MASTER OF SCIENCE
IN
ENVIRONMENTAL SCIENCE AND MANAGEMENT

Curriculum Structure

Faculty of Science and Technology

Pokhara University

2020

POKHARA UNIVERSITY

MASTER OF SCIENCE IN
ENVIRONMENTAL SCIENCE AND MANAGEMENT

1 Program Objectives

The Master of Science in Environmental Science and Management Program under the Faculty of Science and Technology of the Pokhara University has been designed to offer a unique opportunity to acquire highly skillful knowledge and practical tools on multi-disciplinary subjects related to environmental science and management. The course provides fundamental basis for understanding and application of social, physical, biological, legal and economical components of the environment and their holistic integration to provide a comprehensive working knowledge on the environmental science and management. The program focuses on developing social, environmental and developmental outlook and adequate skill in analysis, decision-making, implementation, leadership, and communication among the students. It is aimed at producing high quality professionals- environmental scientists, managers, researchers, counselors *etc*.

The objectives of the program are to:

- offer courses covering fundamentals of environmental science, tools of environment management and advanced courses on environmental science;
- provide opportunities to carrying out research works with the use of cross-cutting and state of the art information and tools;
- provide opportunities to the students to acquire advanced knowledge on the subject and enhance individual skills and expertise; and
- contribute to policy research in the fields of environmental science and management.

2 Curricular Structure

The curriculum is designed to equip students with the competencies, knowledge, skills, and attitudes needed to become successful professionals in the fields of environmental science and management. The coursework gives students a broad and holistic view into the complexity today's environmental concerns. The program intends to help students to develop specialization in the fields of environment to build their professional career, and/or pursue further studies. The curriculum comprises of the following five components:

1. **Fundamental Knowledge Courses (FKC) (18 Credits):** The foundation courses provide necessary academic background and analytical tools for the MSc study and are pre-requisite for the advanced courses.
2. **Environmental Management Tools (EMT) (18 Credits):** An advanced courses on the environmental management tools provide analytical skills and tool required for solving complexity of the environmental problems.

3. **Advanced Courses (AC) (16 Credits):** The courses provide students in-depth understanding on the local and global environment issues.
4. **Elective Courses (EC) (3 Credits):** These courses are expected to help students to develop their specialization into a particular environmental issue.
5. **Thesis (9 Credits):** Students are required to undertake an independent research thesis work that might involve fieldwork, lab work, data processing, and empirical analysis. The students are required to prepare a thesis on a prescribed format.

3 Program Features

The features of the MSc Env Science and Mgmt. program are competitive learning, market driven concentration, and flexibility. This degree program focuses on the technical, managerial and policy issues associated with environmental and developmental outlook and adequate skill in analysis, environmental decision-making, implementation, leadership, and communication among the students. The MSc program features both theoretical and practical aspects of the environmental science and management.

The regular MSc program is to be completed within two years.

The program will use a range of pedagogical inputs that include in-campus learning through classroom lectures, discussions, presentations, lab works, case studies and guest lecture, as well as off-campus learning through project/field works.

4 Entry Requirements and Admission Procedure

4.1 Eligibility

The candidate pursuing the admission must have bachelor degree in science, forestry, agriculture and engineering and other technical subjects or equivalent from recognized institutions to become eligible to enter into the MSc in environmental science and management. The candidate must have secured minimum of CGPA 2 or 2nd division (45%) or equivalent grade in the bachelors' degree. Besides fulfilling basic academic requirements, the students must also pass the entrance examination.

4.2 Required Documents

The applicant is required to submit the following documents with the application form:

- Application form
- Transcripts of previous degree
- Migration certificate

Certificates of all degrees should be photocopied and submitted with proper attestation.

4.3 Admission Procedures

A notice inviting applications for the admission is publicly announced. The application forms

and information brochures are provided on request. The eligible candidates are informed to take the entrance test. The date and time for the entrance test are informed to the applicants. Final selection of the students is made on the basis of their aggregate scores in the entrance test, and personal interview.

5 Academic Schedule and Course Schedule

The academic year will be of two semesters. The admission to the program is given twice a year according to the schedule published by the Dean Office. The students are required to register courses at the beginning of each semester.

6 Addition and Withdrawal from Courses

A student will have option to add or drop from the course. This can, however, be done only during the first week of the semester. A student wishing to withdraw from a course should apply on the prescribed form given by the college within two weeks from the starting date of the semester.

7 Attendance Requirements

The students must attend every lecture, tutorial and practical classes. However, to accommodate for late registration, sickness and other such contingencies, the attendance requirements will be a minimum of 80% of the classes actually held.

8 Normal and Maximum Duration of Study

The normal and maximum duration for completion of the MSc Env. Science and Mgmt. program are as follows:

Normal duration: Two years (Four Semesters)
Maximum duration: 4+1 years from the date of registration.

(All the courses have to be completed within four years, and additional one year can be given to thesis work on special request upon the approval of concerned authority).

9 Evaluation System

A student's academic performance in the course is evaluated in two phases:

- Internally by the concerned faculty, and
- Externally by the Office of the Controller of Examinations in semester-end examinations.

A sixty percent weightage is given to the internal evaluation and forty percent to the external evaluation. The pass mark for both, the internal evaluation and the external evaluation, is sixty

percent. A student must qualify in both evaluations separately to get a pass grade in a particular course. The final grade awarded to a student in a course is based on their consolidated performance in both, internal and external evaluations.

The internal evaluation may consist of various components like project works, quizzes, presentations, written examinations, reflection notes *etc*. A student will get NOT QUALIFIED (NQ) status in the internal evaluation if his/her performance falls below the minimum requirements. Such students will not be allowed to sit in the semester-end examinations of that particular course.

The pass mark in each course will be a minimum Grade of C. However, students must secure a minimum CGPA of 3.0 at the end of the program for graduation.

10 Grading System

Pokhara University follows a four-point letter grade system. The letter grades awarded to students will be as follows:

Letter Grade	Grade Point	Description
A	4.0	Excellent
A-	3.7	
B+	3.3	Good
B	3.0	Fair
B-	2.7	
C+	2.3	
C	2.0	Work satisfying minimum requirement for credit
F	0.0	Fail

If a student cannot finish all the assigned works for the course, he/she will be given an incomplete grade 'I'. If all the required assignments are not completed within the following semester, the grade of 'I' will automatically be converted into 'F'.

The performance of a student is evaluated in terms of two indices: (a) Semester Grade Point Average (SGPA) which is the grade point average of the particular semester, and (b) Cumulative Grade Point Average (CGPA) which is the grade point average of all the semesters.

Where,

Honor Point = Grade point earned in a subject × Number of credits assigned to that subject

11 Degree Requirements

To graduate from the MSc Env. Science and Mgmt. program, a student

- should have a 'C' or better grade in each of the courses as specified in the curricular structure section;
- complete all the courses and Thesis as specified in the curricular structure section within the maximum time period specified in the normal and maximum duration of the study section;
- Have a final CGPA of 3 or better on the University's 4.0 grade scale.

12 Distinction and Dean's List

A student who obtains a cumulative CGPA of 3.75 or better will receive the MSc Env. Science and Mgmt. degree with Distinction. To qualify for Dean's list, a student must have a CGPA of 3.80 or better.

13 Repeating a Course

A course may be taken only once for grade. Since passing of all courses individually is a degree requirement, the student must re-appear the failed courses when offered and must complete. A student will be allowed to re-appear maximum of two courses to achieve a minimum CGPA of 3.0. The grade earned on the reappeared examinations will substitute the earlier grade earned by the student in that course. A student can retake a course only when it is offered by the college/university.

14 Credit Transfer and Withdrawal

A maximum of 25% of the total credit hours of course work completed by a student in an equivalent program of a recognized university/institution may be transferred/ waived for credit by the Dean on the recommendation of the Principal/ Head of the college. However, for such transfer of credit, a student must have received a grade 'B' or better in that particular course. Courses taken more than two years earlier than the date of application will not be accepted for transfer of credit.

Credit transfers will also be allowed from different programs of Pokhara University. In such cases, all credits earned by students in compatible courses with a minimum grade 'B' may be transferred to the new program.

The student may apply for withdrawal from the entire semester only on medical grounds. However, partial withdrawal from courses registered in a semester will not be considered.

15 Unfair Means

Students are strictly forbidden from adopting unfair means in class assignments, tests, report-writing, final examinations and thesis work. The following would be considered as adoption of unfair means during examination:

- Communicating with fellow students for obtaining help.
- Copying form another student's script/report/paper.
- Copying from disk, mobile, palm of hand or other incriminating documents and equipment.
- Possession of any incriminating documents, whether used or not.
- Any approach in direct or indirect form to influence teacher concerning grade.
- Unruly behavior which disrupts academic program.

If the instructor/invigilator detects a student using unfair means, the student may be given an 'F' grade at the discretion of the Examination Board. Adoption of unfair means may result in the dismissal of the student from the program and expulsion of the student from the college and as such from Pokhara University.

16 Dismissal from the Program

A student is normally expected to obtain a SGPA of 3.0 in the semester-end examinations of the MSc Env. Science and Mgmt Program. If a student's performance falls short of maintaining this SGPA continuously over the semesters, he/she may be advised to leave the program or dismissed from the program.

17 Detailed Curricular Structure

The MSc Env. Science and Mgmt program students are required to complete 20 courses, and a Thesis work. The courses consist of six fundamental courses (equivalent to 18 credit hours), seven environmental management tools courses (equivalent to 18 credit hour), six specialization courses (equivalent to 16 credit hours), elective course (equivalent to 3 credits) and a thesis (equivalent to 9 credit hours). The total credit hour of the program is 64. Students are required to attend classes in the college and take written examinations conducted by the Controller of Examination, PU to be held at the end of the every semester.

CURRICULAM STRUCTURE

Fundamental Knowledge Courses	**(15 Credit Hours)**
ENV 501 Biophysical and Forest Environment	3
ENV 502 Environmental Engineering	3
MGT 501 Environmental Governance, Policy and Legislations	3
SOC 501 Sociology and Cultural Components	3
STT 501 Statistics	3

Environmental Management Tools and Techniques	**(16 Credit Hours)**
ENV 511 Environmental Assessment (IEE, EIA, SIA, SEA)	3
ENV 512 Environmental Management System (LCA, RA, CP, QMS)	3
ENV 514 GIS and Remote Sensing	3
MGT 512 Strategic Planning, Conflict Management and Consensus Building	2
RCH 621 Research Methodology	3
MGT 621 Multi-Criteria Decision Analysis	2

Advanced Courses	**(15 Credit Hours)**
ECO 511 Environmental Economics	3
ENV 621 Urban Environmental Management	3
ENV 622 Climate Change	3
ENV 641 Wildlife Conservation	3
ENV 623 Watershed Management	3

Elective Courses	**(3 Credit Hours)**
EFW 622 Sustainable Forest Management	3
EFW 636 Biodiversity Conservation	3
EFW 637 Watershed Hydrology	3
EFW 638 Population and Environmental Health	3
ENV655 Mountain Environment	3
ENV656 Disaster Risk Management	3

Research and Practical	**15 Credit Hours**
ENV 691 Thesis work	9
ENV 503 Environmental Science Practical (air, water, soil and flora and Fauna	2
ENV 515 Environmental Science Field Work, Case Study, Term Paper	2
ENV 624 Environmental Science Field Work, Case Study, Term Paper	2

