

Scheme & Syllabus of

Bachelor of Science in Environmental Science

(B.Sc. Env Sci)

Batch 2020 onwards



By

Board of Study CIVIL AND ENVIRONMENTAL SCIENCE

Department of Academics

IK Gujral Punjab Technical University

IK Gujral Punjab Technical University
B.Sc. Environment Science

Bachelors of Science in Env Science (B.Sc. Env Sci):

It is an Under Graduate (UG) Programme of 3 years duration (6 semesters) **Eligibility for Admission:** All Those candidates who have passed in 10 + 2 or its equivalent examination in any stream conducted by a recognized Board/University/Council

Courses & Examination Scheme:

First Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN10 1-20	Core Theory	Elements of Ecology	3	1	0	40	60	100	4
BSEN10 2-20	Core Theory	Basics of Biostatistics	3	1	0	40	60	100	4
BSEN10 3-20	Core Theory	Environmental Chemistry	3	1	0	40	60	100	4
BSEN10 4-20	Core Practical/Laboratory	Ecology Lab	0	0	4	60	40	100	2
BSEN10 5-20	Core Practical/Laboratory	Environmental Chemistry Lab	0	0	4	60	40	100	2
BSEN10 6-20	Core Practical/Laboratory	Biostatistics Lab	0	0	4	60	40	100	2
BTHU10 3/18	Ability Enhancement Compulsory Course (AECC)-I	English	1	0	0	40	60	100	1
BTHU10 4/18	Ability Enhancement Compulsory Course (AECC)	English Practical/Laboratory	0	0	2	30	20	50	1
HVPE10 1-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules	3	0	0	40	60	100	3
HVPE10 2-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules (Lab/ Seminar)	0	0	1	25	--**	25	1
BMPD10 2-18		Mentoring and Professional Development	0	0	1	25	--**	25	1
	TOTAL		13	03	16	460	440	900	25

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

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****The Human Values, De-addiction and Traffic Rules (Lab/ Seminar) and Mentoring and Professional Development course will have internal evaluation only.**

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Second Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN20--20	Core Theory	Biodiversity components	3	1	0	40	60	100	4
BSEN202-20	Core Theory	Ecosystem Dynamics	3	1	0	40	60	100	4
BSEN203-20	Core Theory	Natural Resources and Management	3	1	0	40	60	100	4
BSEN203-20	Core Practical/Laboratory	Biodiversity components lab	0	0	4	60	40	100	2
BSEN204-20	Core Practical/Laboratory	Ecosystem lab	0	0	4	60	40	100	2
BSEN205-20	Core Practical/Laboratory	Natural resources Management Lab	0	0	4	60	40	100	2
EVS102-18	Ability Enhancement Compulsory Course (AECC) -III	Environmental Science	2	0	0	40	60	100	2
BMPD202-18		Mentoring and Professional Development	0	0	1	25	--	25	1
TOTAL			11	03	13	365	360	725	21

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

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Third Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN301-20	Core Theory	Renewable and Non-Renewable Energy Resources	3	1	0	40	60	100	4
BSEN302-20	Core Theory	Fundamentals of Nanotechnology	3	1	0	40	60	100	4
BSEN303-20	Core Theory	Environmental Microbiology and Biochemistry	3	1	0	40	60	100	4
BSEN304-20	Core Practical/Laboratory	Energy Resources lab	0	0	4	60	40	100	2
BSEN305-20	Core Practical/Laboratory	Nanotechnology Lab	0	0	4	60	40	100	2
BSEN306-20	Core Practical/Laboratory	Microbiology and biochemistry lab	0	0	4	60	40	100	2
BSEN307-20	Skill Enhancement Course-I	Basics of computers	1	0	0	40	60	100	1
BSEN308-20	Skill Enhancement Course- Laboratory	Computer Lab	0	0	2	30	20	50	1
BMPD302-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		10	03	15	395	380	775	21

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

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Fourth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN401-20	Core Theory	Environmental Pollution	3	1	0	40	60	100	4
BSEN402-20	Core Theory	Water and wastewater: treatment and conservation	3	1	0	40	60	100	4
BSEN403-20	Core Theory	Environment Toxicology	3	1	0	40	60	100	4
BSEN404-20	Core Practical/Laboratory	Pollution Monitoring Lab	0	0	4	60	40	100	2
BSEN405-20	Core Practical/Laboratory	Water and wastewater lab	0	0	4	60	40	100	2
BSEN406-20	Core Practical/Laboratory	Environment Toxicology Lab	0	0	4	60	40	100	2
BSEN407-20	Skill Enhancement Course-II	Environment Impact Assessment (EIA)	1	0	0	40	60	100	1
BSEN408-20	Skill Enhancement Course- Laboratory	Environment Impact Assessment Lab	0	0	2	30	20	50	1
BMPD402-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		10	03	15	395	380	775	21

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

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Elements of Ecology

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN10 1-20	Core Theory	Elements of Ecology	3	1	0	40	60	100	4

Unit-I:

Definition, scope, types, components of environment (atmosphere, hydrosphere, lithosphere and biosphere). interrelationship and interactions, ecosystems, organisation, structure and models, people and environment. Climatic factors - solar radiation, temperature, water and precipitation

Unit-II:

Rock types and formation, the rock cycle. Soil formation process, soil types and its status, physical, chemical and biological characters of soil, soil profile and concept of soil erosion, topographic factors.

Unit-III:

Population: basic concepts, characteristics of population – density, natality, mortality, age-structure, dispersion and movement. Causes for population explosion, population growth and population regulation. Intraspecific and interspecific interactions among population – competition, predation, parasitism, mutualism and commensalism.

Unit-IV:

Basic concepts of community, community structure, growth form, life form, stratification, methods of plant community analysis, Ecotone, edge effect, ecological niche, keystone species and ecological succession.

Unit-V

Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake; role of mycorrhizae; decomposition and nutrient release; nutrient use efficiency; nutrient budget; nutrient conservation strategies.

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References:

1. Thomas M. Smith and Robert L. Smith (2012), Elements of Ecology (8th Edn), Pearson Benjamin Cummings,
2. George L Clark (1956), Elements of Ecology, John Wiley & Son Inc. Newyork
3. Charles Krebs (2013), Ecology: Pearson New International Edition (6th Edin),
4. Michael Begon, Colin R. Townsend and John L. Harper (2006), Ecology: From Individuals to Ecosystems (4th Edition), John Wiley & Sons, New Jerssy.
5. Eugene P. Odum and Gary W. Barrett (1953), Fundamentals of Ecology (5th edn), brooks/cole, US
6. Krebs, Charles J (2009), Ecology: The Experimental Analysis of Distribution and Abundance (6th Edn), Benjamin-Cummings Publishing Company
7. Muller-Dombols, D. and Ellenberg, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York.

Basic of Biostatistics

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN10 2-20	Core Theory	Basics of Biostatistics	3	1	0	40	60	100	4

Unit 1: Introduction to Statistics:

Definition and application of statistics, qualitative data, quantitative data, frequency distribution, cumulative frequency, diagrammatical representation of statistical data (bar, pie charts), graphical representation of frequency distribution (histogram, frequency polygon, cumulative frequency curves). Measures of central tendency: mean, median, mode, geometric mean (merits and demerits), measures of dispersion: range, standard deviation, variance,(merits and demerits), coefficient of variation.

Unit 2: Probability

Basic concepts of probability: trial, event, sure event, random event, sample space, definition of probability, mutually exclusive events, independent event, law's of probability – simple problems, probability distributions, normal curve and applications.

Unit 3 : Hypothesis Testing:

Hypothesis, types of hypothesis, level of significance, type 1 and type 2 error, standard error,degrees of freedom, chi square test, student's t test: sample t test, paired t test.

Unit 4: Correlation and Regression

Correlation: definition, types of correlation, karlpearson's coefficient of correlation, simple linear regression, ANNOVA.

Unit 5: SAMPLING

Basics of sampling, Random and Non-random sampling, advantages and disadvantages of sampling, concepts of simple random sampling, concepts of stratified random sampling, concepts systematic sampling

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References:

1. Palanisamy, M (1989) A Text Book of Statistics, Paramount Publication, Palani
2. Vittal, R.R (1986) Business Mathematics and Statistics, Murugan Publications
3. Gupta, S.P. (1996) Statistical Methods, Sulthan Chand and Sons Publications, New Delhi
4. Banerjee, Pranab Kumar (2014) Introduction to Biostatistics , Publisher: S. Chand & Company Pvt. Ltd
5. Clarke, G.M. & Cooke, D., A (1998) Basic course in Statistics.

Environmental Chemistry

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN103-20	Core Theory	Environmental Chemistry	3	1	0	40	60	100	4

Unit 1:

Composition and structure of earth-atmosphere, hydrosphere, lithosphere, biosphere, Distribution of temperature and pressure in atmosphere, particles, ions, radicals in atmosphere, thermal inversion, chemical and photochemical reaction in atmosphere, oxygen and ozone chemistry, causes and effect of Greenhouse effect, Ozone Hole, Acid Rain, El-Nino and La Nino, oceanic circulation.

