization
- Learn to do the critical analysis arguments relating to the Environmental Economics and their likely impact on Environment will also get an exposure on various approaches and methods [illegible] environmental goods and services.

Examination Schedule			
CIA	MSE	ESE	Total
12.5	12.5	25	50

COURSE CONTENT

UNIT-I: ENVIRONMENTAL AUDITING

1.1 Scope and objectives. Pre-Audit, On-Site Audit and Post Audit objectives and actions

1.2 Standard for auditing, registration and implementing the audit

1.3 Audit Report and Environmental Statement (ES): Importance of Audit Report – Reporting Environmental Audit Findings: Fundamentals; Coverage; Confidentiality; Opportunity for dialogue

1.4 Environmental Statement and Public Information: Definition and scope; Protocols; Preparation of Flow diagrams; Material Balance; Preparation of EIS.

UNIT-II: ECONOMY & NATURAL ENVIRONMENT

2.1 The Human Economy – Natural Environment Interaction. Biophysical Foundations of production and consumption of human economy. Material Balance Approach: the concept and conditions of sustainability of the human economy

2.2 Role of Externalities as the fundamental determinants, Property Rights, Market, Spatial-temporal dimensions of externality

2.3 Empirical approaches in environmental valuation: Indirect Methods of environmental valuation: a) Hedonic Pricing, b) Household Production Function approach - defensive cost, health cost and travel cost methods

2.4 Natural capital stock and sustainable resource accounting, Strong and weak Sustainability, Environmental Adjustment of National Income.

UNIT III: TRADE & ENVIRONMENT

3.1 Environmental Kuznets Curve. Development vs conservation of environmental resources.

3.2 Ecosystem flips and irreversibility: Krutilla-Fisher equation

3.3 Environmental standard as a determinant of (a) pattern of trade and its welfare implications. (b) the locational distribution of polluting industries across the developed and developing countries and (c) that of the direction of flow of foreign direct investment.

3.4 WTO and global convergence of environmental standard. Analysis of two cases in GATT WTO: Tuna-Dolphin and Shrimp-Turtle.

4. Teaching -Learning Process

Effective teaching and learning process for Environment: Auditing & Economics involves five sequential steps. First, organizing the course's disciplinary content as per demand of the Indust... 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.
- Understanding of methods and approaches taught and their application to the range of environmental issues.
- Student will complete written quizes, exams, presentation etc.
- Critical Thinking: Class presentations, the underlying emphasis would be on developing attitude of independent thinking on contemporary environmental issues and critical evaluation public policy for addressing environmental problems.

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. Nick Hanley, Jason F Shorgen and Ben White 1997 2006, Environmental Economics
6. Theory and Practice, First/Second Edition, MacMillan.
7. Charles D Kolstad, 2012, Intermediate Environmental Economics, Indian Editon, Oxford University Press, New Delhi
8. David W Pearce and R Kerry Turner, 1990, Economics of Natural Resources and the Environment, Harvester Wheatsheaf
9. Ramprasad Sengupta, 2013, Ecological Limits and Economic Development, Oxford University Press, New Delhi

Semester III

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: Atmospheric Science & Climate Change

Contact Hours / Week: 2

Credits: 2

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

- Understand the fundamental concept of Earth Climate system and its components
- Understand basic concept and phenomenon of atmospheric sciences
- Read the synoptic and vertical metrological charts and maps
- Understand the skill required for professional level

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

UNIT I: INTRODUCTION

1.1 Basics of Atmosphere and atmospheric stability

1.2 Climate system, basic ingredients of climate system

1.3 Factors across different time scales and their interaction of climate system

1.4 Cloud Formation and precipitation

UNIT II: FUNDAMENTALS OF METEOROLOGY

2.1 Weather versus Climate

2.2 Wind driving forces, pressure belts

2.3 Atmospheric circulation models

2.4 Stability and daily weather

UNIT III: THE CLIMATE SYSTEM

3.1 Climate Classification (Koppen)

3.2 Climate Variability, Global Dimming versus Global Warming

3.3 Basic theories on climate change, El-nino and Southern Oscillation (ENSO)

3.4 Impact of climate change on important sectors. Adaptation and Mitigation Strategies for Climate Change

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

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	**MSE**	**ESE**	**Total**
12.5	**12.5**	**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 and animals 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

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-basedpractical'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. 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. MefteG.k. and C.RonalsCorrol(1994) Principles of Conservation Biology, Sinaur Associates, Inc. Sunderland, Massachusetts.