POKHARA UNIVERSITY
MASTERS OF SCIENCE IN ENVIRONMENTAL SCIENCE AND MANAGEMENT
CURRICULAR STRUCTURE AND COURSE CYCLE

Semester I			**Semester II**		
Course Code	Course Description	Credit Hours	Course Code	Course Description	Credit Hours
ENV501	Biophysical and Forest Environment	3	ECO511	Environmental Economics	3
ENV502	Environmental Engineering	3	ENV511	Environmental Assessment (IEE, EIA, SIA, SEA)	3
ENV503	Environmental Science Practical (Air, Water, Soil and Vegetation)	3	ENV512	Environmental Management System (LCA, RA, CP, QMS)	3
MGT501	Environmental Governance, Policy and Legislations	3	ENV513	Wildlife Conservation	3
SOC501	Sociology and Cultural Components	3	ENV514	GIS Application and Remote Sensing	2
STT501	Statistics		ENV515	Environmental Science Field Work , Case Study, Term Paper	2
			MGT512	Strategic Planning, Conflict Management and Consensus Building	
		18			18
Semester III			**Semester IV**		
Course Code	Course Description	Credit Hours	Course Code	Course Description	Credit Hours
ENV621	Urban Environmental Management	3	ENV691	Thesis Work	9
				Electives	
ENV622	Climate Change	3	EFW622	Sustainable Forest Management	3
ENV623	Watershed Management Environmental Science	3	EFW636	Biodiversity Conservation	3
ENV624	Field Work, Case Study/ Term Paper	2	EFW637	Watershed Hydrology	3
MGT621	Multi-criteria Decision Analysis	2	EFW638	Population and Environmental Health	3
RCH621	Research Methodology	3	ENV655	Mountain Environment	
			ENV656	Disaster Risk Management	
		16			12

POKHARA UNIVERSITY TYPICAL CURRICULUM FOR MASTERS OF SCIENCE IN ENVIRONMENTAL SCIENCE AND MANAGEMENT

Areas	Courses	Semester
Fundamental Knowledge Courses / Introductory Courses	ENV501 Bio-Physical and Forest Environment	I
	ENV502 Environmental Engineering	I
	ENV503 Environmental Science Practical (Air, Water, Soil and Vegetation)	I
	MGT501 Environmental Governance Policy and Legislations	I
	SOC501 Sociology and Cultural Components	I
	STT510 Statistics	I
Environmental Management Tools and Techniques Courses / Advance Courses	ECO 511 Environmental Economics	II
	ENV 511 Environmental Assessment (IEE, EIA, SIA, SEA)	II
	ENV 512 Environmental Management System (LCA, RA, CP, QMS)	II
	ENV 513 Wildlife Conservation	II
	ENV 514 GIS Application and Remote Sensing	II
	ENV 515 Environmental Science Field Work, Case study / Term Paper	II
	MGT 512 Strategic Planning, Conflict Management and Consensus Building	II
Specialized Courses Research and application in Environmental Management	ENV 621 Urban Environmental Management	III
	ENV 622 Climate Change	III
	ENV 623Watershed Management	III
	ENV 624 Environmental Science Field Work, Case Study / Term Paper	III
	MGT 621 Multi-criteria Decision Analysis	III
	RCH 621Research Methodology	III
	ENV 691 Thesis (Research Work)	IV
Elective Course	ENV651 Sustainable Forest Management ENV652 Biodiversity Conservation ENV653 Watershed Hydrology ENV654 Population and Environmental Health ENV655Climate Change and Mountain Environment ENV656 Disaster Risk Management	IV

Thesis (Research Project)

In the fourth semester of their study period, students are required to undertake a research project and prepare an integrative research report in any areas of environmental science and management as approved by the college/school. The students are required provide a seminar

presentation and attend viva-voce examination organized by the college/school. Detailed evaluation scheme of the research project work is as below. For the evaluation of the research report, the college/school shall appoint internal and external examiners.

Evaluation scheme

SN	Activity	Mark Allocated for Scheduled Submission or Delayed Submission				Marks Obtained
		On Schedule	Late by One Week	Late by Two Weeks	Late by More than Two Weeks	
1	Thesis proposal draft final submission	50	48	44	40	
2	Thesis proposal defense and final submission	25	24	22	20	
3	Literature review submitted for evaluation	50	48	44	40	
4	Primary and secondary data collected and submitted for evaluation	50	48	44	40	
5	Midterm report submitted for evaluation and presentation	100	96	88	80	
6	Draft final report submission and evaluation	100	96	88	80	
7	Thesis defending evaluated	100	96	88	80	
8	Final Report submission and evaluation after incorporating comments	25	24	22	20	
	Total	500	480	440	400	

Evaluation system

1. Serial number 1 to 4 shall be evaluated by the program coordinator and the research guide. Average of the two shall be taken.
2. Serial number 5 to 7 shall be evaluated by an external evaluator 50%, thesis guide 25% and program coordinator 25%.
3. Serial number 8 shall be evaluated by the program coordinator.

ENV 501 Biophysical and Forest Environment

Course Objectives

This course provides concepts of bio-physical and forest components of the environment. Moreover, it enables students to learn relationship between biophysical and forest environments.

Course contents

Unit I: Physical Environment (10 hrs)

Nature and functioning: atmosphere, hydrosphere, lithosphere and biosphere in a specific biophysical environment including: atmospheric processes, climatic components, climatic variation; operation of the water cycle and the role of water in geomorphological processes; parent material, slope processes, weathering, mass movements, erosion, transport and deposition and soil formation; human impacts on the functioning of the atmosphere, hydrosphere, lithosphere and biosphere.

Unit II: Biological Environment (10 hrs)

Biosphere, biological cycle (H_2O, C, N, O, S, P), biotic communities; ecosystem types, function and stress: concepts of ecosystem; homeostasis and structure of an ecosystem, function of ecosystem; types of ecosystem: aquatic, terrestrial, agricultural landscape, food chain, food webs, tropic levels, ecological pyramids, ecosystem energetics, ecological succession, eco-tones, edge effect, adaptation and ecotypes, ecological niche.

Unit III: Forest Environment (8 hrs)

Forest Environment: Forest ecosystem; role of forest in environment; forest resources: forest types and their characteristics; distribution of forest types by ecological zone, forest and livelihood inter linkage; Non-timber forest products and Medicinal and Aromatic Plants (MAPs) and their importance in Nepal

Unit IV: Forest Management (10 hrs)

Forest management of Nepal; concept and current management practices: community forestry, private forestry, leasehold forestry, national forestry, collaborative forestry, : religious forest, protected forests and forests under protected areas; Sustainable Forest Management: sustainable growing stock; site quality; rotation; silviculture system; sustainable yield; Forest resource planning; Forest resource Management Policies, Acts, Rules and Strategies of Nepal.

Unit V: Environmental stress and impact (10 hrs)

Identification and explanation of biophysical issues and their importance in sustainable management of the environment by providing case studies related to:

Atmosphere : greenhouse warming, acid rain and ozone depletion

Biosphere : biodiversity loss, impact and management (ecosystem diversity, species diversity and genetic diversity), biogeography, biomes, ethno biology, endemic and invasive species, forestry and fire

Hydrosphere : river regulation, urban run-off, flood and drought

Lithosphere : soil degradation, soil erosion, salinization, soil contamination and mass movement

Text Books

1. Miller, Jr, T. G. (2004). *Living in the Environment.* Canada: Thompson Learning
2. Odum, E. P. (1971). *Fundamentals of Ecology*. Canada: Thompson Learning

References

1. William A. Leuschner 1984. *Introduction to Forest Resource Management*. John Wiley& Sons
2. MFSC (2005). *Guideline for promotion and development of NTFP*. Ministry of Forest and Soil Conservation.
3. Sharma, V.K. (1986). *Geomorphology, Earth Surfaces, Processes and Forms*. TATA McGrew Hill Publishing Company
4. Hamblin, W.K., Chriseitiansen, E.H. (2003). *Earth's Dynamic Systems*.Jones andBarlettlearning
5. Chapman, J. L., Reiss, M. J. (1998). *Ecology: principles and applications.* CambridgeUniversity Press
6. Chiras, D. D. (2004). *Environmental science: creating a sustainable future*. Jones and Bartlett Publishers
7. Rajbhandari K. R (2001). *Ethnobotany of Nepal*. Ethnobotanical Society of Nepal Publisher.

ENV502 Environmental Engineering (3 Credit Hour)

Course Objectives:

- Introduce the students to the fundamental concepts of environmental engineering;
- Familiarize the students with the engineering solutions to the environmental issues with emphasis on the local environmental issues; and
- Enable students to pursue advance course on environmental engineering.

Course Contents:

Unit I: Introduction to Environmental Engineering (9hrs)

Engineering vs science; air and water pollution concentrations, measurements and unit conversion (standard condition and ppm); waste water engineering; systems, hierarchy and types of systems; material balance; mass/energy transfer and conservation laws; completely mixed system; steady systems; conservative and non-conservative substances; reaction/decay rates; dissolved oxygen (DO); sag curve and related numerical exercises.

Unit II: Environmental Quality Parameters (3hrs)

Environmental quality and pollution; environmental pollution monitoring; water quality parameters (physical, chemical, biological), Air quality parameters, Noise quality parameter.

Unit III: Water Pollution Treatment (12hrs)

Physical processes: Screening; sedimentation, Stoke's Law; filtration; aeration; chemical processes: chemical precipitation; adsorption; disinfection; biological processes: objectives of biological treatment; introduction to microbial metabolism; role of microorganisms; carbon and energy sources; biological oxidation; nutritional requirement for microbial growth; growth kinetics; Monod's theory; stages of microbial growth; effects of endogenous metabolism; effects of pH &temperature; numerical exercises.

Unit IV: Air Pollution Control (9hrs)

Types of air pollution and air pollutants; origins, properties, effects & natural removal mechanisms of key air pollutants**;** chemical species of particulate pollutants; air pollutant concentration prediction models; air pollution control technologies/devices

Unit V: Noise Pollution Control (6hrs)

Types & sources of sound/noise; role of frequency in noise pollution; equivalent noise level & noise level prediction/addition; effects of noise on people; noise control techniques/approaches

Unit VI: Solid and Hazardous Waste Management (9hrs)

Sources, types, composition & properties of municipal solid waste (MSW); integrated management of MSW; sources, types and properties of hazardous waste; integrated management of hazardous wastes; state of waste management in Nepal including various initiatives in policy, plan, and strategy level and legislation and institutional development.

Text book:

1. Peavy, H. S., Rowe, D. R., Tchobanoglous, G. (1985).*Environmental Engineering*. McGraw-Hill International Editions
2. Davis, M. L., Cornwell, D. A. (1998) *Introduction to Environmental Engineering*. McGraw-Hill International (3rd Edition)
3. Weiner, R. F., Matthews, R. A. (2003). *Environmental Engineering.* Butterworth-Heinemann

References:

1. La Grega, M. D., Buckingham, P. L., Evans, J. C. (1994).*HazardousWaste Management*. McGraw-Hill Inc.
2. Tchobanoglous, F. L. (1991).*Wastewater Engineering: Treatment, Disposal and Reuse.*Tata McGraw-Hill, New Delhi
3. De Nevers, N. (2010). *Air Pollution Control Engineering(2nd Edition)*. McGraw- Hill International Editions.
4. Bishop, P. L. (2000). *Pollution Prevention: Fundamentals and Practice*. McGraw Hill International Edition
5. Solid Waste Management Act, 2068 BS and Solid Waste Management Rules, 2070 BS
6. Tchobanoglous G., Theisen H., Vigil S. A. (1993).*Integrated Solid Waste Management (Engineering Principles & Management Issues)*. McGraw-Hill International Editions, New York

ENV 503 Environmental Science Practical (3Credit Hours)

Air and noise

1. Determination of concentration of PM_{10},$PM_{2.5}$, TSP, SOx, NOx in the sample of ambient air acquired using the High Volume Sampler.
2. Noise measurement using noise meter.

Water:

1. Determination of primary production in an aquatic system.
2. Physical and chemical parameters analysis of water sample -temperature, transparency, pH, conductivity, turbidity, TS, TDS, EC, dissolved oxygen, BOD, hardness, alkalinity, chloride.
3. Water flow and discharge measurement.
4. Determination of water quality parameters by gravimetric, volumetric & colorimetric analysis method/s
5. Biological parameters analysis of water sample – COLIFORM,

Soil and rocks

1. Measurement of slope, elevation, aspect of terrain.
2. Soil sampling and sample collection for laboratory analysis -pH, organic Matter, Available Nitrogen, Phosphorus, Potassium.
3. Determination of soil types by textural analysis.
4. Identification of rock types.