Unit 2:

Fundamentals of aquatic chemistry: dissolution/precipitation reactions, complexation reactions, chelation, species distribution in freshwaters, nutrients in water and sediments, organic matter and organic chemicals, seawater composition and chemistry- salinity concepts, major constituents, dissolved gases, nutrients, trace elements, sediments and sedimentary components

Unit-3:

oxidation-reduction, redox reactions, NERNST equation and chemical equilibrium, limits of pE in water, pE values in natural water systems, pE - pH diagrams, corrosion, stoichiometry, CO₂ equilibrium in natural water systems

Unit 4:

Chemistry of the solid earth: mineral components of soil, primary and secondary minerals, weathering processes, organic components, soil pH and redox potential, ion exchange (physisorption), ligand exchange (chemisorption), adsorption process, isotherms

Unit 5:

Fate of organic compounds, diversity of organic compounds, identifying sources of hydrocarbons, chemical partitioning, chemical transformation and degradation, light absorption and the beer-lambert law, photolysis in aqueous systems, photochemistry of brominated flame retardants, physical behaviour of particles in the atmosphere, the composition of inorganic particles, radioactive particles, composition of organic particles, effects of particles, water as particulate matter

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References:

1. Brady, N.C. 1990. The nature and properties of Soils, Tenth Edition. Mac Millan Publishing Co., New York.
2. Botkin, D.B and Kodler E.A., 2000, Environmental Studies: The earth as a living planet. John Wiley and Sons Inc.
3. Rao M.N. and H.V.N. Rao, 1989 : Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Tyler Miller Jr. G. 1990. Living in the Environment. Wadsworth Publishing Company, Belmont California.
5. Odum, E.P., 1983, Basic Ecology. Halt Saundurs, International Edition Japan.
6. De, A.K. 1990, Environmental Chemistry, Wiley Eastern Ltd., New Delhi.

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Ecology Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN104-20	Core Practical/Laboratory	Ecology Lab	0	0	4	60	40	100	2

1. Introductory Laboratory Techniques
2. Determination of requisite size of the quadrant for vegetation analysis.
3. Analysis of frequency distribution of plants in a piece of vegetation by quadrat method.
4. Analysis of soil grain size
5. Study of soil profile
6. Quantitative analysis of soil pH.
7. Quantitative analysis of soil conductivity.
8. To study pore space and water holding capacity of soil.
9. To study bulk density of soil.
10. Quantitative analysis of soil organic carbon
- 11 and 12. Case studies of visit to specific ecosystems and identifying the characteristics.

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Environmental Chemistry Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN105-20	Core Practical/Laboratory	Environmental Chemistry Lab	0	0	4	60	40	100	2

1. Visualisation and verification atmospheric process and effects (showing some educational videos on the subject)
2. Collection and preservation of environmental samples
3. Determination of carbonate and bicarbonate in water samples
4. Correlation between acidity, alkalinity and hardness
5. Estimation trace elements and nutrients in water
6. Redox reactions: construction of pE – pH diagrams
7. Experiment on solubility and precipitation
8. Analysis of soil samples for various characteristics like pH, minerals, cation exchange capacity etc.
9. Adsorption experiments and preparation isotherms
10. Estimation of organic compounds in environmental samples
11. Chemical and biological degradation of organic compounds
12. Absorption and scattering of light due to particles.

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Biostatistics Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN106-20	Core Practical/Laboratory	Biostatistics Lab	0	0	4	60	40	100	2

1. Data collection from field or forests
2. Secondary data collection from existing literature
3. Classification and Tabulation of collected data
4. Frequency distribution and graphs from the collected data
5. Estimation of central tendency and dispersion from the collected data
6. Testing exercise for t-test
7. Exercises to find out the statistical parameters and correlation based on SPSS software and MS Excel
8. Exercise on multiple regression analysis on collected data
9. Time series data analysis on any environmental issues
10. To calculate ratio by one way annova method
11. Data analysis through statistical software for multivariate data
12. Exercise on correlation coefficient between two different variables

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English

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BTHU103/18	Ability Enhancement Compulsory Course (AECC)-I	English	1	0	0	40	60	100	1

Detailed Contents:

Unit1- 1 (Introduction)

- Theory of Communication
- Types and modes of Communication

Unit- 2 (Language of Communication)

- Verbal and Non-verbal
- (Spoken and Written)
- Personal, Social and Business
- Barriers and Strategies
- Intra-personal, Inter-personal and Group communication

Unit-3 (Reading and Understanding)

- Close Reading
- Comprehension
- Summary Paraphrasing
- Analysis and Interpretation
- Translation(from Hindi/Punjabi to English and vice-versa)

OR

Precis writing /Paraphrasing (for International Students)

- Literary/Knowledge Texts

Unit-4 (Writing Skills)

- Documenting
- Report Writing
- Making notes
- Letter writing

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, DrRanjanaKaul,

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DrBratiBiswas

5. On Writing Well. William Zinsser. Harper Resource Book. 2001

6. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

English Practical/Laboratory

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BTHU10 4/18	Ability Enhancement Compulsory Course (AECC)	English Practical/Laboratory	0	0	2	30	20	50	1

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self Introduction , Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Monologue
- Effective Communication/ Mis- Communication
- Public Speaking

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.

2. Business English, Pearson, 2008.

3. Practical English Usage. Michael Swan. OUP. 1995.

4. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

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Human Values, De-addiction and Traffic Rules

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
HVPE10 1-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules	0	0	2	30	20	50	1

Unit-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Unit-II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
2. Understanding the needs of Self (‘I’) and ‘Body’ - Sukhand Suvidha
3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Swasthya

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

Unit-III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding harmony in the Family- the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
3. Understanding the meaning of Vishwas; Difference between intention and competence

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4. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): samadhan, Samridhi, Abhay, Sah-astitvaas comprehensive Human Goals

6. Visualizing a universal harmonious order in society- Undivided

Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

Unit-IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the nature
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

Unit-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
 - Ability to utilize the professional competence for augmenting universal human order
 - Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
 - Ability to identify and develop appropriate technologies and management patterns for above production systems.
 - Case studies of typical holistic technologies, management models and production systems
 - Strategy for transition from the present state to Universal Human Order:
 1. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
 2. At the level of society: as mutually enriching institutions and organizations

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Text Book

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.

Reference Books

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. A Nagraj, 1998, Jeevan Vidyaek Parichay, Divya Path Sansthan, Amarkantak.
4. Susan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.
5. PL Dhar, RR Gaur, 1990, Science and Humanism, Common wealth Publishers.
6. A.N. Tripathy, 2003, Human Values, New Age International Publishers.
7. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books

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Human Values, De-addiction and Traffic Rules (Lab/ Seminar)

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
HVPE10 2-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules (Lab/ Seminar)	0	0	1	25	--**	25	1

One each seminar will be organized on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar at least once during the semester. It will be binding for all the students to attend the seminar.

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Mentoring and Professional Development

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD10 2-18		Mentoring and Professional Development	0	0	1	25	--**	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

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Biodiversity components

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN201-20	Core Theory	Biodiversity components	3	1	0	40	60	100	4

Unit-I:

Biodiversity: Basic concepts, importance and conservation need, Species diversity, Biological and phylogenetic species concept, speciation, natural longevity of species and optimum biodiversity, species extinction.

Unit-II:

Classification, taxonomic nomenclature, Principles of classification and nomenclature of plants, animals and micro-organism, Micro-organism: main taxonomic groups of micro-organism. Organization and function of a bacterial and fungal cell.

Unit-III

General Characteristics, habitat and economic importance of microorganism-Chemoautotrophs, Bacteria, Blue-Green Algae, Yeasts, Fungi and Algae, Microbial toxins in environment, Microbial Diseases of man

Unit-IV:

Diversity of insects, nematodes, fishes, birds, reptile and other mammals, their role in environment and economic, food, fisheries, pollination and seed dispersal, importance of wild life, endangered species, Bryophytes and lichen, land habit in Bryophytes, role of bryophytes in soil building. Lichens as ecological indicators, Pteridophytes, gymnosperms and angiosperms, general characteristics, habitat, role in environment and economic uses

Unit-V

Concept of threatened species, Threatened and endangered animals of India, Importance and conservation of tropical regions, wetlands, mangroves, coral reefs, Ex-situ and In-situ conservation, Wild life sanctuaries, National Parks and Biosphere Reserve, Concept of genetic diversity, gene and germ-plasma banks, Biodiversity convention, Socio-cultural aspects of biodiversity,

References:

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1. Chandel, K.P.S., Shukla, G. And Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India Conservation and Utilization, National Bureau of Plant Genetic Resources, New Delhi.
2. Zachos, Frank E.; Habel, Jan Christian (2011) Biodiversity Hotspots, Distribution and Protection of Conservation Priority Areas, Springer
3. Council of Scientific and Industrial Research (1986). The Useful Plants of India Publication and Information Directorate, CSIR, New Delhi.
4. Nair, M.N.B. et. al. (Eds.) (1998). Sustainable Management of Non-wood Forest Products. Faculty of Forestry, University Putra. Malaysia. 434 004 PM Serdang, Selangor, Malaysia.
5. Soule, M.E. (ed.) (1986). Conservation Biology. The Science of Scarcity and Diversity. Sinaur Associates, Inc., Sunderland, Massachusetts.

Ecosystem Dynamics

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN202-20	Core Theory	Ecosystem Dynamics	3	1	0	40	60	100	4

Unit-I:

Ecosystem: Basic concepts, structure of ecosystem, Abiotic and Biotic components, food chains and food webs, Trophic levels, Ecological pyramids.