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester – III

Subject Course Title: Environment : Impact 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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**37.5**	**75**

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

4. 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.

5. 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

OPEN ELECTIVES FOR SEM-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 understand behavior 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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**37.5**	**75**

COURSE CONTENT

Unit I: Introduction to Watershed

1.1 Definition of Watershed, Size of Watershed, Watershed Characteristics, Watershed Deterioration and Hydrological Cycle

1.2 Soil Characteristic, Soil moisture conditions, Water soil interaction, priority watersheds

1.3 Land capability classification, Characteristic of various land capability classes, Soil and Land Capability Surveys

1.4 Principal Factors Influencing Watershed Operations, Rainfall and Runoff, Factors affecting runoff

Unit II: Watershed Management

2.1 Watershed Management: Introduction, Characteristics, Objectives, Watershed approach in Government Programs

2.2 Water conservation practices in irrigated lands, Soil and moisture conservation practices in dry lands, water conservation structures,

2.3 Watershed planning: principles, Preparation of watershed development, Monitoring and evaluation system.

2.4 Identification of Watershed Problems, Objectives and Priorities

Unit III: Erosion and its control

3.1 Erosion process–Factors affecting erosion, Types of erosion Assessment of erosion,

3.2 Contour and Staggered Trenching, Contour Trenching, Trench Types

3.3 Control measures for soil erosion – vegetative and mechanical (including design), for agricultural and non-agricultural lands

3.4 Gully and Ravine Reclamation

Unit IV: Watershed Management in India

4.1 Watershed development in India. Common Guidelines. Allocation of funds. People's Participation

4.2 Wetland management- types. hydrologic conditions and water budget. Ramsar convention.

4.3 Drought and its management-causes and impacts. management objectives and strategy-short term and long term measures.

4.4 Crop water management and crop planning with special reference to different agro-ecological zones in India. Water conservation practices for deserts

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.

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	**MSE**	**ESE**	**Total**
18.75	**18.75**	**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.

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	MSE	ESE	Total
18.75	18.75	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.

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	MSE	ESE	Total
18.75	18.75	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.

4 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.

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 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

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. 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

Syllabus for MSc in Environmental Sciences

Semester-III

Course Title: Environmental Statistics

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

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

- Understand and analyze the complex environmental datasets.
- Gain fundamental understanding of important statistical parameters to design the research problems and assess the environmental impacts.
- Extract the quantitative information using appropriate statistical methods.

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
18.75	**18.75**	**37.5**	**75**

COURSE CONTENT

UNIT-I Variables and Frequency Distributions

1.1 Population and Sample; Variables: Discrete and Continuous

1.2 Raw Data, Arrays and Frequency Distributions

1.3 Histograms and Frequency Polygons

1.4 Relative-Frequency Distributions, Cumulative-Frequency Distributions and Ogives

UNIT-II Descriptive Statistics

2.1 Mean, Median and Mode; Root Mean Square

2.2 Quartiles, Deciles, and Percentiles; Range and IQR

2.3 Standard Deviation and Variance

2.4 Skewness and Kurtosis

UNIT-III Probability and Probability Distribution

3.1Elementary Probability Theory

3.2 Conditional Probability; Independent and Dependent Events

3.3 Probability Distributions; Binomial, Normal, Log-normal Distributions

3.4 Probability Distributions; Student-t, F-distribution and Poisson Distributions

UNIT IV:Hypothesis Testing andCorrelation-regression analysis

4.1 Central Limit Theorem, Hypothesis testing, Type-I and Type-II Errors

4.2 Z-Test and t-Test

4.3 Basics of Linear Regressions

4.4 Correlation: Pearson's, Spearman's and Kendall's correlation coefficients

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
- 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 on software
- 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. Murray Spiegel, Larry Stephens, Narinder Kumar. Statistics (Schaum's Outline Series). McGraw Hill Education (India) Private Limited. 4 edition (2010). ISBN: 978-0070151536.
2. S.C. Gupta, Fundamentals of Statistics. Himalaya Publishing House. (2014). ISBN: 978-9350517697
3. NabenduPal and Sahdeb Sarkar, Statistics: Concepts and Applications. PHI Learning Private Limited, 2 edition (2007). ISBN: 978-8120334458