Flora and Fauna

1. Enumeration of floral and faunal diversity using different sampling techniques such as quadrate, transect, and point count.
2. Determination of primary production in terrestrial system.
3. Determination of secondary production
4. Assessments of floristic composition of terrestrial ecosystem, eg. DBH, height, frequency, biomass, density, cover of forest and vegetation mapping.
5. Determination of biodiversity in grassland and forest ecosystem. and altitudinal biodiversity gradients
6. Classification of animals through tropic dynamic analysis – species diversity, similarity and heterogeneity.
7. Study about interdependency of living organisms through food chain in grassland or forest ecosystem.

MGT 501 Environmental Governance Policy and Legislations (3 Credit Hours)

Course Objectives:

- Provide concepts of policies, laws and institutions related to Environment
- Equip the students with a knowledge on the relevant linkages
- Enable the students to learn the advanced topics on the subject

Course Contents:

Unit I: Introduction (9 hrs)

Overview of global environmental issues, Human dimension and environment, Global environmental governance, Major elements of environmental governance (participation, transparency, accountability and governance norms) and Key steps adopted for global environmental governance, Evolution of People's Participation in environment-related policy process, Environmental diplomacy and creative environmental diplomacy, North-South Co-operation and equity concerns

Unit II: Initiatives for Environmental Management - Policies, Plans and Strategies (12 hrs)

Global Initiatives: Agenda 21, Johannesburg Declaration on Sustainable Development, Rio+20, Millennium Development Goals (MDG) and Sustainable Development Goals (SDG) of UN, Other major legally non-binding Environmental Instruments.

National Initiatives: Evolution of Environmental Policy, Major National Environmental Policies, Plans and Strategies, Implementation Status of the selected global legally non-binding Environmental Instruments including MDGs in Nepal.

Unit III: Environmental Laws (6 hrs)

Principles of International Environmental Law, Major National Environment Laws, Environmental crime/pollution control laws, Enforcement and Compliance of Environmental Law, Role of Judiciary for Protection of the Environment

Unit IV: International Environmental Instruments: (9 hrs)

Legally-binding Environmental Instruments, Salient Features of the Selected Environmental Conventions, Nepal's Participation on Legally-binding Environmental Instruments

Unit V: Policies and Laws to Address Climate Change (3 hrs)

*International legal initiative:*UNFCCC and associated protocols/agreements;

National initiatives: Climate Change policy, adaptation and mitigation policies and laws

Unit VI: Trade and fiscal Laws for Environmental Management (3 hrs)

International Trade related instruments and Environment, Intellectual property and environment, Economic instruments for environment protection and Payment for Ecosystem service policies

Unit VII: Environmental Institutions (6 hrs)

International Environmental Institutions and their roles in Environmental Management: International Environment-related Institutions (UNEP, SARCC, SACEP, ICIMOD, IUCN, WWF and others) and their major responsibilities.

National Environment-related Institutions: Advisory bodies (such as NPC, EPC), Policy-making bodies (such as Parliamentary committee on Environment and Ministries), local bodies; NGOs/CBOs, Community Users Group and their roles in Environmental management.

Text Book

1. Khadka, R.B., and Shrestha, U.S. (2010). *Environmental Governance and Diplomacy: an introduction*. Lambert Academic Publications

References:

1. ADB (1986).*Environmental Planning and Management*. Asian Development Bank (ADB), Manila
2. Dahal, M.K. and Dahal, D.R. (1993). *Environment and Sustainable Development: Issues in Nepalese Perspective*. Nepal Foundation for Advanced Studies.
3. EPC (1993*). Nepal Environmental Policy and Action Plan*.EPC, Kathmandu, Nepal.
4. NPC/IUCN (1991).*Legislative and Institutional Framework for Environmental Management in Nepal*. National Planning Commission, Government of Nepal, IUCN
5. WECS (2002). *Water Resources Strategy Nepal.*Water and EnergyCommission Secretariat (WECS), Government of Nepal, Kathmandu, Nepal.
6. MoSTE(2011). *Climate Change Policy*.Ministry of Science, Technology and Environment(MoSTE), Government of Nepal, Kathmandu, Nepal.
7. MoSTE(2011*). NAPA and PALA*. Ministry of Science, Technology and Environment (MoSTE), Government of Nepal, Kathmandu, Nepal.
8. MFSC (2002). *Nepal Biodiversity Strategy*. Ministry of Forests and SoilConservation, (MoFSC), Government of Nepal
9. MOPE (1998).*Environment Protection Acts and Environment Protection Regulations*. Ministry of Population and Environment (MOPE), Kathmandu, Nepal
10. NPC, IUCN (1988). *Building in Success, National Conservation Strategy.*National Planning Commission (NPC) Government of Nepal

SOC501 Sociology and Cultural Components (3 Credit Hour)

Course Objectives:

- Provide concepts of sociology and cultural aspects of the environment
- Equip the students with a knowledge on the linkages between the social components and environmental attributes,
- Enable the students to learn the advances in Sociology and diversity.

Course Contents:

Unit I: Human Ecology (6 hrs)

Anthropology and concept of culture, cultural ecology and system perspective in human-ecology, recent trends.

Unit II: Demography (8 hrs)

Population and resources, nature and scope of demography, population processes, interrelationship of population and resources, different viewpoints, illustrative study from Nepal, gender and development: concept of gender, approaches in development issues, women and natural resources management.

Unit III: Environmental Ethics, Tradition and Religion (8 hrs)

Role of culture in conservation and management, ethics, religion and environment, culture and biodiversity conservation, tragedy of the commons, reconciling conservation and development, issues on Himalayan environmental degradation.

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Unit IV: Community structure, Participation and local planning (14 hrs)

Social/community structure, caste and caste like systems, symbolic capitals, ethnic groups and boundaries, participatory development and environmental management: emergence of the concept, people's participation in development, participatory management of resources, community organization: past and present, traditional socio-economic organizations, new organizations and groups; forest user groups and other groups.

Unit V: Indigenous people and Knowledge (12 hrs)

Indigenous knowledge and its importance for conservation and development, ethno-science (ethno ecology/ethno biology), indigenous people and intellectual property rights, indigenous people and conservation.

(Field visit to traditional human community at least for whole day and learn from their behavior to be carried out during the 2 semester field work component)

Text Book:

1. Berkes, F., Folke, C., Colding, J., (2000).*Linkingsocial and ecological systems: management practices and social mechanisms for building resilience.*Beijer International Institute of Ecological Economics, The Royal Swedish Academy of Sciences.

References:

1. Hardesty, D. L. (1977). *Ecological Anthropology*. John Wiley and Sons
2. Milton, Kay (1997).*Ecologies: Anthropology, Culture and Environment*. International Social Science Journal, 49(4): 477-495
3. Social Survey Method: Afield guide for development workers; Oxfam, 1991

STT501 Statistics **(3 Credit Hour)**

Course Objectives:

- Provide knowledge on application aspects of statistics and quantitative analysis
- Develop skills in using the statistical tools for research and development
- Enable the students to learn the advanced topics on the subject

Course Contents:

Unit I: Random Variable and Theoretical Distribution (6hrs)

Concept of variable, Types of variable, random variable and mathematical expectation, Probability Distribution: Binomial distribution, Poisson distribution and Normal distribution.

Unit II: Correlation and Regression (9hrs)

Concept of correlation, Karl Pearson's Coefficient of Correlation, Concept of simple regression, Multi-variate correlation and regression: Partial correlation Coefficient, Coefficient of Partial Determination, Multiple correlation, Coefficient of Multiple Determination, Multiple Regression Analysis, Multivariate analysis

Unit III: Linear and Non-linear Model (8hrs)

Unit IV: Sampling (10 hrs)

Objective of Sampling, Census vs. Sample survey, Methods of Sampling: Simple Random Sampling, Stratified Sampling, Cluster Sampling, Multi-stage sampling, Sampling and Non-sampling Errors. Sampling Distribution, Standard Error, Use of Standard Error.

Unit V: Estimation (8 hrs)

Point Estimate, Interval Estimate, Confidence Interval Estimate of the Population Mean, and Confidence Interval Estimate of the Population Proportion.

Unit VI: Testing of Hypothesis (7 Hrs)

Concept of Hypothesis, Types of hypothesis, Types of Error, Testing of Hypothesis for Large Samples (z-test), Testing of Hypothesis for Samples (t-test), F-test and Analysis of Variance: one way Analysis of Variance, Two way Analysis of Variance, Chi Square Test: Test of Goodness of Fit, Test of Independence of Attributes.

References:

1. Berthouex, P. M., Brown, L. C.(2010). *Statistics for Environmental Engineers*. Lewis Publishers.
2. Manly, B. F. J.(2000).*Statistics for Environmental Science and Management*. CRC press.

ECO 511 Environmental Economics (3 Credit Hours)

Course Objectives

The objectives of the course are to

- Enablestudents to understand the environmental economics and gain knowledge of natural resource and environmental economics.
- Make students capable to apply the tools of the economics in environmental decision making processes.

Course Contents

Unit 1: Introduction (2 hrs)

Introduction of environmental economics, sustainable development, environmental degradation, population and economic growth, natural resource management, environmental ethics, externality

Unit 2: Cost Benefit Analysis (6hrs)

Environment Cost Benefit Analysis, Expected-Value Calculations, Types of Efficiency: Allocative Efficiency, Production Efficiency, Distributive Efficiency, Supply and Demand,

Unit 3: Sustainability: A Neoclassical View (6hrs)

Introduction, measuring sustainability: net national welfare, natural capital depreciation, future benefits, costs, and discounting, an example of discounting, choosing the ‘‘right’’ discount rate for pollution control, social discounting versus market discounting

Unit 4: Role of Government and Market Failure (6hrs)

The meaning and purpose of government, the role of government, governmental solutions to market failure imperfect competition, imperfect information, externalities, public goods, property right and the environmental right.

Unit 5: Market Allocation and Pollution (6hrs)

Economic and regulatory instruments to control pollution, market allocation of pollution, different economic and regulatory instruments of pollution reduction.

Unit 6: Trade-offs and the Economy (6hrs)

Trade-offs between present, and future, discount future benefits, discount future costs, dynamic efficiency, present-value calculations, and discount rates.

Unit 7: Valuation Biodiversity and Environmental Quality (6hrs)

Biodiversity loss, models of biodiversity loss, cost-benefit applications, valuing costs and benefits, types of values, measures of value, economic values of environment and non-marketed valuation method, conventional economic valuation and the environmental valuation, economic growth and the environment vis-à-vis sustainability.

Unit 8: Environmental Policy (4 hrs)

Command-and-control regulations, incentive-based solutions, market approaches to automobile externalities around the world, tradable emissions rights: a two-firm pollution model, tradable emissions rights, in practice, mixed approaches to carbon, emissions in china and the united states.

Unit 9: Resource Accounting (2 hrs)

Resource accounting, resource accounting in Nepal and its recent development.

Unit 10: Population, Poverty, and Economic Growth (4 hrs)

Population growth and resource scarcity, Thomas Malthus, the economics of population growth, poverty, and other determinants of waste, the growing problem of municipal solid waste, demographic trends and the determinants of waste, economic growth and the environment (special reference to Nepal)

Text Book

1. Anderson, D A. (2010). *Environmental Economics and Natural Resource Management*. Park Square, Milton Park, Abingdon, Oxon, OX14 4RN, New York, USA.

2. Goodstein, E. S. (2011). *Economics and the Environment.* JOHN WILEY & SONS, INC, Printed in the United States of America.