Unit-II :

Function of ecology- material and Energy flow in ecological systems, energy efficiencies, Concept ecological pathways, conservation of matter.

Unit-III:

Significance of biogeochemical Cycles: gaseous and sedimentary cycles. Oxygen, Carbon, Nitrogen, Phosphorus and Sulphur Cycles, Hydrological cycles.

Unit-IV:

Evolution and Succession: Concepts of succession, succession process- 'r' and 'k' hypothesis, Types of Succession. Clements' theory of succession, Climax and stability, seral community, Coevolution and group selection, Forest succession.

Unit-V:

Biomes and classification, Characteristics of major biomes-terrestrial fresh water and marine ecosystems, important terrestrial and aquatic ecosystems of India, Major biomes of the world.

References:

1. W. S. C. Gurney, R. M. Nisbet (1998), Ecological Dynamics, Oxford University Press. in.
2. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.
3. Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
4. Singh K.P. and J.S. Singh (1992). Tropical Ecosystems: Ecology and Management. Wiley Eastern Limited, Lucknow, India.
5. Singh, J.S. (ed.) 1993. Restoration of Degraded Land: Concepts and Strategies. Rastogi Publications, Meerut.
6. Smith, R.L. (1996). Ecology and Field Biology, Harper Collins, New York.

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7. Botkin, D.B. and Keller, E.A. 2000. Environment Science: Earth as a living planet. Third Edition. John Wiley and Sons Inc.

Natural Resources and Management

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN203-20	Core Theory	Natural Resources and Management	3	1	0	40	60	100	4

Unit –I:

Basic concepts, role in human civilization, World energy scenario, Renewable and non renewable sources of energy, Non Renewable Energy Resources: Fossil fuels and their reserves, Nuclear energy, types, uses and effects. Energy utilization and its effects on environment, Energy crisis

Unit –II:

Renewable Energy Resources: Hydropower, Solar energy, geothermal, tidal and wind energy, Energy conservation: In agriculture and industrial sector, Energy plantation; Petro crops, Hydrogen as a future energy source, waste to energy concept, Sustainable use of energy resources, Biotechnological approach of Energy management- Biomass, biogas, bioethanol, biohydrogen, advantages

Unit –III:

Biological resources: Types and uses of biological resources, Forest resources and conservation in India, Wild life conservation efforts in India, Project tiger, range management, Soil and Mineral resources: mineral resources in India, types of soil, soil erosion. soil conservation techniques. Types of land use, Land conservation strategies

Unit –IV:

Water resources: Types and uses of water resources, Methods of enhancing fresh water supply, Watershed management & its importance, Sustainable management of water resources in agriculture, industry and urbanization, Remote sensing in resource management

Unit –V:

Concept of sustainable development and management of natural resources, Environment awareness and education, major conservation effort of National Agency- MoFE and CPCB, introduction to major international agency – WWF, IUCN, UNEP, CITES, ENVIS

References:

1. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
2. Donahue R.L. and Miller R.W. 1997 Soils In Our Environment, Prentice Hall of India Pvt. Ltd., New Delhi.

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3. Morgen, M.D. Morgen J.M. and Wiersima J.H. 1993, Environmental Science: Managing Physical and Biological Resources Wm C Brown Publishers London.
4. Tyler Miller Jr. G. 2005. Living in the Environment. Wadsworth Publishing Company, Belmont California.
5. Botkin, D.B and Keller E.A., 2000, Environmental Studies: The earth as a living plant. Charles E. Merrill, Publishing Co. London.
6. Shastri M.N.1995, Energy Options: Himalaya Publishing House, New Delhi.
7. Dhaliwal G.S., Sangha G.S. and Ralhan P.K. 2000, Fundamentals of Environmental Science, Kalyani Publishers, New Delhi.
8. Singh J.S., Singh S.P. and Gupta S.R., 2006, Ecology Environment and Resource Conservation, Anamaya Publishers, New Delhi.

Biodiversity components lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN20 3-20	Core Practical/Laboratory	Biodiversity components lab	0	0	4	60	40	100	2

1. To determine chlorophyll content of the given plant material.
2. Quantitative analysis of soil organic carbon.
3. Preparation of field report based on the survey of local flora.
4. Preparation of field report based on the survey of local fauna
5. Visit to in situ or ex situ conservation centre
6. Study of centre of diversity of plants from maps.
7. Comments on life cycle of some economically important insects.
8. Identification of museum specimens of some economically important fishes.
9. Studies on life cycle of birds
10. Preparation of field report based on the visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve.
11. To determine the soil pH, conductivity, soil texture and water holding capacity of soil.
12. Studies on aquatic weeds

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Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN204-20	Core Practical/Laboratory	Ecosystem lab	0	0	4	60	40	100	2

1. Sampling techniques.
2. To determine basal cover of trees in a forest ecosystem/forest plantation.
3. Demonstration of water conservation techniques.
4. Field Ecology – Terrestrial and aquatic flora
5. To prepare a report on various types of local fresh water ecosystem.
6. Characterization and categorization of threatened species and habitat for biodiversity conservation in peri-urban forest ecosystem
7. Study of flora of an urban terrestrial ecosystem
8. Study of fauna of an urban terrestrial ecosystem
9. Identification and classification of phytoplankton's from water sample
10. Identification and classification of zooplankton's from water provided sample
11. Estimation of biomass from grassland by harvest method
12. To determine the importance value index (IVI) and species diversity index of grassland ecosystem

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Natural resources Management Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN205-20	Core Practical/Laboratory	Natural resources Management Lab	0	0	4	60	40	100	2

1. Vegetation analysis: Frequency, Abundance and Density, Cover and Basal area, Important and Value Index
2. Identification of rocks on the basis of physical characteristics
3. Physical and chemical properties of minerals
4. Visit to forest areas with different site conditions
5. Determination wind velocity by anemometer.
6. Identification of biological specimens and economical important.
7. Identification of fresh water microbes
8. Small projects/ models on wind energy
9. Monitoring of micro-meteorological parameters, maximum and minimum temperature, relative humidity
10. Preparation of wind rose diagram
11. Identification of coal fields - Economic aspects, availability of coal or Usage of topographic maps - to study about land forms
12. Small projects on Biogas

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Environmental Science

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
EVS102-18	Ability Enhancement Compulsory Course (AECC) -III	Environmental Science	2	0	0	40	60	100	2

Unit-I Introduction to Environmental Studies Multidisciplinary nature of Environmental Studies: Scope & Importance, Need for Public Awareness

Unit- II : Natural Resources :Renewable and non-renewable resources, Natural resources and associated problems.Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

Unit-III : Ecosystems : Concept of an ecosystem, Structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems: a. Forest ecosystem b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-IV : Biodiversity and its conservation : Introduction – Definition : genetic, species and ecosystem diversity, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India

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Unit-V : Social Issues and the Environment : From Unsustainable to Sustainable development, Resettlement and rehabilitation of people; its problems and concerns., Environmental ethics : Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust, Case Studies, Public awareness.

Field Work

Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary

Documentation & preparation of a Biodiversity (flora & fauna) register of campus/river/forest

Visit to a local polluted site: Urban/Rural/Industrial/Agricultural

Identification & Photography of resident or migratory birds, insects (butterflies)

Public hearing on environmental issues in a village

References & Books

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, New Delhi.
1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd
4. Environment Biology by Agarwal, K. C., Nidi Publ. Ltd. Bikaner.
5. Principle of Environment Science by Cunningham, W.P.
6. Essentials of Environment Science by Joseph.
7. Perspectives in Environmental Studies by Kaushik, A.
8. Elements of Environment Science & Engineering by Meenakshi.
9. Elements of Environment Engineering by Duggal.

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Mentoring and Professional Development

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD202-18		Mentoring and Professional Development	0	0	1	25	--	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

1. Overall Personality
2. Aptitude (Technical and General)
3. General Awareness (Current Affairs and GK)
4. Communication Skills
5. Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

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1. Sports/NSS/NCC
2. Society Activities of various students chapter
3. Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty in charges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

3rd Semester

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3rd Semester
Renewable and non- renewable Energy Resources

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN301-20	Core Theory	Renewable and non-renewable Energy resources	3	1	0	40	60	100	4

Unit-1: Energy Scenario: Indian and global, Present and future energy demands, Energy crisis, Classification of various energy sources, Renewable and non-renewable energy sources, Pattern of energy consumption.

Unit-2: Solid Fuels: Coal: Origin, formation, analysis, classification, washing and carbonization, Treatment of coal gas, Recovery of chemicals from coal tar, Coal gasification, Liquid fuel synthesis from coal, Carbonization of coal, Briquetting of fines. Liquid and Gaseous Fuels: Crude petroleum, Physical processing of crude petroleum, Fuels from petroleum, Storage and handling of liquid fuels, Natural and liquefied petroleum gases, Gas hydrates, Gasification of liquid fuels, Carbureted water gas. Non Renewable Energy Resources: Fossil fuels and their reserves Nuclear energy, types, uses and effects Energy utilization and its effects on environment Energy crisis

Unit-3:Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations. 8 II Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants

Unit- 4 Geothermal Energy: Resources of geothermal energy, thermodynamics of geo- thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations..