Semester-III
Course Title: Introduction to Meteorology
Credits: 2 **Contact Hours / Week: 2**

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

- Understand the weather activities and mechanism at local to global level
- Know about basic concept of atmospheric stability
- Read the synoptic and vertical metrological charts and maps
- Understand the skill to understand different meteorological thermodynamic diagram

Examination Schedule			
CIA	**MSE**	**ESE**	**Total**
12.5	**12.5**	**25**	**50**

COURSE CONTENT

UNIT I: INTRODUCTION

1.1.Various branches of Meteorology and their scope
1.2.Meteorological elements: Atmospheric Pressure, Dry Bulb, Wet Bulb,
1.3.Atmospheric Moisture and its representation
1.4.Virtual Temperature, Potential Temperature, equivalent Potential Temperature

UNIT II: Atmospheric stability

2.1. Concept of lapse rates, Laws of thermodynamics, Concept of Geopotential height
2.2. Geostrophic wind, pressure-height curve,
2.3. Thermodynamic diagram.Fog,
2.4. Clouds and precipitation, basic knowledge of their formation.

UNIT III: Weather Processes

3.1. Scales of weather systems. Indian summer monsoon,
3.2. Monsoon depressions, Easterly wave structure and associated weather,
3.3. Waves in mid-latitude westerlies, Western disturbance,
3.4. Jet streams around the globe and weather

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

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. Monsoon Meteorology by C.P. Chang &amp: T.N. Krishnmoorthy
2. Mesoscale Meteorological Modelling by Roger A. Pielke
3. Mesoscale Atmospheric Circulation by B.W. Atkinson
4. Atmospheric Turbulenceby Panofsky and J.A. Dutton.
5. Introduction to Boundary Layer Meteorology&quot: Stull
6. The Atmospheric Boundary Layerby R.M. Stewart, WMO-523
7. Climate Change: The Science of Global Warming and Our Energy Future by Edmond Mathez
8. Tropical Meteorology Volume I & II by G.C. Asnani
9. Synoptic Meteorology by M.Kurz

CENTRAL UNIVERSITY OF JAMMU

Syllabus for MSc in Environmental Sciences

Semester-IV

Course Learning Outcomes (CLOs): Students will be able to learn about:

- **Practical based hands on training at departmental labs/ institutions/ NGOs/ industries/ ICAR/ICMR etc. on the part dissertation and outreach activity**
- The purpose of this course is to help students Organize Ideas, Material and Objectives and to prepare themselves as per the latest content available on SWAYAM MOOC Platform.

Course Code	CORE 8 Credits (Dissertation/OJT)	Credit	CIA	MSE	ESE	Total Marks	
	Dissertation	7+1#	25#	50	125	200	
Open Electives will be selected of 12 credits from the Swayam platform, one must be on Computer Programming Language							
Audit Course/ Qualifying Courses (QC) 2 Credits							
	Commercialization Skills (Qualifying)	2	12.5	12.5	25	50	
Award of Post Graduate Degree (After 2 year)*							

 # 1 credit goes to outreach activity among any one (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

1. Teaching -Learning Process

Teaching process includes

- Practicum and field-based learning:
- The use of prescribed textbook and e-learning resources and other self-study materials;

- Open-ended project work, some of which may be team-based;
- Activities designed to promote the development of generic transferable and subject-specific skill;
- Internship and visit to field sites, and industrial or other research facilities etc.

2. Assessment methods

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

- Problem based assignments
- Practical assignment on softwareor practical reports
- Oral presentations, including seminar presentation
- Viva-voce/interviews
- Exams in regular intervals
- Peer and self-assessment etc. and any other pedagogic approaches as per the context.

3. 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.