References

1. ADB (1996). *Economic Evaluation of Environmental Impacts – A Workbook.* Environment Division, Asian Development Bank, Philippines
2. Field, B. C.,(1994). *Environmental Economics – an introduction*. McGrawth-Hill, Singapore.
3. Von Rabenau, B., (1993). *Project Financial Analysis forPhysical Planners*. GTZ/DHUD/MHP, Kathmandu/Nepal and Columbus, Ohio/ USA
4. IUCN-Nepal (1998). *Environmental Economics in Nepal*, *Proceedings of Workshops on Environmental Economics 12*. March and 28 October 1998, IUCN-Nepal.

ENV 511 Environmental Assessment (IEE, EIA, SIA, SEA) (3 Credit Hours)

Course Objectives:

- To provide in depth knowledge on concepts, theories and methods of Environmental Assessment
- To develop students' skill in carrying out or critically reviewing the reports of IEE, EIA and SEA etc.

Course Contents:

Unit I: Introduction of EIA and Sustainability (4 hrs)

Policy, legislation, regulations, standards; international conventions, obligations and local Agenda21.

Unit II: Environment Assessment and Management (6 hrs)

Introduction to Scoping, IEE, EIA, SIA and SEA, Trends of EIA in developing countries, EIA principles and procedures, EIA and the project management, Cumulative and sector specific EIA, ISO-14000 series and Environmental Management System, Life cycle analysis and Eco-audit, EIA process in Nepal as per EPR (1997).

Unit III: EIA Tools and Methods (16 hrs)

Screening /scoping, and TORpreparation, data collection, compilation and interpretation, impact identification and analysis of significance, environmental monitoringand auditing, environmental management plan and EIA report review process, use of GIS and computer softwarein EIA studies, and writing of EIA reports.

Unit IV: Strategic Environmental Assessment (SEA) (8 hrs)

Definition and perspectives of SEA, application of SEAin decision-making: integrated planning, socio-economic assessment,usefulness of SEA; field of application, screening process, relation of SEAwith EIA: EIAbased process, comparison with other tools incorporation of SEAin decision-making: pre-requisite for SEA, formal and non-formal processes, types of SEA, scope of SEA.

Unit V: Process and Procedures (8 hrs)

Role of public and environmental agencies/authorities in the SEA process, SEA procedures, Linkage of EIA with SEA, SEA report quality and review mechanism.

Unit VI: Methods and Techniques of SEA (6 hrs)

Preparation of SEA studies, alternative at strategic level, identification and analysis of impacts in sea, dealing with uncertainties, analysis of cumulative impacts, analysis of effects on sustainabledevelopment.

Text Book:

1. Khadka, R B, Gorzula, S., Joshi, A.R., Mathema, A. B. (2012). *Environmental impact Assessment (EIA)- Process procedure and Practice of South Asia (Nepal, India, Bangladesh and Bhutan)*. SchEMS, Kathmandu

References:

1. Canter, L. W., (1999).*Environmental Impact Assessment.*CRC Press LLC
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu. (1997). *Environmental Impact Assessment for Developing Countries in Asia. Volume 1 - Overview.* 356 pp.Asian Development Bank (ADB).
3. NPC, IUCN, (1992).*National EIA Guidelines 1993*. National Planning Commission, Government of Nepal, IUCN

ENV512 Environmental Management System (3 Credit Hour)

Course Objectives:

- To provide concepts, theories and methods of various EMS tools.
- To enable the students to acquire skills in using these tools.
- To enhance the knowledge of the students in critically reviewing EMS reports.

Course Contents

Unit I: Introduction (2 hrs)
Environmental management system and tools

Unit II: Life Cycle Assessment (8hrs)
Overview, history, LCA types, principles of LCA, LCA methodology, simplified LCA,application of LCA.

Unit III: Quantitative Risk Assessment (8hrs)
Human health risk assessment, ecological risk assessment, role of risk assessment in environmental management decision.

Unit IV: Quality Management System (12hrs)
Evaluation of organization and products, ISO 9000, ISO 14000 and ISO 18000, environmental performance evaluation, environmental auditing, activities in Nepal.

Unit V: Cleaner Production (10hrs)
Cleaner production and cleaner development mechanism, Principles of CP, environmental labeling, eco-design, CP activities in Nepal.

Unit VI:International and national Initiatives: (8hrs)

Text Book:

1. Wenzel et al. (1997), *Environmental Assessment of Products*. Chapman and Hall

References:

1. La Grega, M. D., Buckingham, P. L., Evans, J. C. (1994) *Hazardous Waste Management*. McGraw Hill Publication
2. Bishop, P. L. (2000) *Pollution Prevention: Fundamentals and Practice*. McGraw Hill International Editions.

ENV 514 GIS and Remote Sensing (3 Credit Hours)

Course Objectives*:*

1. to impart knowledge on Geographic Information System (GIS) and Remote Sensing,
2. To make the students able to acquire and manage spatial data and geodatabase and analyze for the purpose of planning and decision making in the environmental sector imparting clear concept on national geographic information infrastructure and GIS project modeling and implementation.

Upon the successful completion of training, participants will be able to:

1. Create, analyze and visualize the spatial data in solving environmental problems
2. Model components of Environmental phenomena in GIS
3. Design GIS based environmental project

Course Contents:

Unit I: GIS introduction and components, history, GIS operations and applications (4hrs)

Unit II: Coordinate systems and projection, projection properties and type, geo referencing (4hrs)

Unit III: Data and modeling (4hrs)
Vector and raster, simple features, topological and non-topological data, object-oriented data model, rules and geographic behavior, elements of raster data model and types, TIN and DEM, digital ortho photos, raster data structure, compression and conversion, spatial data base design.

Unit IV: Spatial data acquisition (4hrs)
Scanning and digitization, introduction and principles of remote sensing, electromagnetic spectrum, energy interactions, spectral signature and atmospheric windows, types of remote sensing, sensor and orbits, radiometric correction, image enhancement, geometric correction, visual interpretation of satellite image, classification of satellite image, change detection and land cover mapping using satellite images, GPS, segments, errors and GPS data processing, using aerial photographs, concept on land resources data.

Unit V: Data Editing and management (4hrs)
Concepts of errors and accuracy, data standards, topological data editing, Non topological editing, attribute data types, attribute data entry, field manipulation, geometric calculation (coordinates, length and area).

Unit VI: Spatial data analysis (4hrs)
Measurement, buffering, retrieval and classification functions, overlay, neighborhood, and connectivity functions, seek and spread computations, distance and density mapping.

Unit VII: Spatial data visualization (4hrs)
Typography, theme of map design, map design, Map layout cosmetics, Map production.

Unit VIII: Terrain Mapping and Analysis (4hrs)
Digital terrain model (DTM), Slope, aspect, Hill shade, view shed analysis

Unit IX: GIS Models, Modeling and simulation (4hrs)
Model concepts and types, system, process models, index and binary models, simulation in GIS, watershed modeling, hydrology modeling, flood modeling, application of GIS in environmental modeling, application of GIS in bio-diversity data management system

Unit X: GIS System Development Process (4hrs)
Environmental project planning; project requirement analysis and needs assessment, GIS project development for environmental sector, data sharing and partnership, spatial data infrastructure, clearinghouse, components of NSDI, SDI status in Nepal, GIS development in Nepal;

Computer Laboratory Exercise (8 hrs)
Introduction to GIS software and concept on data preparation, software anatomy, interface and available platform, concept on project , data frame and data file and layersconcept of metadata, how to use GIS for creating spatial project and visualize the given set of data.

Spatial Data modeling, data acquisition from the field based on ground surveying (a sample of already collected data shall be used), Data acquisition using GPS, Data acquisition based on Remote Sensing imagery (Sample image shall be used for visual interpretation), How to use aerial photograph, Adding attributes to the data acquired, Applying the appropriate coordinate system to the data acquired

Digitization of Map Features
Database modeling in GIS, digitizing map features (using scanned image), adding attributes to polygon features, line themes and polygons, topology and its characteristic in geospatial database, topological editing spatial data in Arc GIS, Adding the GPS acquired data over the existing map and visualize them

Attribute Manipulation and Basic Queries
Introduction and modify tabular data, link tables and performs basic queries, summarizing tables table display, joining and linking the spatial database with the other attribute set, hotlinks

Map Projection and Coordinate Transformation
Map coordinate system: geographic and projected coordinates, transformation of coordinate system (why necessary?), types of projection system and changing from system to the other, map projection selection, define projection (assigning the projection properties in the existing spatial data), set a data frame's map projection, GPS relevant table creation, plotting of GPS data into maps.

Datum transformation
Projecting the GPS data into the suitable projection system, coordinate conversion from metric to decimal degree and vice versa, changing the data from one projection to the other on, geo-referencing an image in ARCGIS (image to image registration and draping of geo-referenced image over the existing vector data set).

Spatial Query and Measurement Operation (Vector-based)
Point measurement (Automatically calculating X and Y coordinates), line measurement (automatically calculating lengths), polygon measurement (automatically calculating area and perimeters), geometric selection , attribute selection, statistics of selection, save selected feature, spatial query based on the selected features, clip, intersect, union, buffer operations, suitability analysis using vectors model

Map Printing
Map layout design, editing layout component, printing the layout component

Applying GIS with case studies
Interpolation of contour data for DEM generation, slope and aspect calculation, view shed calculation, water inundation area calculation, interpolation of temperature and rainfall data, mapping meteorological information in GIS environment, hydrology modeling,, flood modeling , mapping the effect of climate change using GIS, estimation of water volume caused by dam construction water volume storage, suitability analysis using raster data model, analyzing habitat patches using GIS, noise pollution modeling

Exploring web based resources through available portal
Google earth and google maps: loading your map over google earth, getting the data traced in google earth to your GIS, geo-portal, NSDI portal, geo-node

Text Books:

1. Huisman, O., de By,R. A., (2009). *Principles of Geographic Information System*. Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, The Netherlands
2. Templi, K., Kerle, N., Huurneman, G. C., Janssen, L. L. F., (2009). *Principles of Remote Sensing*. Faculty of Geo-Information Science and Earth Observation (ITC) , University of Twente, The Netherlands

References:

1. Chang, K. (2010).*Introduction to Geographic Information Systems*. TATA McGraw-Hill edition.

ENV 515 Environmental Field Work, Case Study/ Term Paper (2 Credit Hours)

Economics:

1. Visit the nearby terrestrial ecosystem and enumerate the environmental resources with certain economic value for them including
2. Visit the plant or animal resource based industry and prepare report on its contribution in economic growth

Environmental Assessment:

1. Complete field based exercise on:
   a. Point project
   b. Band project
   c. Report writing
   d. Presentation
2. Field visit to any physical infrastructure construction site and identify the different types of impacts on environment (e.g. Hydropower, Irrigation Projects)
3. Research project in solid waste illustrating:
   a. Collection
   b. Dumping at transfer site
   c. Segregation
   d. Final Dumping at the land fill site.
4. Field visit for the demonstration of waste water treatment projects and sanitary waste landfill site

Environmental Management System

1. Demonstration in industrial estate
   a. EMS application
   b. LCA
   c. Industrial Process
   d. Certification

2. Case Study on study about life cycle assessment (LCA) of cement factory and prepare report

Ecosystem Services Management:

1. Field Visit, Case studies and project work on following topics

- Listing of ecosystem services of any National Park and Buffer Zone
- Analysis of ecosystem services tradeoffs of any National Park and Buffer Zone
- Valuation of ESs of any National Park and Buffer Zone
- Assessment of human environmental system of any local cultural and religious site
- Assessment of cultural ecosystem services of any local cultural and religious site
- Development of PES mechanism for provision of water service considering Shivapuri

National Park and Buffer Zone as service provider and inhabitants of Kathmandu as service receiver

GIS:

1. Visual interpretation of panchromatic aerial photographs and separation of forest, water, human used land
2. Visual characteristics of water, soil and vegetation from multiband images
3. Use GPS and GPS data; transformation and projection
4. GIS modeling for early warning system, watershed modeling, wildlife habitat modeling, snow cover

Note: For a course in a semester there must be two days field Visit excluding the reporting time.