Unit-5 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

Unit6 Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants

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- Text Book:** 1. Raja et al, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications, 2006.
4. D.S. Chauhan, “Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle, “Renewable Energy Power For A Sustainable Future”, Oxford University Press

Text Books: 1. Rao, S. and Parulekar, B.B., Energy Technology-Non-conventional, Renewable and Conventional, Khanna Publishers (2000).

2. Gupta, O.P., Elements of Fuel, Furnaces and Refractories, Khanna Publishers (1996)

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Fundamentals of Nanotechnology

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN302-20	Core Theory	Fundamentals of Nanotechnology	3	1	0	40	60	100	4

Unit1: Fundamentals of Nanoscience , History of Nanoscience and Nanotechnology; Properties at nanoscale (optical, electronic and magnetic); Theory, definitions and concepts of scaling

Unit 2: Classes of Nanomaterials, Metal and Semiconductor Nanomaterials; Quantum Dots, Wells and Wires; Bucky balls and Carbon Nanotubes; Organic-based nanomaterials

Unit 3: Synthesis and Characterization of Nanomaterials, Top-down method of synthesis - Nanolithography, CVD, ball milling; Bottom-up method of synthesis – Colloidal synthesis, solgel method; Self-assembly method; Molecular design and modeling; Physico-chemical characterization on nanomaterials – optical method (UV-vis absorption and fluorescence spectroscopy), electron microscopy techniques (SEM and TEM) and scanning probe method

Unit 4: Nanotechnology and Environment, Treatment of contaminated surface water, groundwater and wastewater; Nanofiltration for water purification, nano filters for air pollution; environmental remediation

Unit 5: Applications of Nanomaterials, Nanomedicine – Chemical and biosensors, Nanobiotechnology, Drug Delivery, Green Nanotechnology – Nanomaterials as solution to environmental problems Renewable energy – Nanomaterials for solar cells and fuel cells

Reference:

1. A.Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007
3. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		

BSEN303- 20	Core Theory	Environmental Microbiology and biochemistry	3	1	0	40	60	100	4
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Unit 1 Microorganisms and their Habitats

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes, Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

Unit 2 Microbial Interactions and Biogeochemical Cycling

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, Predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions, Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent Bacteria. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilization, Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese.

Unit 3 Microbial Bioremediation and Waste Management

Principle and types of bioremediation. Overview on the microbial bioremediation of inorganic (metals) matter and biodegradation of common organic pollutants (pesticides, hydrocarbons, and, biosurfactants). Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (Composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, Secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary Sewage treatment.

Unit 4 Introduction to Biochemistry

A historical prospective,

Carbohydrates:- Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of monosaccharides.

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, serotonin, GABA, histamin, glutathione); biosynthesis of essential & non-essential amino acids.

Proteins: Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

UNIT 5 Lipids and Nucleic acids

Lipids: Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, membrane protein – structural aspects,

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Lipoproteins (elementary idea). Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, Ketone bodies.

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA, Biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine.

References

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Heidelberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.

Energy resources lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN304-	Core	Energy resources lab	0	0	4	60	40	100	2

20	Practical/Laboratory								
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Energy Resources lab

1. Study of Solar Radiation by using Pyranometer.
2. Study of Solar Distillation or Solar Still.
3. To study the constructional details of a box type solar cooker
4. Study of Forced circulation solar water heating system
5. Study of Solar Street Lighting and Lanterns.
6. Study of Horizontal Wind Mill.
7. To study biogas plants
8. To study the production process of biodiesel
9. To study briquetting machine
10. To study solar photovoltaic system

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Nanotechnology Lab

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Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN305-20	Core Practical/Laboratory	Nanotechnology Lab	0	0	4	60	40	100	2

Nanotechnology Lab

1. To calculate the absorption coefficient from UV-Vis spectrometer
2. To do the peak analysis of IR transmission spectrum using FTIR spectrometer
3. Trace out the emission spectra for UV excited luminescent sample
4. To determine particle size of nanoparticles using UV spectra
5. To synthesis nanoparticles using colloidal method

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Microbiology and biochemistry lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN306-20	Core Practical/Laboratory	Microbiology and biochemistry lab	0	0	4	60	40	100	2

1. Microbiology Good Laboratory Practices (GLP) and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation; synthetic media, Complex media, Nutrient agar, MacConkey agar.
4. Simple staining, negative, Gram staining.
5. Isolation of pure cultures of bacteria by streaking method.
6. Estimation of CFU count by spread plate method/pour plate method.
7. Motility by hanging drop method.
8. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non-reducing sugars.
9. Qualitative/Quantitative tests for lipids and proteins.

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Basics of computers

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN307-20	Skill Enhancement Course-I	Basics of computers	1	0	0	40	60	100	1

Unit-I Human Computer Interface Concepts of Hardware and Software; Data and Information. Functional Units of Computer System: CPU, registers, system bus, main memory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors. Devices: Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter. Memory: Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks. Data Representation: Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication).

Unit-II Concept of Computing, Types of Languages: Machine, assembly and High level Language; Operating system as user interface, utility programs. Word processing: Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, equation editors.

Unit-III Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs. Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.

Digital Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education
2. Computer Fundamentals, A. Goel, 2010, Pearson Education.
3. Fundamentals of Computers, P. K.Sinha & P. Sinha, 2007, BPB Publishers.
IT Tools, R.K. Jain, Khanna Publishing House
4. "Introduction to Information Technology", Satish Jain, Ambrish Rai & Shashi Singh, Paperback Edition, BPB Publications, 2014.

Reference Books:

1. “Introduction to Computers”, Peter Norton
2. Computers Today, D. H. Sanders, McGraw Hill.
3. “Computers”, Larry long & Nancy long, Twelfth edition, Prentice Hall.

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Computer Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN308-20	Skill Enhancement Course- Laboratory	Computer Lab	0	0	2	30	20	50	1

Word Orientation: The instructor needs to give an overview of word processor.

Details of the four tasks and features that would be covered Using word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

1. Using word to create Resume Features to be covered: - Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.

2. Creating an Assignment Features to be covered: - Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

3. Creating a Newsletter Features to be covered :- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs

4. Creating a Feedback form Features to be covered :- Forms, Text Fields, Inserting objects, Mail Merge in Word. Excel Orientation: The instructor needs to tell the importance of Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered Excel – Accessing, overview of toolbars, saving excel files,

1. Creating a Scheduler Features to be covered :- Gridlines, Format Cells, Summation, auto fill, Formatting Text

2. Calculations Features to be covered :- Cell Referencing, Formulae in excel – average, std.deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP

4. Game (like Cricket, badminton) Score Card Features to be covered :- Pivot Tables, Interactive Buttons, Importing Data, Data Protection, Data Validation Presentation Orientation:

1. Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows

2. This session helps students in making their presentations interactive. Topics covered includes : Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts
3. Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides. Auto content wizard, Slide Transition, Custom Animation, Auto Rehearsing
4. Power point test would be conducted. Students will be given model power point presentation which needs to be replicated

Reference Books:

1. IT Tools, R.K. Jain, Khanna Publishing House.
2. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
3. Introduction to information technology, Turban, Rainer and Potter, John Wiley and Sons
- . 4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen F Monk, Thomson Learning

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Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD302-18		Mentoring and Professional Development	0	0	1	25	--	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

4th Semester

IK Gujral Punjab Technical University
B.Sc. Environment Science
Environment Pollution

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN401-20	Theory	Environment Pollution	3	1	0	40	60	100	4

Unit -I

Air pollution: sources of air pollution, Primary and secondary air pollutants, Origin and effects of SO_x, NO_x, CO_x, CFC, Hydrocarbon, Photochemical smog, heavy metals, control of air pollution.

Noise pollution – sources; frequency, intensity and permissible ambient noise levels; effect on communication, impacts on life forms and humans; control measures.

Unit -II

Soil pollution: Causes of soil pollution, Effects of soil pollution, Pesticides in soil environment and their effects, Biological magnification, mining and pollution

Unit -III

Water pollution: sources and types of water pollution, Effects of water pollution on living organism, Eutrophication, A brief idea sources, effects and control measures of marine pollution, ground water pollution, thermal pollution

Unit -IV

Climate change: Causes and effects, advanced techniques and methods in pollution control-particulate matter, POPs, NO_x, CO, catalytic converter, scrubber, other advanced techniques

Unit –V

Health and environment-Water born diseases, respiratory hazardous, climate change and human health, Metal toxicity-Mercury, Lead, Cadmium, Arsenic, Radiation damage, Influences of meteorological factors on air quality,

Text Books:

- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. Environmental and Pollution Science. Elsevier Academic Press.
- Purohit, S.S. & Ranjan, R. 2007. Ecology, Environment & Pollution. Agrobios Publications.

Reference Books:

- Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis.
- Hester, R.E. & Harrison, R.M. 1998. Air Pollution and Health. The Royal Society of Chemistry, UK.
- Park, K. 2015. Park's Textbook of Preventive and Social Medicine (23rd edition). Banarsidas Bhanot Publishers.

IK Gujral Punjab Technical University
B.Sc. Environment Science
Water and Wastewater: treatment and conservation

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN402-20	Theory	Water and Wastewater: treatment and conservation	3	1	0	40	60	100	4

UNIT-I Hydrology, Sources of water and its characteristics, Distribution of water on Earth. Physical and Chemical properties of Water, Various types of water demands, per capita demand water quality standards for various uses. Water Pollution, Water quality standards for various uses, parameters, sources and types of Pollution.