MGT512 Strategic Planning and Conflict Management and Consensus Building (2 Credit Hours)

Course objectives:

- To provide a clear understanding of topics in relation with environmental management
- To let the students familiarize with the participatory approach.
- To develop the skills of the students in understanding and critically analyzing the literature, proposals, projects and models related to the subject matter.

Course Contents:

Unit I: Strategic Planning and Project Cycle Management (6hrs)
Introduction, evolution, concept and application, approach, elements, benefit; PCM method, background, advantages and issues.

Unit III: Situation Analysis Method (6hrs)
Main steps of analysis - participation, problems, potentialities, objectives, alternatives and project selection.

Unit IV: Project Planning Method (8hrs)
Project design matrix – objectives hierarchy, performance indicators, means of verification, important assumptions/risks and preconditions, inputs; plan of operation and project evaluation.

Unit V: Participatory Rapid Appraisal (8hrs)
Philosophy and values, evolution, application, PRA vs. other research methods, PRA - main tools and techniques, possible dangers, do's and don'ts by facilitators, PRA report writing.

Unit VI: Conflict Management (4hrs)
Concept and definitions, conflict analysis – stages, cycle; conflict management process, conflict handling styles, negotiation process.

References:

ENV 641 Wildlife Conservation (3 cr hr)

Course Objectives

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

- understand fundamentals of invertebrate and vertebrate taxonomies
- understand the fundamentals of wildlife ecology including wildlife habitat, behavior, population structure and dynamics
- learn different wildlife techniques on food assessment, habitat suitability analysis, wildlife census techniques, and viability of animal population
- learn different approaches to wildlife conservation
- understand practices of wildlife conservation and management in Nepal

Course Contents

Unit I: Introduction (8 hrs)

1.1 Invertebrates taxonomy and diversity

1.2 Vertebrate taxonomy and diversity: Fishes and ectotherms (amphibians, reptiles); Birds and mammals (carnivores, hooved mammals, primates); Vertebrates of Nepal

Threats to wildlife (HIPPO concept), biodiversity crisis (Anthropocene Threats, causes and threatening process

2 Threatened species: IUCN RED List Category and Assessment procedures

3 Wildlife endangerment and extinction---extinction crisis; characteristics of extinction prone species; and mass extinction

1.3

1.4 Need and importance of wildlife conservation and management

Unit II: Wildlife Ecology (8 hrs)

2.1 Wildlife Habitat: Concept of habitat and ecological niche, habitat triangle (food, cover and water)

2.2 Wildlife Behavior: Teritoriality and resources selection (diet, patch and mate choice), risk-sensitive habitat use

2.3 Population structure and dynamics: Population characteristics, population dynamics (metapopulation and source-sink dynamics), population growth (growth models) and regulation of population size

2.4 Predator- prey relationship, theories and models of predation

Unit III: Wildlife Study Techniques (10 hrs)

Forage: Food and nutrition; foraging theory

3.1 Diet analysis techniques of carnivores and herbivores

3.2 Evaluation habitat quality and suitability (habitat suitability index), carrying capacity bnd habitat improvement

3.3 Population - Population dynamics, Estimating abundance (absolute and relative abundance), wildlife censuses techniques

3.4 Methods to assess survival rates and the viability of animal populations (ecology, ecological role and behavior of Tiger, elephants etc. on Viability Analysis, PVA), population projection models

3.5 Wiildlife behavior: Forage selection; habitat selection theories and measures, Social organization and mate choice

Unit IV: Wildlife Conservation Approaches (12 hrs)

4.1 Habitat improvement and management, corridor and connectivity, control and management of invasive species
4.2 In-situ conservation
4.3 Ex-situ conservation: Captive- breeding and reintroduction, translocation
4.4 Population management: Small population, declining population, metapopulation management, optimum harvest and population management
4.5 Species management: Single species and multi-species, species conservation action plan
4.6 Ecosystem and landscape management

Unit V: Wildlife Conservation in Nepal (10 hrs)

5.1 Practices of wildlife conservation
5.2 Wildlife -human interactions
5.3 Wildlife Tourism
5.4 Measures to curb poaching: role of the army, park-based antipoaching units, community-based antipoaching operations, wildlife crime investigation
5.5 Wildlife conservation/management policies

References

1. Bolen, E.G. and Robinson, W.L. (2003). Wildlife ecology and management. 5th ed. Prentice Hall. New Jersey.
2. Groom, M., Gary, J., Meffe, K., and Carroll, C. R. (2006). Principles of conservation biology. 3rd ed. Sinauer Associates, Inc., Sunderland, USA.
3. Krebs, CJ. (2014). Ecological methodology. Addison-Wesley Longman Publication.
4. Sodhi, N.S. and Ehrlich, P.R. (2010). Conservation biology for all. Oxford University Press, New York. http://www.mongabay.com/conservation-biology-for-all.html.
5. Sutherland, W. (2006). Ecological census techniques. Cambridge.

ENV 621 Urban Environmental Management (UEM) (3 Credit Hours)

Course Objectives:

- To provide an overview of urban planning, urbanization process and address the issue of sustainability in cities;
- To make the students understand the problems of urban environmental management;
- To make the students familiar with the urban infrastructures essential to manage the UEM problems;
- To demonstrate the UEM problems and prospects in the context of Nepal.

Course Contents:

Unit I:Basic Concepts and Issues and Problems (6hrs)

Rural and urban areas; urban environment; urban environmental planning and management; sustainable and inclusive cities; built environment; green building; and environmental problems and issues in urban areas of Nepal.

Unit II: Sustainable Urbanization (6hrs)

Urbanization and its impacts on environment; urbanization in Nepal; sustainable development, resource region and sustainable cities, national urban system - spatial planning and integration andrural-urban linkages; bioregionalism, carrying capacity and ecological footprint; and strategies for sustainable urbanization

Unit III: Land-Use Planning and Nepal's Experience in Housing and Urban Development (6hrs)

Land-use, land policy and administration; perspectives on land, evolution of land-use planning, urban land-use pattern; heritage sites, open space, and greenery; land development in Nepal – site and services, guided land development (GLD) and land pooling projects; environmental assessment and methods of urban planning; integrated action planning; apartment housing and environment; and national housing and urban policy of Nepal.

Unit IV: Urban Infrastructure (6hrs)

Changing modes of infrastructure provision; infrastructure planning and business plan; health and environment – water and sanitation, and drainage and solid waste management; transportation - traffic management andsustainable urban mobility, and integration of land use planning and transport management; building system and energy consumption; and air and noise

pollution. 6 hours

Unit V: Safer Cities and Climate Change (6hrs)
Climate change and cities - causes andconsequences; adaptation and mitigation measures; urbanization and climatechange; risk sensitive land-use planning; and climate change and sustainableurban development.

Unit VI:Urban Governance (6hrs)
Concepts of inclusive urban development; key players of urban governance and their mobilization; community participation;privatization and public private partnership.

Unit VII: International Context and Nepal's Experience (6hrs)
HABITAT II; Agenda 21; sustainable cities programs; urban management programs; healthy cities and eco-towns; and relevant emerging concepts and issues. 6 hours

Unit VIII: Preparation of an Action Program for UEM of a town in Nepal with field investigation as required and Workshops Presentation (6hrs)

Text Book:

1. Joshi, Jibgar (2011). *Managing Environment and Cities for Sustainable Development*. Lajmina Joshi, Kathmandu.

References:

1. Mitlin, Diana and David Satterthwaite. *"Cities and Sustainable Development"background paper.* Global Forum '94, Manchester, 1994.
2. Price, Charles and A. Tsouros., eds. 1996. *Our Cities, Our Future: Policies and Action Plans for Health and Sustainable Development*. Copenhagen: Healthy Cities Project Office.
3. Rees, W. and M. Wackernagel (eds.) 1994. *"Ecological footprints and appropriated carrying capacity: measuring the natural requirements of the human economy" in Increasing in Natural Capital: the Ecological Economics Approach to Sustainability*. Washington: Island Press.
4. Resources 1996–97. New York/Oxford: Oxford University Press.
5. Rodney R. White *Urban Environmental Management: Environmental Change and Urban Design*. John Wiley & Sons, Chichester, 1994.
6. UNEP. *Agenda 21*: Chapter 7. 1992.
7. UNCHS. *The Habitat Agenda 1996* (*Sustainable human settlements development in an urbanizing world*).
8. World Bank. 1996. *Livable Cities for the 21st Century.* Washington D. C. The World Bank, 2012. Urban Growth and Spatial Transition, an initial assessment-Nepal. April 2012.
9. WRI(1996). *The Urban Environment*, A Special Reprint from World.
10. Joshi, Jibgar (2009). *Regional Strategies for Sustainable Development in Nepal*,

Kathmandu: Lajmina Joshi.
11. Joshi, Lajmina. 2001. *"Understanding Development from Human and Ecological Perspectives: The management of bio-regional resources in Jha,* P. K., and others, eds., Environment and Agriculture: Biodiversity, agriculture, and pollution in South Asia. Kathmandu: Ecological Society (ECOS), Nepal.

ENV 622 Climate Change (3 Credit Hours)

Course Objectives

- To impart understanding on the drivers of climate change and its consequences on various sectors like health, energy, food security, agriculture;
- To familiarize student with the climate change indicators and the models used to predict climate change scenarios;.
- To familiarize student with the societal concerns and implication of climate change,
- To make student capable undertake risk, hazard, vulnerability assessment of the climate.

Course contents

Unit 1: Understanding Climate system and Climate change (8hrs)

Concept on climate system, defining concepts and terminologies, theories and drivers of climate change, climate change indicators, climate modelling

References:

- Cowie, J. (2009).*Climate Change: Biological and Human aspects*. University Press, Cambridge, ISBN 978-0-521-87399-4.
- Tippal, B.S. (2013). *The DBS Handbook of Climate Change*. DBS imprints, ISBN: 978-81-92372-89-1.
- IPCC, (2007).*Climate Change: Synthesis Report*

Unit 2: Greenhouse gas, global warming and climate change (5hrs)

Introduction, greenhouse effect andglobal warming, global warming potential, climate change and energy

Practical exercise: short field visit focusing on application of any alternative energy sites(hydropower, waste water treatment plant, farming site, bioenergy).

References:

- Dawson, B., Spannagle, M. (2009).*Thecomplete guide to climate change*. ISBN 0-203-88846-4
- Garnaut, R (2008).*The Garnaut Climate Change Review: Final Report.* Cambridge

University Press. (available at www.garnautreview.org.au/2008-review.html)
- National CO_2 emissions from fossil-fuel burning, cement manufacture and gas flaring 1751-2008, available atcdiac.ornl.gov/trends/emis/tre_coun.html
- Tippal, B.S. (2013).*The DBS Handbook of Climate Change*. DBS Imprints, ISBN: 978-81-92372-89-1.
- Timothy, J. W, Srinivasan, J., Nielsen, O. J. and Highwood, E.J. (2004). *GREENHOUSE GASES AND GLOBAL WARMINGin Environmental and Ecological Chemistry[Ed. AleksandarSabljic] inEncyclopedia of Life Support Systems (EOLSS) Developed under the Auspices of the UNESCO*. Eolss Publishers, Oxford ,UK, [http://www.eolss.net]
- IPCC (2007). *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by S. Solomon, et al. Cambridge, UK and New York, NY: University of Cambridge, 2007.

Unit 3: Social and Human Dimensions to CC (7 hrs)

Introduction, Indigenous people and climate change, Enhancing the social dimensions of climate change,Politics of greenhouse gases,Cross cutting issues: Issues of equity and GESI, The Concept of Ethics in relation to climate change

Practical exercise: paper writing on the cross cutting issues (GESI, human health, etc.)

References:

- Salick, J. and Byg, A. (2007).*Indigenous people and Climate change*. A Tyndall CentrePublicationTyndall Centre for Climate Change Research, Oxford.
- Tippal, B.S. (2013).*The DBS Handbook of Climate Change*. DBS imprints, ISBN: 978-81-92372-89-1.
- UNDP (2009).*Resource guide on Gender and Climate change*. 2nd ed. United Nations Development Programme, ISBN: 978-92-1-326031-9.

Unit 4 Risk, hazard, vulnerability and climate change induced disasters (8 hrs)

Introduction, types of climate induced hazards, vulnerability to climate change, framework for DRR and DRR tools, climate change risk management in Nepal

Practical exercise: Vulnerability Assessment Tools (VA steps: hazard mapping/ hazard ranking/ climate threat profile etc.).

References:

- IPCC Fourth Assessment Report, Working Group I, Glossary of Terms: http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Annexes.pdf.
- UNISDR (United Nations International Strategy for Disaster Reduction) (2002). ISDR. Background paper for WSSD. Geneva: UN.
- UNISDR (United Nations International Strategyfor Disaster Reduction) (2004).*Livingwith risk: a global review of disaster reduction initiatives*. Geneva: ISDR

- USAID (2011) Introduction to disaster risk reduction. USAID/OFDA.

Unit 5: Mitigation-limitingclimate change (4 hrs)
Concept of mitigation, mitigation options, mitigation approaches, mitigation strategies applied in Nepal (for e.g. REDD+)

References

- Dawson, B.,Spannagle, M. (2009).*Thecomplete guide to climate change.* ISBN 0-203-88846-4
- IPCC (2007). Climate Change 2007: *Mitigation of Climate Change*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, B. Metz, O. R. Davidson, P. R. Bosch, R. Dave and L. A. Meyer (eds), Cambridge University Press, Cambridge and New York.
- Luintel, H., Silori, C.S., Frick, S. and Poudyal, B.H. (2013).*Grassroots Capacity Building for REDD+*: Lessons from Nepal.Journal of Forest and Livelihood 11(2). ISBN 1684-0186.
- REN21 2010 (Renewable Energy Policy Network for the 21st Century. Renewables 2010: Global Status Report p53.available at **http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR_2010_full_revised%20Sept2010.pdf**
- Tippal, B.S. (2013).*The DBS Handbook of Climate Change*. DBS imprints, ISBN: 978-81-92372-89-1.

Unit 6: Adaptation: Living with climate change (8hrs)
Concept of adaptation, approaches to adaptation,principles and strategies for adaptation, limits to adaptation, cost and benefits of adaptation.

Practical exercises:

- Poster preparation for local adaptation focusing on any sector/ecosystem
- Field visit: site visit (e.g. forest, wetland etc) for exploration of adaptation options

References:

- Dawson, B.and Spannagle, M. (2009).*The complete guide to climate change*. ISBN 0-203-88846-4
- IPCC (2007).*Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability.* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.(available at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch17s17-4-2.html)
- Regmi, B. R. and Bhandari, D. (2013).*Climate change adaptation in Nepal: exploring ways to overcome in the Barriers.* Journal of Forest and Livelihood 11(1). ISBN 1684-0186.

Unit 7 CC Initiatives (8 hrs)

CC related Initiatives: Introduction to CC Events (Global and National); (IPCC, UNFCCC, COP, CBD,UNCCD, Kyoto Protocol and its mechanism: CDM, Joint implementation and emission trading, REDD+); (NAPA, LAPA/CAPA, Climate change related policies).

Practical exercises

- preparation of LAPA report of any VDC

References:

- Dawson, B.and Spannagle, M. (2009).*The complete guide to climate change*. ISBN 0-203-88846-4
- HELVETAS Swiss Inter cooperation Nepal (2011).*Nepal's climate change policies and plans: local communities' perspective environment and climate series* 2011/1
- MoSTE (2004). *National Communication Report to the COP of the UNFCCC*

Text Book for all units:

- Pittock, A. B.(2009).*Climate Change: The Science, Impacts and Solutions*. Second Edition, CSIRO, ISBN: 978-1-84407-786-1

References:

- Dawson, B., and Spannagle, M.,*The Complete Guide to Climate Change,* Routledge Taylor and Francis Group. ISBN: 0-203-88846-4
- *Nepal Climate Change and Development Portal*, (Online Library). Ministry of Science, Technology and Environment-MoSTE.
- Publications and reports of MoSTE including- *National* Communication Report to the COP of the UNFCCC (2004); National Adaptation Programme of Action (NAPA); Local Adaptation Plan for Action (LAPA); Strategic Program for Climate Resilience (SPCR)
- Singh, Bharat Tippal "*The DBS Handbook of Climate Change*". ISBN: 978-81-92372-89-1
- Pittock, A. Barrie "*Climate Change: The Science, Impacts and Solutions*, Second Edition". CSIRO, ISBN: 978-1-84407-786-1
- IPCC, 2007 "Climate Change: Synthesis Report"

ENV623 Watershed Management (3 Credit Hours)

Course Objectives:
The students will be able to understand physical and natural processes of the land and water, and their management, and their integration into the community and sustainable development

Course Contents:
Unit I: Introduction (8 hrs)
Concept of Watershed, Watershed Components, Natural Resources (Forests, Water, Land, Animals); Social Components (Farmers, traders, tourists, castes, demographic features); Institutional Component (community, development groups, religious groups, administration units).

Unit II: Water and Hydrological Cycle: (9 hrs)
Rainfall (measurement, intensity, duration, frequency), hydrograph components (infiltration, percolation, evaporation and transpiration, land water interaction, soil water flow, water potential; role of watershed in hydrological cycle; concept of "too much and too little water"; importance of watershed management; who manages watersheds, and the water conflict.

Unit III: Land and land use (8 hrs)
Land system, land capability classification, law of minimum, landuse; factors forcing landuse change; impact of landuse change in water yield

Unit IV: Degradation of watershed (8 hrs)
Degradation of Natural Resources (Land degradation, erosion, landslide, gully formation; measurement of sediment, land depreciation, water degradation, degradation of forest and other vegetation); Degradation of Social Components; Degradation of Institutional Component.

Unit V: Watershed Management in Nepal (6 hrs)
Historical Perspective, Institutional Perspective, Managerial Perspective, Government Policies and Programmes, Changing dependency on ecosystem services in emerging urban – rural continuum context.

Unit VI: Climate Change and Watershed Management (9 hrs)
Introduction to the concept of climate as a dynamic Earth system; weather variability and its impact on water resources; extreme events; watershed's role in adaptation to climate change impacts.

References:

1. Ives, J.D. and Messerli, B. 1989. The Himalayan Delima, Reconciling Development and Conservation, Routledge, London
2. Lovejoy D. (ed) 1979. *Landuse and Landscape Planning*, Leonard Hill, Glasgow, U.K

ENV 624 Environmental Field Work, Case study/ Term Paper (2 Credit Hours)

Urban Environmental Management:

1. Case study of Urban Planning, Land pooling and Status of Urban development in any certain community (area).
2. Field Visit to compare the different land use pattern in urban area and Waste management Techniques.
3. Division of class into different groups as per the responsibility assigned on different thematic areas to prepare an action plan for managing urban environment.

Climate Change:

1. Field visit focusing on application of any alternative energy sites (hydropower, waste water treatment plant, farming site, bioenergy)
2. Practical exercises (4hrs)
    - Debate on REDD process and mechanism
    - Poster preparation for local adaptation focusing on any sector/ecosystem
    - Field visit: site visit (e.g. forest, wetland etc.) for exploration of adaptation options
3. Vulnerability Assessment Tools (hazard mapping/ hazard ranking/ climate threat profile) of climate change, steps of vulnerability assessment
4. Paper writing on the cross cutting issues (mainstreaming of GESI in CC, mainstreaming of CC in development, mainstreaming of CC in human health). Study of local people perceptions on cc in any project area. Preparation of LAPA/CAPA report of any VDCs or community

Watershed Management:

1. Field visit and case study of any nearby watershed
2. Strategic Planning, Conflict Management and Consensus Building
3. Participate the students in Public hearing of EIA or any other conflict context
4. Case studies/ PRA report writing
    - Policy formulation and implementation
    - Analysis of policy and legal implication
    - Relevant case studies
    - Exercise on consensus building
    - Exercise in conflict management

Note: For a Course in a Semester there must be two days field Visit excluding the reporting time

MGT 621Multi-criteria Decision Analysis (2Credit Hours)

Course Objectives:
A decision is required in all environmental and social processes to arrive at a decision are not an easy task. There are methods to systematize our decisions.

Decision is a conscious, irrevocable allocation of resources with the purpose of achieving desired objective. Decision analysis is a methodology and a set of probabilistic frameworks for facilitating high quality logical decision; illuminating difficult decision makers.

Environmental decisions are a multi-dimensional process and in such situation to arrive at a decision multi-criteria decision analysis is required. This course basically highlights the decision making process and also provides the basic foundation of MCDA applicable to environmental and social issues**.**

Course Contents:
Unit 1: Introduction to Decision Analysis (3 hrs)
How do you make decisions? Key terms and concepts? What is decision analysis? Why use decision analysis.

Unit 2: Decision making in a complex world (3 hrs)
Why are decisions difficult? Wealth in information; poor in attention, Frequency and consequence of decision making, Dealing with uncertainty and judging the consequences, Uncertainty and ambiguity.

Unit 3: Decision - Making choices (6 hrs)
Types of decisions, Rationality in decision making

Unit 4: Framework for planning and decision making (6 hrs)
The participants in the decision process, Hierarchy of decision, Decision making models - Intelligence phase, Design phase, Choice phase

Unit 5: Multi-criteria Decision Analysis (6 hrs)
Phases of MCDA, Sensitivity analysis, Application on MCDA in Environmental Decision Making

Practical works on MCDA with the application of computer software (Definite) (8hrs)

References:
1. DavidC.Skinner; *An introduction to Decision Analysis*: *A practitioners Guide to improve theDecision quality;probability* ,2001 USA NERA, DLTR multi criteria analysis manual; National Economic Research Associates; London, 2005;Robert T.Clement; making Hard Decision; An introduction to decision analysis, Duxbury press, USA

RCH621 Research Methodology (3 Credit Hours)

Course Objectives:

- To explain the students with the techniques of conducting research in environmental management
- To develop students' skills, an understanding and skills of research.
- To provide the fundamental concept of research methods
- To make the students able to understand the researchproblems and research methods & to apply in the practical field
- To make the students able to develop research proposal

Course Contents:

Unit I: Introduction (3hrs)

Philosophical Issues of Research: Inductive & Deductive Logical Reasoning; Meaning, objectives, and types of research: pure and applied; quantitative and qualitative; Scope of and need for environment science & management; ethical issues environmental research, Scientific communications

Unit II: Research Design and Types (4hrs)

Theoretical and Conceptual Framework, Operational Definition; Research design: historical, experimental, exploratory, explanatory, descriptive, ex-post facto; Action, survey, field study, case study.

Unit III: Elements of Research Proposal (6hrs)

Selection of topic; Problem identification; Objectives of the study; Hypothesis formulation; Literature review; Methodology: Type of data; data collection method; and tools for analysis, References; Time frame and Budgeting

Unit IV: Method of Data Collection (6hrs)

Sources of information, Sampling Design, Sampling Size Determination; Field survey, qualitative studies, Probability and non-probability sampling; types of sampling; their importance and limitations, Uses and limitations of specific data collection techniques.

Unit V: Data Processing and Analysis (3hrs)

Data Processing: Editing, coding, and organization of data; Measurement scale of variables (nominal, ordinal, interval, and ratio).

Unit VI: Analysis for Qualitative data (8hrs)

Overview, strategies for qualitative analysis; quantifying qualitative data; Reliability and validity test; Statistical analysis & interpretation of the result of qualitative data.