UNIT-II : Ground water Hydrology, Occurrence of groundwater, Ground water zones, and Groundwater System. porosity, permeability and types of Aquifers. The Water Table, ground water flow, functions and Topography, Ground water depletion, Ground water Quality, Ground water pollution.

UNIT-III :Water purification-Screening – Treatment system- sedimentation, coagulation, filtration – rapid sand filter, slow sand filter, advantages and disadvantages. Disinfections – Methods of disinfections, water softening process. taste and odor removal (Aeration).

Wastewater treatment: Characteristics of wastewater, Screening & Grit chambers sedimentation and flocculation, overview to secondary treatment.

Unit 4: Water Conservation: Watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings. Water resources and conflicts on its sharing, case studies on river water disputes between Punjab, Haryana and Rajasthan; Multipurpose river valley projects in India and their environmental and social impacts; water logging : causes, effects and remedial measures, case studies of dams - Narmada and Tehri dam issues;

Reference Books:

1. Water and waste water Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)
2. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
3. Standard Methods for Examination of Water and Waste Water
4. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill, Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor. and company, New Delhi (1974)
5. Water and waste Engineering, Vol.I and II, Fair, G.M. Geyer T.C. and Okun. D.A. (1984): John Wiley and Sons, Strauss, (1975) & (1984)

IK Gujral Punjab Technical University

B.Sc. Environment Science

6. Waste water treatment processes, Metcalf and Eddy Inc. Academic Press, New York. (1979)
7. Standard Methods for Examination of Water and Waste Water American Public Health Association (5th Ed) (1980)
 1. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
 2. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor.

IK Gujral Punjab Technical University
B.Sc. Environment Science
Environment Toxicology

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN403-20	Theory	Environment Toxicology	3	1	0	40	60	100	4

Unit I. Introduction to Environmental Toxicology

- 1.1 Definition, concept and scope of Environmental Toxicology
- 1.2 Common environmental toxicants Heavy metals: Sources and their effects on life and environment Pesticides: Types, uses and harmful effect of pesticides; brief note on biopesticides , persistent organic pesticides.
- 1.3 Mutagenic and carcinogenic chemicals, polycyclic aromatic hydrocarbons , nitrosamines, organic solvents, alcohol, carbon tetrachloride, anaesthetic (chloroform, ether, xylocaine) tobacco chewing and smoking

Unit II. Toxicity Assessment

- 2.1 In-vivo and in-vitro toxicity assessment
- 2.2 Acute , subacute , sub chronic and chronic toxicity test
- 2.3 Skin and eye test, behavioural, neurotoxic, reproductive, mutagenic test, hypersensitivity and allergy.
- 2.4 LD₅₀, LC₅₀, EC₅₀, and IC₅₀
- 2.5 Factors affecting toxicity

Unit III. Systemic Toxicity

- 3.1 Absorption, translocation and excretion Xenobiotics: Membrane permeability and mechanism of chemical transfer, Absorption of xenobiotics, distribution of toxicants, storage depots, translocation of xenobiotics, membrane barriers, excretion of xenobiotics (major detoxifying glands)
- 3.2 Neuro toxicity, hepatotoxicity, immunotoxicity, cardio-vascular toxicity, respiratory dysfunction and hypersensitivity

Unit IV. Biotransformation, Bioaccumulation and Biomagnification

- 4.1 Biotransformation: Principle, sites, biotransformation enzymes, biotransformation for gaseous toxicants
- 4.2 Bioaccumulation: Principle, sublethal and indirect effects of bioaccumulation
- 4.3 Biomagnification, bioconcentration
- 4.4 Bioremediation

Unit V. Environmental Health and Risk Assessment

- 5.1 Risk assessment
- 5.2 Risk assessment models
- 5.3 Risk assessment methods
- 5.4 Risk Management

IK Gujral Punjab Technical University
B.Sc. Environment Science

REFERENCES :

1. Principles of Environmental Toxicology: I. C. Shaw and J. Chadwick; Taylor&Francis ltd
2. Basic Environmental Health (2001): AnnaleeYassi, TordKjellstom, Theo de Kok, Tee Guidotti
3. Environmental Health : Monroe T. Morgan
4. Handbook of Environmental Health and Safety – principle and practices : H. Koren; Lewis Publishers
5. Moore, G.S., 2002, Living with the Earth: concepts in Environmental Health Science (2nd Ed.), Lewis publishers, Michigan
6. Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001. Principles of Ecotoxicology. 2nd Ed. Taylor & Francis, London.
7. Environmental biology and Toxicology, by Sharma P.D. Rastogi and Lamporary.,

IK Gujral Punjab Technical University
B.Sc. Environment Science

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN404-20	Practical	Pollution Monitoring Lab	0	0	4	60	40	100	2

- 1: Monitoring of PM₁₀ and PM_{2.5}
- 2: Determination of noise levels at different places
- 3: Determination of CO₂ emission at different places
- 4: Determination of SO_x and NO_x in ambient air
- 5. Identification of biological indicators of pollution in terrestrial and aquatic habitats
- 6. Determination of Dissolved oxygen in Water
- 7. Determination of BOD in Water
- 8. Determination of COD in Water

References:

1. W.H.O.: Selected Methods of Measuring Air Pollutants.
2. Pandey and Carney: Environmental Engineering
3. Standard Methods for Examination of Water and Waste Water American Public Health Association (5th Ed) (1980)

IK Gujral Punjab Technical University
B.Sc. Environment Science
Water and Wastewater Lab

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN 405-20	Practical	Water and Wastewater Lab	0	0	4	60	40	100	2

1. Determination of pH, TDS and Chloride content of Water
2. Determination of DO in water and wastewater samples
3. Determination of BOD
4. Determination of COD
5. Determination of porosity and permeability of different soils.
6. Determination of infiltration and runoff characteristics.
7. Determination of nitrite content of water samples
8. Determination of phosphate content of water samples
9. Visit to water & wastewater treatment plants

Reference Books:

1. Standard Methods for Examination of Water and Waste Water
American Public Health Association (5th Ed) (1980)
2. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor. and company, New Delhi (1974)
3. Standard Methods for Examination of Water and Waste Water
American Public Health Association (5th Ed) (1980)
4. Waste Water Engineering, Metcalf and Eddy Tata Mc Graw Hill,
5. Physico – Chemical Process for Water quality, Weber. W.J, Ann Arbor.

IK Gujral Punjab Technical University
B.Sc. Environment Science

Environment Toxicology Lab

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN406-20	Practical	Environment Toxicology Lab	0	0	4	60	40	100	2

1. Assessment of toxicity on an organism (fish or tadpole) through dose response relation (LC50/LC50)
2. Bioremediation experiment with the help of water hyacinth
3. Assessment of impact of high temperature on organisms (control experiment)
4. Study of risk assessment model through flow chart Case study of biomagnification in any food chain
5. Case study of biomagnification in any food chain
6. Quantitative analysis of heavy metals in environmental samples. Lead, Cadmium, Mercury, Chromium and Arsenic in air, water and soil samples

Suggested Books

1. Newman, M.C. (2012) Quantitative Ecotoxicology, Second Edition, CRC Press, New York.
2. Newman, M.C. (2009) Fundamentals of Ecotoxicology, Third Edition, CRC Press, USA.
3. Johnson, E (2010) Ecotoxicology, Academic Press, New York.
4. Walker, C.H., Sibly, R.M., Hopkin, S. P., Peakall, D.B. (2012). Principles of Ecotoxicology, Fourth Edition, CRC Press.
5. Calow, P.P. (2009). Handbook of Ecotoxicology, Wiley, USA.
6. Thompson, K.C., Wadhia, K., Loibner, A.P. (2005). Environmental Toxicity Testing, Taylor & Francis, UK.

IK Gujral Punjab Technical University
B.Sc. Environment Science

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN407-20	Theory	Environment Impact Assessment (EIA)	0	0	4	60	40	100	2

Unit I. Environmental Impact Assessment (EIA)

- 1.1. Concept, scope and objectives of EIA
- 1.2. Evolution of EIA and its development
- 1.3. Developmental projects under EIA
- 1.4. Protocol for environmental impact statement (EIS)
- 1.5. EIA Laws and Policy: An overview
- 1.6. EIA guidelines 1994: Notifications of Government of India
- 1.7. EIA Notification 2006 and subsequent modifications

Unit II: Methods of Impact Analysis

- 2.1. Procedure of EIA
- 2.2. Screening, scoping and baseline data collection for EIA
- 2.3. Impact prediction on air, water, land, biota, socio-economic environment
- 2.4. Impact assessment methodologies (Ad-hoc, Simple Checklist, Overlays, Matrices, Network, Combination Computer aided)
- 2.5. Concept of Cumulative Environmental Impact Assessment (CEIA)
- 2.6. Case studies of EIA: River valley projects, mining, roadconstruction, industries

Unit-III: Statuary Clearance Procedure and PublicConsultation

- 3.1. Expert Appraisal Committee (EAC)
- 3.2. Environmental Clearance, Wildlife Clearance and ForestClearance
- 3.3. Permission for carrying out survey and investigation
- 3.4. State Expert Appraisal Committee (SEAC) and State EIAAuthority (SEIAA)
- 3.5. Concept and objectives of Public Consultation
- 3.6. Techniques and consultation approach for publicConsultation

References:

1. EIA manual. Ministry of Environment and Forests, Government of India (<http://www.envfor.nic.in/legis/eia/so195.pdf>).
2. EIA notification, Gazette Notification:SO1533dated14-09-2006, MOEF. GOI (2006).
3. MunnRE, Environmental Impact Assessment -Principles and Procedures, Scientific Committee on Problems of the Environment (SCOPE)-5 (1979).
4. Petts J, Handbook of Environmental Impact Assessment, Taylor & Francis (1995).

IK Gujral Punjab Technical University
B.Sc. Environment Science
Environment Impact Assessment (EIA) Lab

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BSEN408-20	Practical	Environment Impact Assessment (EIA) Lab	0	0	4	60	40	100	2

1. Presentation of EIA through flowchart
2. Presentation of case study of EIA of any developmental project
3. Presentation of procedure of environmental auditing through flow chart
4. To prepare an audit report for submission to the regulatory body
5. Presentation of environmental clearance (EC) through flow chart
6. Presentation of forest clearance (FC) through flow chart
7. Presentation of wildlife clearance (WC) through flow chart

References :

1. Anjaneyulu, Y.(2002), Environmental Impact Assessment Methodologies. BSP BS Publications, Hyderabad.
2. Shukla S.K and Shrivastav P.R (1992). Concepts in Environmental Impact analysis. Commonwealth Publishers, New Delhi
3. Shukla S.K and Shrivastav P.R.(1992). Methodology of Environmental Monitoring and Assessment. Commonwealth Publishers, New Delhi.

IK Gujral Punjab Technical University
B.Sc. Environment Science

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD10 2-18		Mentoring and Professional Development	0	0	1	25	--**	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

IKG Punjab Technical University

B.Sc (Environmental Science

Fifth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN501-20	Skill Enhancement Course-III	Environmental Monitoring and Techniques	1	0	0	40	60	100	1
BSEN502-20	Skill Enhancement Course-Laboratory	Advanced instrumentation Techniques	0	0	2	30	20	50	1
BSEN503-20	Open Elective-I	Environmental Agriculture#	3	1	0	40	60	100	4
BSENXX X-20	Elective-I	Elective I	3	1	0	40	60	100	4
BSENXX X-20	Elective-II	Elective II	3	1	0	40	60	100	4
BSENXX X-20	Elective-I Laboratory	Elective I Lab	0	0	4	60	40	100	2
BSENXX X-20	Elective-II Laboratory	Elective –II Lab	0	0	4	60	40	100	2
BSEN520-20	Project	Minor Project	0	0	2	Satisfactory / Un Satisfactory			2
BMPD502-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		10	03	13	335	340	675	21

Any of the available courses in other programmes such as management or Sciences relevant to the field can also be considered with the approval of the BoS/University.

List of Elective

List of Elective-I

BSEN504-20 Sustainable Development Goals (SDG's)
BSEN512-20 Sustainable Development Goals (SDG's) Practical
BSEN505-20 Environmental Ethics and Human Values
BSEN514-20 Environmental Ethics report writing
BSEN507-20 Hazards and Risk Assessment
BSEN515-20 Hazards and Risk Assessment Practical

List of Elective-II

BSEN508-20 Solid and Hazardous Waste Management
BSEN516-20 Solid and Hazardous Waste Management Practical

BSEN509-20 Climatology
BSEN517-20 Climatology Practical
BSEN510- Environment and Society
BSEN518-20 Environment and Society Practical

Environmental Monitoring and Techniques

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN501-20	Skill Enhancement Course-III	Environmental Monitoring and Techniques	1	0	0	40	60	100	1

Unit 1: Environmental Monitoring: Concept and objectives of environmental monitoring; Global environmental monitoring system (GEMS); National environmental monitoring programs; Bioindicators and biological monitoring.

Unit 2: Conceptual Basis of Environmental Monitoring Systems: Basic concepts, applications and importance of Environmental Monitoring; Environmental laboratories; Standards procedures for the sampling and analytical techniques; Instrumentation, equipment and facilities for environmental sampling and analysis; Reference materials; Representative samples; Precision and accuracy; Measurement of uncertainty; Environmental monitoring data analysis and management.

Unit 3: Sampling Techniques: Sampling of waters and wastewaters; Flow measurement and composite sampling; Ambient air quality monitoring; Stack monitoring; Tail pipe emissions monitoring; Noise monitoring; On-line monitoring; Preservation, storage and transportation of environmental samples.

Unit 4: Analytical Techniques: Gravimetry, titrimetry, potentiometry (including ion analyzers), turbidimetry, conductimetry, and colorimetry (UV-visible spectrometry); preparation (digestion, extraction, etc.) environmental samples for analysis; Flame photometry, AAS; Chromatography, GC, HPLC; PM₁₀, PM_{2.5}, high volume samplers, Flue gas analyzers.

Reference Books:

1. Shukla SK and Srivastava PR, Methodology for Environmental Monitoring and Assessment, IK Publishers (1992)
2. Wiersma G, Environmental Monitoring, CRC Press (2004)
3. Standard Methods for Examination of Water and Wastewater: APHA-AWWA-WEF; Boston (1989)
4. Skoog DA, Holler FL and Nieman TA, Principles of Instrumental Analysis, Harcourt College Publishers (1997)

Advance Instrumentation Techniques

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN502-20	Skill Enhancement Course-III Lab	Advance Instrumentation Techniques	0	0	2	30	20	50	1

List of Experiments

1. Principle, working and handling of pH meter.
2. Principle, working and handling of Turbidity meter.
3. Principle, working and handling of Conductivity meter.
4. Principle, working and handling of Fluorescence spectrophotometer.
5. Principle, working and handling UV-VIS Spectrophotometer.
6. Principle, working and handling of IR spectrophotometer.
7. Principle, working and handling of Gas Chromatograph.
8. Principle, working and handling of HPLC Chromatograph.

Reference Books:

1. Eugene WR, Rodger BB, Andrew DE, Lenore SC (editors), Standard Methods for Examination of Water and Wastewater: APHA-AWWA-WEF; Boston(2012).
2. Pradyot P, Handbook of Environmental Analysis Chemical Pollutants in Air, Water, Soil and solid wastes, CRC Press (2017).
3. Skoog DA, Holler FL and Crouch, Principles of Instrumental Analysis, Cengage Publishers (2018).
4. Gunzler H and Williams A, Handbook of Analytical Techniques, Wiley-VCH (2002).

Agriculture and Environment

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN503-20	Open Elective -I	Agriculture and Environment	3	1	0	40	60	100	4

Unit 1: Soils: Cultivation; Major problems associated with the soils (Loss of soil fertility, Soil erosion, Salinity and sodicity, Soil structural decline, Soil acidification, and Buildup of chemical residues); Impacts on soil organic carbon and soil biotic community; soil conservation measures.

Unit 2: Crops and cropping patterns: Food, fodder, energy and fiber crops; Impacts on biodiversity, Water logging; Salinization; agricultural drainage and pollution of water bodies and ground water pollution; Irrigation by treated effluent; drip irrigation; sprinkler systems of irrigation.

Unit 4: Chemicals in agriculture: Pesticides and inorganic fertilizers; Integrated pest control; biofertilizers and biopesticides; Organic farming; composting and vermicomposting; Ecological farming; Limited till and Zero tillage farming, Nature Farming, Integrated Nutrient Management

Unit 5: Agricultural residues and wastes: Integrated agricultural systems; Biomass fuels (anaerobic digestion, biodiesel); fiber source; **Sustainable Agriculture:** Green revolution and its impact; Impact of climate change on agriculture; unsustainable features of different agricultural practices; Nature and importance of sustainable agriculture; Sustainability concepts for the management soil, water, plants and animals, and for the control of weeds, pests and diseases; Examples of farming practices that are economically viable, environmentally sound and socially responsible, Green house culturing and Urban agriculture.

Reference Books:

1. Mason J, Sustainable Agriculture, 2nd ed, Land links, (2003).
2. Vandermeer JH, The Ecology of Agroecosystems, Jones and Bartlett (2011).

Environmental Ethics and Human values

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN506-20	Elective-I	Environmental Ethics and Human values	3	1	0	40	60	100	4

Unit 1. Environmental Ethics

Definition and concept of environmental ethics, Resource consumption patterns and need for equitable utilization, Anthropocentrism, stewardship, biocentrism, ecocentrism, cosmocentrism, Conservation ethics, traditional value system in India.

Unit-II: Introduction to Human Values

Values, Characteristics, Types, Developing Value system in Indian Organizations, Values in Business Management, Value based Organization, Trans-Cultural Human values in Management. Swami Vivekananda's philosophy of Character building, Gandhi Concept of Seven sins, APJ Abdul Kalam view on role of parents and Teachers.

Unit- III: Principals of Ethics

Secular and Spiritual values, Levels of value Implementation. Features of spiritual values, Corporate Social Responsibility (CSR)- nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates

Unit-IV: Human Values and Present Practices

Issues: Corruption and Bribe, Privacy Policy in Web, and social media, Cyber threats, Online Shopping. Remedies Introduction to sustainable policies and Practices in Indian Economy.

Reference Books

1. Gaur RR, Sangal R, A foundation course in Human Values and Professional Ethics, Excel Books (2010).
2. Justice: What's the Right Thing to do? Michael J. Sandel, Penguin UK (2008).
3. Tripathi AN, Human Values, New Age International (2006).
4. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
5. <https://www.india.gov.in/my-government/schemes>
6. Nagendra M, A Review of Handbook of Human values and Professional Ethics, Notion Press (2020).
7. Mark R, Human Value, Environmental Ethics and sustainability The Precautionary Health Principle, Rowman and Littlefield (2016).