Unit VII: Analysis for Quantitative Data (12 hrs)

Introduction, preparing data for analysis; Tabulation, array, range, frequency distribution,

Presentation of data-graphic, polygon, O-give, describing data; Using statistics- Mean, Mode, Median, Dispersion/ Skewness, Examining relationship, differences and trend; Correlation, regression (time-series cross sectional, panel (pooled)); Estimation and hypothesis testing using z test, t test and chi square test.

Unit VIII: Report Writing and Thesis Format (6 hrs)

Writing research report; procedure for preparing research report; thesis writing format, format of the report/thesis (including footnotes, quotations, references, etc.); subject matter and organization of the report/thesis; presentation of research report/thesis; introduction to project work

Note: Computer simulation using SPSS/Excel/STATA

Text Books

1. Donald R Cooper and Pamela S Schindler (New Edition). *Business Research Methods*. Tata McGraw Hill Education Pvt. Ltd. New Delhi, India.
2. Patel, Bharati K. (New Edition). *The Green Book*: *A Guide to Effective Graduate Research in African Agriculture, Environment, and Rural Development*. The African Crop Science Society, African Agricultural Resource Husbandry Programme.
3. Sekaran Uma &Bougie Roger (New Edition). *Research Methods for Business*, Fifth Edition. A John Wiley & Sons, Ltd, Publication, UK.
4. RossiterD G (New Edition). Preparation for M. Sc. Thesis Research at ITC and in Joint Education Programmes. International Institute for Geo-information Science & Earth Observation. (ITC), Enschede (NL)

ENV 625 Thesis **(9 Credit Hours)**

Course Objective

1. For the final Semester the students will carry on research work by the guidance of their Supervisor so that they will have better knowledge to conduct research works in the real field.

Parts of Thesis

There shall be three main divisions in a thesis: (a) Preliminaries; (b) Main body and (c) Supplementary materials

The chapter-wise full contents of these divisions or sections of a thesis will be as follow:

Chapter Outline for Thesis

A: Preliminary Section
Content
Cover Page
Title page
Certification
Abstract
Acknowledgements
Table of Contents
List of Tables
List of boxes
List of Photographs
List of Figures
List of Abbreviations
B: Main Body of the Report

CHAPTER I: INTRODUCTION
1.1. Background of the Study
1.2. Statement of the Problem
1.3. Research Questions
1.4. Objectives of the Study
1.5. Hypotheses
1.6. Significance of the Study
1.7 Limitations of the study
1.8. Chapter Outline

CHAPTER 2: LITERATURE SURVEY/REVIEW OF LITERATURE
2.1. Literature Review

CHAPTER 3: MATERIALS AND METHODS/RESEARCH METHODOLOGY

2. 3.1. Theoretical Framework
3. 3.2. Conceptual Framework
4. 3.1. Research Plan and Design
5. 3.2. Description of the Sample (types of research design e.g. Qualitative or quantitative)
6. 3.3. Data Collection Procedure and time frame (sampling methods, sample size, types of sampling e.g. probability)
7. 3.4. Validity and Reliability
8. 3.5. Model Specification
9. 3.6. Analysis Tools

CHAPTER 4: RESULTS AND DISCUSSION/ DATA PRESENTATION AND ANALYSIS

10. Presentation of Results
11. Descriptive Analysis Type of Statistical Test(s) Performed Inferential Analysis and Discussion
12. (Present the data according to objectives wise and interpret the result)

CHAPTER 5: SUMMARY AND CONCLUSION

5.1. Summary of Major Findings
5.2. Conclusion
5.3. Recommendations
C: Supplementary Section

•Appendices
•References (Use APA Manual 6th Edition format for citation and reference)

ELECTIVE COURSE – ENV651 SUSTAINABLE FOREST MANAGEMENT (cr hr 3)

General objective: The course aims to impart technical know-how on the planning, approaches and regulation of forest resources for sustainable and wise use.

Specific objectives: With the completion of the course, students will be able to:

- Understand concept and approaches of forest management
- Compare forest management practices in Nepal and other countries
- Understand tools and techniques of forest regulation to optimize production
- Prepare forest management plans at micro and macro level.
- Analyze forest policies in changing context

Unit 1: Forest Management Practices (8 cr hr)

1.1 Objective and scope of forest management
1.2 Global forest management history
1.3 National forest management history
1.4 Comparison of forest management approaches (developed countries / Nepal)
1.5 Concept, strategies and practices of forest management in;
1.5.1 Community Forestry, Collaborative forestry, Leasehold forestry, Private forestry and Government managed production forestry, Scientific Forest Management, Religious Forests, Protection Forests
1.6 Problem and prospects of forest management (global, regional and national)

Unit 2: Sustainable Forest Management (4 cr hr)

2.1 Sustainable forest management
2.1.1Concept and approach
2.1.2 National and International practices
2.1.3 Criteria and indicator for SFM
2.2 Forest Certification
2.2.1Importance of forest certification
2.2.2 Methods of certification
2.2.3 Appropriateness and practice of forest certification in Nepal

Unit 3: Growing Stock and Normal Forest (4 cr hr)

3.1 Introduction and definition of growing stock
3.2 Determination of growing stock
3.2.1 Determination based on types of enumeration
3.2.2 Determination based on silvicultural system
3.3 Relationship between growing stock and yield
3.4 Concept of forest normality, Basic requirements for normality and Abnormality situation in forest
3.5 Implication of normality concept in Nepal

Unit 4: Forest Utilization and Forest Projection (4 cr hr)

4.1 Forest Utilization
4.1.1 Non-timber forest products of economic importance in Nepal
4.1.2 Forest based industries in Nepal
4.1.3 Management, collection, processing and marketing of high value NTFPs in Nepal, value chain of high value wood and non wood products
4.1.4 Role and function of private sector, cooperatives institutions
4.2 Forest Protection

4.2.1 Cause of forest health (Natural, artificial: fire and disease)
4.2.2 Forest paste and disease
4.2.3 Management of forest paste and diseases

Unit 5: Sustained Yield and Site Quality (4 cr hr)

5.1 Principles of sustained yield
- 5.1.1 Yield types
- 5.1.2 Prerequisites for sustained yield
- 5.1.3Limitations in Nepal's conditions
- 7.1.4Steps for achieving sustained yield

5.2 Importance and determination of site quality
- 5.2.1 Site assessment for potential production of a site
- 5.2.2 Reasons for assessment (Land allocation and development planning, choice of species, growth of species, forecasting of growth and yield)
- 5.2.3 Site assessment method
- 5.2.4 Maximum mean annual increment

Unit 6: Yield Regulation (6 cr hr)

6.1 Introduction and concept of yield regulation
6.2 Scope of yield regulation
6.3 Regulating plantation forest /natural forests: Concepts & Applications
6.4 Allowable cut methods: Area control, Volume control, Combined area and volume control
6.5 Yield regulation practices in Nepal

Unit 7: Forest Management Plan (4 cr hr)

7.1 Management plan
- 7.1.1 Definition, objectives and limitations
- 7.1.2 Types of forest management plan

7.2 Preparation of management plans
- 7.2.1 Data collection: -Bio-physical & -Socio-economical
- 7.2.2Maps and sketches
- 7.2.3 Contents and write up
- 7.2.4Plan update (Method and Scope)

7.3 Operational plans
- 7.3.1 Scope of operational plan
- 7.3.2 Procedure of operational plan preparation

Unit 8: Forest Policy (6 hr)

8.1 History of forest policy in Nepal
8.2 Basis for policy formulation
8.3 Policy evaluation (Existing policy and current issues in forestry-National/International scenario)
8.4 Policy amendment procedure and future prediction

Practical (12 hr)

- A field visit will be organized to study different approaches and practices of forest management in nearby sites. Students will have to study different thematic areas of forest management in groups, present the work of study and submit reports according to the prescribed format provided by the tutor.
- Term paper: related to forest management

References

- Aery, T.E. and Burkhart, H.E. (1983): Forest Measurements, McGraw Hill Book Company.
- Amatya, S, M., Shrestha, K, R., and Edwin, C. (2016). Nepal Forestry Handbook. Nepal Foresters´ Association, Kathmandu, Nepal.
- Clutter J.C. et al. (1983). Timber Management. A quantitative approach. John Wiley & Sons.
- Davis, L.S., Johnson, K.N., Bettinger, P.S. and T.F. Howard. (2001). Forest Management. 4th Ed. McGraw Hill, New York.
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- GON. (2002): Leasehold Forest Policy. Ministry of Forest and Soil Conservation, Government of Nepal (GON), Kathmandu, Nepal.
- GON. (2014). Scientific Forest Management Guideline 2014: Ministry of Forest and Environment, Government of Nepal (GON), Kathmandu, Nepal.
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- Philips, M.S. (1983): Measuring Trees and Tree Crops. University of Dar es Salam..
- Prakash, R. (1986): Forest Management. International Book Distributors. Dehradun.
- Saigal, S., Arora, H. and Rizvi, S. (2002): The New Foresters : The role of private enterprise in the Indian Forestry Sector. International Institute of Environment and Development, London, UK

ELECTIVE COURSE – ENV652 CONSERVATION BIODIVERSITY (3 CR HR)

General objective:
To develop understanding on biodiversity conservation and management approaches.

Specific objectives:
- to provide knowledge on biodiversity and it conservation.
- to acquaint with the conventions, policy, strategies and approaches of biodiversity conservation.
- to provide understanding on human and biodiversity interface.

UNIT 1: INTRODUCTION TO BIODIVERSITY (4 hrs)
Earth history and changes in species distributions, Biodiversity concept, Species diversity, Genetic diversity and Ecosystem diversity, Theory of Biodiversity conservation, Global biodiversity, its values and ethics, erminology (Biology, diversity, conservation, protection, threat, extinction, endanger etc)

UNIT 2: TYPES OF BIODIVERSITY (4 hrs)
Types of biodiversity based on geography (Tarai, Hill and Himalaya), Types of biodiversity based on the life (Plants, animals, birds *etc*.), Aquatic biodiversity, Forest and outside forest biodiversity (agriculture), Urban forest and biodiversity

UNIT 3: EVOLUTION AND EXTINCTION (4 hrs)
Evolutionary aspects of diversity, Speciation and Evolution measures of diversity, Overexploitation, habitat destruction and extinction, Geological patterns of extinction, Current patterns of extinction, Colonization and extinction, Extirpation (local extinction), Global climate change and extinction.

UNIT 4: THREATS TO BIODIVERSITY AND ITS CONSEQUENCES (4 hrs)
Human population growth and its impact, Habitat fragmentation, degradation and loss, Global climate change, Overexploitation (harvest models), Biodiversity & ecosystem functioning, Biodiversity & ecosystem services, Biodiversity valuation

UNIT 5: ASSESSING BIODIVERSITY (4 hrs)
The nature and function of biological diversity, Distribution and measuring of biodiversity (Shannon wiener index, Simpson index), Ecological economics of biodiversity, keystone species and resources (Direct use value, indirect use value and ethical value)

UNIT 6: APPROACHES TO BIODIVERISTY CONSERVATION (8 hrs)
Restoration ecology (principle, aim and practices), Species, Ecosystem and Landscape Approaches to Conservation, Protected Areas (Establishing Protected Areas, Designing Networks of Protected Areas, Managing Protected Areas), Restoration of Damaged Ecosystems and Endangered Populations, Significance of ecological restoration in conservation, Rhododendron conservation, Conservation outside the Protected Areas, Role of zoos, zoological gardens and botanic gardens in conservation, The Integration of Conservation Science and

Policy, Government Actions, conservation programs and international approaches in Nepal, Ex-situ and In-situ Conservation Strategies.

UNIT 7: CONSERVATION AND HUMAN INTERFACE (4 hrs)

Conservation for whom?, Conservation in Human-Modified Landscapes, Political ecology of community-based biodiversity conservation approaches, Conservation and Sustainable Development at the Local and National Levels, An International Approach to Conservation and Sustainable Development

UNIT 8: BIODIVERSITY CONSERVATION POLICIES AND INSTITUTION (4 hrs)

International convention on Biological Diversity, Convention on International Trade in Endangered Species Of Wild Fauna And Flora (CITES), Biodiversity conservation, Cartagena Protocol, Nagoya Protocol, RAMSAR, GTI, NBS, Species conservation plans, IUCN, NTNC, WWF and other conservation agencies

PRACTICAL (12)

- **Field Exercise: Students will visit nearest sites for i**dentification of threats on biological diversity of local habitat, measuring and valuing biodiversity functioning and services, visit to molecular lab for genetic study. Each student will prepare separate report for each visit and submit for evaluation in prescribed format.
- **Term Paper:** Students will study the case of protected area and landscape conservation models within Nepal, and conservation projects. Students will evaluate the conservation projects and present their findings among students and faculties. The report of the case study will be submitted to the tutor for evaluation.

REFERENCES

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- Primer, R.B : Principle of Conservation Biology
- Schonewald-Cox, C. M (et al; eds.). (1983). Genetics and Conservation. Benjamin Cummings, Menlo Park, CA.
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ELECTIVE COURSE: ENV653 WATERSHED HYDROLOGY (3 cr hr)

General Objective: This course provides concept and skill on application of hydrological knowledge for watershed characterization, planning, designing development project and understanding on implication of land use practices on hydrological regime.

Specific Objectives: After the completion of course, student will be able to:

- Develop understanding on hydrological cycle and different hydrological process
- Apply hydrological knowledge and skill on watershed management planning and development
- Learn basic techniques for analysis and integration of hydrologic data, and prediction of hydrologic phenomena using models
- Perform hydrologic analysis and interpretation of different watershed management activities, forest and land use land cover and climate change impacts at watershed scale.
- Understand the role of forest and cryosphere for water supply

UNIT 1: CONCEPT OF WATERSHED HYDROLOGY (6 hrs)

Concept of hydrological cycle in the context of watershed, Scope of watershed hydrology, Hydrological processes, Hydrological characteristics of watershed, Land use land cover and its implication on hydrology

UNIT 2: WATER BALANCE COMPONENTS AND WATER FLOW (10 hrs)

Water balance equation, Precipitation, interception and its measurements, Rainfall data analysis (average precipitation, missing precipitation, consistency), Evaporation, evapotranspiration and its measurement (water balance, energy balance, remote sensing), Infiltration and hydrological soil characteristics, Soil water movement, Surface and ground water flow, Stream flow measurements, Stream flow response to watershed characters, Hydrograph analysis, Peak flow, frequency and return period analysis, Sediment flow and its estimation

UNIT 3: WATERSHED HYDROLOGICAL MODELLING (10 hrs)

Concept and scope of watershed hydrological modeling, Types of watershed hydrological models, Model selection, simulation, calibration, validation and sensitivity analysis, Rainfall - Runoff model, SWAT Model, Erosion Model (RUSLE, RMMF)

UNIT 4: HYDROLOGICAL ROLE OF FOREST (5 hrs)

Forest hydrology concept, Hydrological function of forest, Impact of forest management on hydrological processes, Vegetation management for sustained water yield, Monitoring forest cover changes and hydrological implication at watershed scale

UNIT 5: CRYOSPHERE (5 cr hr)

Components of cryosphere, Permafrost, Glacier mass balance, Impact of climate change on snow hydrology and downstream consequences, Glaciers observations and monitoring

PRACTICAL WORK (12)

Students will perform following field base observations / measurements and lab work for different analysis, specifically: (a) Discharge measurement of spring and stream, (b) Rainfall measurement with rain gauge/rainfall data analysis, (c) Infiltration experiment, (d) Water quality and sediment analysis of stream water, (e) Rainfall-runoff-stream flow relationship, (f)

Hydrograph analysis, (g) Familiarization with hydrological model (SWAT/HEC RAS)

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ELECTIVE COURSE – ENV654: POPULATION AND ENVIRONMENTAL HEALTH (Cr hr 3)

Course Objective: This course develops understanding on the interaction of human population with the environmental factors that cause health implications.

- to develop fundamental concept of the dynamics of human population,
- to give fundamental concepts of the environmental health and sanitation,
- To develop understanding on the exposures of hazardous physical, chemical, and biological agents in air, water, soil, food, and other environmental media or settings that adversely affect human population,
- To develop skill on the methods and approaches in identifying and evaluating environmental sources and hazardous agents those have implication on human population.

Unit – I: Source of Population Data

World: Census, Registration of vital events. Demographic Surveys, Population Registers.

Nepal: Census, Civil Registration System (CRS), Sample Registration Scheme (SRS), National Sample Survey (NSS), Demographic surveys and other sources.

Unit – II: Demographic Methods / Population Analysis, Epidemiology

Population growth models and theories, Methods of population projections, Doubling Time, Concept of ageing, crude rates and standardized methods, Inter – censual / Post – censual estimates of population, the Lexis diagram.

Epidemiological methods- Incidence and prevalence, Rates, Ratios, Proportions,

Cohort and cross – sectional methods,

Occupational health study methods

Unit – III: Population Composition and Change

Spatial and temporal changes in the size, composition & distribution of human population – global perspective with special focus on Nepal. Human evolution and Evolutionary trends of human populations, effects of human revolutions in population dynamics, health events of global significance

Demographic Composition of Nepal including socio-economic and cultural dimensions

Unit – IV: Population, Development and Environment

Inter – relationship between population growth, environment and sustainable development, human Development Index, Implications of population growth on food supply, water, sanitation, housing, employment, health, education, etc., Ecological balance and its maintenance.

Gender equality and demographic effects of changing women's roles, the effect of demographic characteristics on poverty and development activities in Nepal- capital swallowing, age dependent effects, investment diversion effects, and environmental concerns.

Unit II: l Environmental health and sanitation

Concept of environmental health, Environmental factors of health significance, changing paradigm of environmental health, Measuring environmental quality, human exposures and health impacts, Patterns of illness throughout the world.

Environmental hazards -Biological, Chemical, Physical, Mechanical, Psychological, occupational

Sanitation – definitions and significance, Global and national scenario of sanitation, WASH and other initiatives, sanitary technologies

Unit III: Risk Assessment and Management 12 hrs

Hazards and risks, Risk assessment and Risk management framework, Hazard identification in the field, dose-effect relationship, Human exposure assessment, Health risk characterization, approach to managing risk, factors affecting the perception and acceptance of risk, prevention and control of exposures, risk monitoring and use of indicators, special problems in managing environmental health risks, cost-effectiveness and cost-benefit analysis of interventions, obstacles and opportunities for resolving environmental health problems

Unit V: Global and National Initiatives Related to Environmental Health 8 hrs

Policies, plan, strategies, legislations including conventions and treaties

Texts and References

1. Birdsall, N, Kelley, A. C, & Sinding, S. W.: Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World. New Delhi: Oxford University Press.
2. Weeks, J. Population: An Introduction to Concepts and Issues. Singapore Wordsworth Learning.
3. Bhasin, K: Understanding Gender. New Delhi: Kali for Women Publishers.
4. Kawadia, G. &Ahuja, K. Environment Issues of Development. Ambala: Associated Publishers.
5. United Nation. Population Challenges and Development Goals
6. KC, B. K. Population and Development in Nepal. Central Department of Population Studies, TU.
7. CBS. Population Census of Nepal and Other Related Publications.
8. WHO: Epidemiology
9. AnnaleYassi, Tord Kjellstrom, Theo Dekok and Tee Guideotti: Basic Environmental Health, WHO/ENG/98.19

10. UNEP/USEPA/WHO 95.26 Ed. D. Briggs, C. Cosvalan, M. Nurmines, Linkage methods for Environment and Health analysis: General Guidelines.
11. Dr. A. K. Sinha, Human Health
12. Dr. P. K. Roy, Pollution and Health
13. PRIA, Occupational and Environmental Health

ELECTIVE COURSE: ENV565 DISASTER RISK MANAGEMENT (Cr hr 3)

General Objectives:

- To Produce competent professionals on risk management

Specific Objectives:

- To provide knowledge on disaster risk management (DRM)
- To familiarize hazard, risk and vulnerability
- To provide knowledge on risk engineering

Unit 1: Hazard, Risk and Vulnerability

Hazard, risk, exposure and vulnerability; natural and anthropogenic hazards; risk assessment; parameters of vulnerability; vulnerability analysis; disaster: hydro-meterological disaster, manmade disaster; global problems; climate change and disaster; desertification; water crisis

Unit 2: Disasters in Nepal

Hydro-meterological and geological disasters in Nepal; epidemics; spatial distribution of disaster in ecological and physiographic zones of Nepal; documentation of disaster events in Nepal; stakeholders for Disaster Risk Reduction (DRR) in Nepal

Unit 3: Risk Engineering

Structural measures for water induced disasters: erosion, flood, landslide, GLOF; earthquake, industrial disaster, and climate change induced disasters

Unit 4: Urban Risk Management

Nature of risk in urban areas; disaster risk and cultural heritage; urban landscape and climate change; urban institutions, policies and planning for disasters management

Unit 5: Disaster Risk Management and Practices

Evolution of DRM; DRM cycle: pre-disaster activities and mitigation, during disasterresponse, and post disaster activities; comprehensive disaster risk reduction approach; use and application of emerging technologies; disaster response plan; coordination of stakeholders; community based disaster risk management and management planning; participatory disaster risk assessment monitoring and evaluation

Unit 6: Legislation on Disaster Risk Management

DRM in Nepal constitution and periodic plans; natural calamity act, 1982; national strategy of disaster risk management ; Hyogo framework of action, international legal provisions and experience; DRM in South Asian Association for Regional Cooperation (SAARC)

ELECTIVE COURSE: ENV 655 MOUNTAIN ENVIRONMENT (Cr hr 3)

General Objective:
To develop understanding on the prospect of mountain environment and challenges

Specific Objectives:

- To provide knowledge on mountain environment
- To familiarize sustainability issues of mountains
- To provide knowledge on impacts of climate change on mountain environment

Unit 1: Mountains and Hindu Kush Himalayas (15hrs)
Mountains of the earth; Himalayas and Hindu Kush-Himalaya (HKH): climate , water and forests of the Himalayas, Himalayan Environmental Degradation (HED) theory, biodiversity of HKH and conservation attempts; Chure range of Nepal: ecological values, deforestation and environmental degradation; case studies

Unit 2: Mountain and Sustainable Development (15hrs)
Concept, Component, tools and indicators of sustainable development; poverty, environment and development linkages; sustainable accounting; mountain specificities and its implication; challenges in mountain development; Millennium Development Goals (MDGs); Resources Management and Development: tradition practices and indigenous knowledge, government intervention, watershed approach; Mountain Agriculture: highland agriculture, sustainable use of sloping land, agro biodiversity and food security: Case studies

Unit 3: Tools of Mountain Development (15hrs)
Mountain Risk Engineering (MRE): Mountain hazards and their contributing factors, engineering design, principles and materials in MRE, Scope and application of MRE in the context of Nepal Himalayas; case studies
Sloping Agriculture Land Technology (SALT): Philosophy, rationale, types scope and initiatives, characteristic feature of the SALT; case studies
Renewable Energy Technologies (RETs): Role of renewable energy technologies in mountains; case studies
Bioengineering: integrating bioengineering in mountain development; case studies
Community Forestry (CF): Role of community forestry in rural development in mountains; case studies

Unit 4: Human Adaptability and Climate Change (15hrs)
Altitudinal change in mountains; constraints and human adaptability; highland-lowland interaction; mountain livelihood; migration in mountain areas; mountain tourism; prospectus of ecotourism in Nepalese mountains.
Impact of climate change: water resources, snow and glaciers, wetland, biodiversity, forest, rangeland, agriculture, livelihood and human settlement; climate change and vulnerable groups : indigenous people, isolated communities and gender; perceptions and coping strategies of the mountain communities; climate change and alpine ecosystem; case studies.