Environmental Ethics Report Writing

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN505-20	Elective -I Lab	Environmental Ethics Report Writing	0	0	4	60	40	100	2

1. Report writing on different Environmental issues: Climate Change, Land Degradation, Deforestation, Pollution, Desertification, Biodiversity Conservation, Human and Wildlife Conflicts
2. Report writing on Plagiarism
3. Discussion on Conflicts of thought process on different Environment ethical values
4. Case studies and Group Discussion
5. Seminars
6. Expert Lectures

Reference Books

1. Gaur RR, Sangal R, A foundation course in Human Values and Professional Ethics, Excel Books (2010).
2. Justice: What's the Right Thing to do? Michael J. Sandel, penguin UK (2008).
3. Tripathi AN, Human Values, New Age International (2006).
4. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
5. <https://www.india.gov.in/my-government/schemes>
6. Nagendra M, A Review of Handbook of Human values and Professional Ethics, Notion Press (2020).
7. Mark R, Human Value, Environmental Ethics and sustainability The Precautionary Health Principle, Rowman and Littlefield (2016).

Sustainable Development Goals (SDG's)

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN505-20	Elective -I	Sustainable Development Goals (SDG's)	3	1	0	40	60	100	4

Unit I: Development and Environment: Sustainable Development Goals

Strategies and Framework for Sustainable Development, The 2030 Agenda for Sustainable Development, UN Sustainable Development Knowledge Platform, Sustainable Development Goals, Criticisms in Sustainability: Women and Gender Equality, Education, Public Engagement and Sustainable Development

Unit II: Environmental Conservation and Sustainability

Technical Skills in Environment and Sustainability, Environmental Governance and Sustainability, Environmental Economics and Sustainability, Water Conservation and Sustainable Development, Urbanization and Sustainable Cities, Challenges in Energy, Food, Forest and Agriculture

Unit III: New Developments in Sustainability

Appropriate Technology and Sustainability Science, Sustainable Transport, Sustainability Assessment of Food and Agriculture (SAFA), Corporate Sustainability, Sustainability Metrics and Indices, Ecological and Carbon Footprint for Sustainability Measurement, Sustainability Measurement and Reporting Tools, Life Cycle Assessment.

Unit IV: Indian Efforts on Sustainable development Goals (SDG): Planning of Niti Ayog on SDG's, Planning at state and District level for implementation of SDG's

Reference Books

1. Fulekar MH, Pathak B, Kale RK, Environment and Sustainable Development, Springer Nature (2013).
2. Mishra A, Dahiya V, Tandon K, Sustainable Development in Digital Era, JSR Publishing House LLP, (2019).
3. Jeffrey D Sachs and Ban Ki moon, The Age of Sustainable Development Columbia University Press (2015).
4. Kalam APJ, Singh SP, Target 3 Billion: Innovative Solutions Towards Sustainable Development Penguin India (2011).
5. Goel S, Management of Resources for Sustainable Development, The Orient Blackswan (2016).
6. <https://sustainabledevelopment.un.org/memberstates/india>

Sustainability Development Goals (SDG's) Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN505-20	Elective -I Lab	Sustainable Development (SDG's) Practical	0	0	4	60	40	100	2

1. Preparation of documentary on sustainability practices of an organization or agency or village area
2. Studies on measurements of sustainable farming practices
3. Questionnaire survey on sustainability based on online platforms and analysis
4. Measurement of carbon footprint and ecological footprints by using online software
5. Use of OpenLCA software with case study as a sustainability measurement tool
6. Application of CropWat (FAO) software for crop water requirements and irrigation requirements based on soil, climate and crop data
7. Preparation of sustainability report: Study of any Business venture/start-up

Reference Books

1. Fulekar MH, Pathak B, Kale RK, Environment and Sustainable Development, Springer Nature (2013).
2. Mishra A, Dahiya V, Tandon K, Sustainable Development in Digital Era, JSR Publishing House LLP, (2019).
3. Jeffrey D Sachs and Ban Ki moon, The Age of Sustainable Development Columbia University Press (2015).
4. Kalam APJ, Singh SP, Target 3 Billion: Innovative Solutions Towards Sustainable Development Penguin India (2011).
5. Goel S, Management of Resources for Sustainable Development, The Orient Blackswan (2016).

Hazard and Risk Assessment

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN507-20	Elective -I	Hazard and Risk Assessment	3	1	0	40	60	100	4

Unit I: Natural Hazards: earthquakes, tsunamis, volcanoes, floods, landslides, avalanche, cyclone, drought, fire – causes, perception, mitigation and management.

Unit II: Man-made hazards: Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures.

Unit III: Environmental health hazard and risk assessment: biological, chemical, physical and psychological health hazard; health risk assessment and management.

Unit IV: Risk assessment: Introduction and Scope, Project Planning, Exposure Assessment, Toxicity, assessment, Hazard Identification and Assessment, Risk Characterization, Risk Communication, Environmental Monitoring, Community Involvement, Legal and Regulatory Framework, Human and Ecological Risk Assessment.

Unit V: Hazard Mitigation: Identification of hazard prone belts, hazard zonation and risk assessment; risk reduction in vulnerable areas, developing warning systems, forecasting, emergency preparedness, education and training activities, planning for rescue and relief works.

Reference Books:

1. Calow P, Handbook of environmental risk assessment and management. Oxford: Blackwell Science (1997).
2. Kushy TM, Geological Hazards A Source Book on Hazards and Disasters, Green wood Press, Westport, Conn, London (2003).
3. Gupta and Harsh, Disaster Management, Universities Press (India) Pvt Ltd (2003).
4. Louis Theodore, Ryan DR, Environmental Health and Hazard Risk Assessment: Principles and Calculations, CRC press (2012).

Hazard and Risk Assessment Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN515-20	Elective -I Laboratory	Hazard and Risk Assessment Practical	0	0	4	60	40	100	2

1. Identification of landslide: Landslide Prone Zone and Slope stability using GPR and Resistivity Images.
2. Risk assessment of Hazard and Vulnerability mapping are to be studied through map or imagery and submission of report in the form of Record.
3. Preparation of digital map of disaster-prone areas
4. Report on various preparatory models for rehabilitation

Reference Books:

5. Calow P, Handbook of environmental risk assessment and management. Oxford: Blackwell Science (1997).
6. Kushy TM, Geological Hazards A Source Book on Hazards and Disasters, Green wood Press, Westport, Conn, London (2003).
7. Gupta and Harsh, Disaster Management, Universities Press (India) Pvt Ltd (2003).
8. Louis Theodore, Ryan DR, Environmental Health and Hazard Risk Assessment: Principles and Calculations, CRC press (2012).

Solid and Hazardous Waste Management

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN508-20	Elective -II	Solid and Hazardous Waste Management	3	1	0	40	60	100	4

Unit1: Solid and Hazardous Wastes: Definition, sources and characteristics; Sampling and analysis techniques; Inventorying wastes; Strategies for waste minimization.

Unit 2: Municipal Solid Waste Management: Segregation and recycling and reuse of wastes; Collection, transportation and storage of municipal solid waste; Resource recovery from wastes; waste exchanges; Composting and Vermi-composting of wastes; Municipal solid waste management programs; Disposal–siting and design, Biomass.

Unit 3: Biomedical wastes: Definition, sources of generation, categories, Color coding system for segregation, transportation specifications, treatment methods: Incineration, Microwave, Plasma Pyrolysis, Hydroclave. Treatment and disposal of Plastic waste Treatment and disposal of metal-sharps.

Unit 4: E-waste: Electronic waste: definition, types of e-waste, sources and generation of e-waste, trade of e-waste, hazardous substances in e-waste, environmental impacts of e-waste, management of e-waste-recycling, processing and disposal, Solid waste Management Rules 2016; Biomedical waste (Handling and management) Rules, 2016; E-waste (Handling and management) Rules 2016; Plastic Waste Management Rules, 2016: Battery Waste Management Rules, 2020.

Reference Books

1. Thomas C, Solid Waste Technology & Management, John wiley & sons, USA (2011).
2. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Ed McGraw Hill Inc, India (2017).
3. Pichtel J, Waste Management Practices: Municipal, Industrial and Hazardous, CRC Press (2005).
4. Kreith F and Tchobanoglous G, Handbook of Solid Waste Management, McGraw Hill (2002).
5. Freeman H, Standard Handbook for Hazardous Waste Management, McGrawHill (1989).
6. Hester RE and Harrison RM Electronic Waste Management (Issues in Environmental Science and Technology) Ist Edition RSC publishing (2008).
8. Sahai S, Biomedical waste Management, APH Publishing Corporation (2009).
9. Blude AD and Sudaresan BB, Solid waste management in developing Countries, INSDOC (1972).
10. LaGrega M, Buckingham, P, Evans J and ERM, Hazardous Waste Management, McGraw Hill (2000).

Solid and Hazardous Waste Management Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN516-20	Elective -II	Solid and Hazardous Waste Management Practical	0	0	4	60	40	100	2

1. Sampling of a solid waste
2. Physical analysis of the Municipality Solid waste
 - a. Picking analysis/quantifying material fractions as identifiable items.
 - b. Particle size distribution.
 - c. Moisture content.
 - d. Densities. and chemical analysis
3. Chemical analysis of the waste material
 - a. pH and alkalinity.
 - b. Organic matter.
 - c. Inorganics.
 - d. Heating value/calorific value
4. Compressibility tests
5. Leaching tests
6. Respiration tests
7. Biochemical methane potential tests
8. Design of composting plants • Estimate the oxygen requirements for the aerobic conversion of solid waste
9. Design of Biogas plant • Estimate the amount of gas produced from the organic fraction of solid waste under anaerobic conditions

Reference Books:

1. Thomas C, Solid Waste Technology & Management, John Wiley & Sons, USA (2011).
2. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Ed McGraw Hill Inc, India (2017).
3. Pichtel J, Waste Management Practices: Municipal, Industrial and Hazardous, CRC Press (2005).
4. Kreith F and Tchobanoglous G, Handbook of Solid Waste Management, McGraw Hill (2002).
5. Freeman H, Standard Handbook for Hazardous Waste Management, McGrawHill (1989).
6. Hester RE and Harrison RM Electronic Waste Management (Issues in Environmental Science and Technology) 1st Edition RSC publishing (2008).
8. Sahai S, Biomedical waste Management, APH Publishing Corporation (2009).
9. Blude AD and Sudaresan BB, Solid waste management in developing Countries, INSDOC (1972).
10. LaGrega M, Buckingham, P, Evans J and ERM, Hazardous Waste Management, McGraw Hill (2000).

Climatology

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN509-20	Elective -II	Climatology	3	1	0	40	60	100	4

Unit I: Introduction to Climatology: Definition, brief history and scope of Climatology, Atmospheric variables, Standard atmosphere, Vertical structure of the Earth's atmosphere.

Unit 2: Physical and Dynamic Climatology: The energy balance: Nature of radiation, solar source, solar radiation and planetary energy budget, Atmospheric temperature: Seasons, weather, daily temperature changes, vertical distribution of temperature, factor influencing horizontal distribution of temperature, Moisture in atmosphere: Hydrological cycle, relative humidity, evaporation, transpiration, condensation, fog, clouds and precipitation,

Unit 3: Regional Climatology: Definition, microclimate and meso-climate scale, Climate and distribution of vegetation, Mid-latitude climate, Polar and high land climate, Motion in the atmosphere: Atmospheric pressure, wind, Coriolis effect, Global circulation of the atmosphere, Oceans and international variations in climate (El Nino, ENSO, La Nina), Natural and atmospheric extreme events: Tropical cyclone, thunder storms, tornadoes, flood, cloud burst, drought.

Unit 4: Applied Climatology: Human response to climate, Agriculture and Industry, Global Environmental changes and atmospheric chemistry: Acid precipitation, Ozone layer depletion, Natural causes of climate change, Warming of the planet Earth and its consequences. International efforts to arrest Climate Change

Reference Books

1. Hardy JT, Climate Change: Causes, Effects and Solutions. John Wiley & Sons (2003).
2. Harvey D, Climate and Global Climate Change. Prentice Hall (2000).
3. Barry RG, Atmosphere, Weather and Climate. Routledge Press, UK (2003).
4. Maslin M, Climate Change: A Very Short Introduction. Oxford Publications (2014).
5. Mathez EA, Climate Change: The Science of Global Warming and our Energy. Future. Columbia University Press (2009).
6. Mitra AP, Sharma S, Bhattacharya S, Garg A, Devotta S, & Sen K, Climate Change and India, Universities Press, India (2004).
7. Philander SG, Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications (2012).

Climatology Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN517-20	Elective -II lab	Climatology Practical	0	0	4	60	40	100	2

1. Analysis of surface meteorological data from IMD; temperature, pressure, wind speed, rainfall
2. Analysis of upper air data; using radiosondes, ozonesondes
3. Analysis of clouds vertical profiles using satellite sensors, MODIS, CloudSat, CALIPSO
4. Analysis of cloud and precipitation characteristics using ground based instruments; Ceilometer, disdrometer, raingauge
5. Analysis of surface and upper air weather charts for Monsoon
6. Analysis of surface and upper air weather charts for Western Disturbance
7. Analysis of surface and upper air weather charts for Tropical Cyclone
8. Analysis for vertical time and space section

Reference Books

1. Hardy JT, Climate Change: Causes, Effects and Solutions. John Wiley & Sons (2003).
2. Harvey D, Climate and Global Climate Change. Prentice Hall (2000).
3. Barry RG, Atmosphere, Weather and Climate. Routledge Press, UK (2003).
4. Maslin M, Climate Change: A Very Short Introduction. Oxford Publications (2014).
5. Mathez EA, Climate Change: The Science of Global Warming and our Energy. Future. Columbia University Press (2009).
6. Mitra AP, Sharma S, Bhattacharya S, Garg A, Devotta S, & Sen K, Climate Change and India, Universities Press, India (2004).
7. Philander SG, Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications (2012).

Environment and Society

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN510-20	Elective -II	Environment and Society	3	1	0	40	60	100	4

Unit 1: Introduction: Social and cultural construction of ‘environment’; environmental thought from historical and contemporary perspective in light of the concepts of Gross Net Happiness and Aldo Leopold’s Land Ethic.

Unit 2: Issues in environmentalism: Significant global environmental issues such as acid rain, climate change, and resource depletion; historical developments in cultural, social and economic issues related to land, forest, and water management in a global context; interface between environment and society.

Development-Environment Conflict: Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs).

Unit 3: Urbanization and environment: Production and consumption-oriented approaches to environmental issues in Indian as well as global context; impact of industry and technology on environment; urban sprawl, traffic congestion and social-economic problems; conflict between economic and environmental interests. Environment and social inequalities: Inequalities of race, class, gender, region, and nation- state in access to healthy and safe environments; history and politics surrounding environmental, ecological and social justice; environmental ethics, issues and possible solutions.

Unit 4: Community participation: State, corporate, civil society, community, and individual-level initiatives to ensure sustainable development; case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan); corporate responsibility movement; appropriate technology movement; environmental groups and movements, citizen groups; role played by NGOs; environmental education and awareness.

Reference Books:

1. Chokkan KB, Pandya H & Raghunathan H, Understanding Environment. Sagar Publication India Pvt Ltd, New Delhi (2004).
2. Elliot D, Energy, Society and Environment, Technology for a Sustainable Future, Routledge Press (2003).
3. Guha R, 1989, Ecological change and peasant resistance in the Himalaya, Unquiet Woods, Oxford University Press, Delhi (1989).
4. Pandit MK, Chipko: Failure of a Successful Conservation Movement. In: Sodhi NS, Gibson L, & Raven PH, Conservation Biology: Voices from the Tropics, pp. 126-127. Wiley-Blackwell, Oxford, UK (2013).

Environment and Society Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN518-20	Elective -II Lab	Environment and Society Practical	0	0	4	60	40	100	2

Project Report Preparation on:

1. Personal Ecological Footprint Calculation
2. Water Footprint Calculation
3. Carbon Footprint Calculation
4. Sustainable approaches in Rural areas
5. Sustainable approaches in Urban areas
6. Food Cultural Alternatives
7. 3D evaluation of Environmental Problems
8. Role of Society in Environment Protection
9. Role of youth/Common man in Environment protection

Reference Books:

1. Chokkan KB, Pandya H & Raghunathan H, Understanding Environment. Sagar Publication India Pvt Ltd, New Delhi (2004).
2. Elliot D, Energy, Society and Environment, Technology for a Sustainable Future, Routledge Press (2003).
3. Guha R, 1989, Ecological change and peasant resistance in the Himalaya, Unquiet Woods, Oxford University Press, Delhi (1989).
4. Pandit MK, Chipko: Failure of a Successful Conservation Movement. In: Sodhi NS, Gibson L, & Raven PH, Conservation Biology: Voices from the Tropics, pp. 126-127. Wiley-Blackwell, Oxford, UK (2013).

Mentoring and Professional Development

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD502-18		Mentoring and Professional Development	0	0	1	25	---**	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.

For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

IKG Punjab Technical University
B.Sc. (Environmental Science)
Sixth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN601-20	Skill Enhancement Course-IV	Eco-restoration and Development	1	0	0	40	60	100	1
BSEN602-20	Skill Enhancement Course- Laboratory	Environmental Biotechnology Techniques	0	0	2	30	20	50	1
BSEN603-20	Open Elective-II	Environmental policy and economics#	3	1	0	40	60	100	4
BSENXX X-20	Elective-III	Elective-III	3	1	0	40	60	100	4
BSENXX X-20	Elective-IV	Elective-IV	3	1	0	40	60	100	4
BSENXX X-20	Elective-III Laboratory	Elective-III Lab	0	0	4	60	40	100	2
BSENXX X-20	Elective-IV Laboratory	Elective-IV Lab	0	0	4	60	40	100	2
BSEN622-20	Project	Major Project	0	0	6	Satisfactory / Un Satisfactory			6
BMPD602-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		10	03	17	335	340	675	25

Any of the available courses in other programs such as management or Sciences relevant to the field can also be considered with the approval of the BoS/PTU.

List of Elective -III

BSEN604-20 Environmental Management

BSEN613-20 Environmental Management Practical

BSEN605-20 Environmental Law

BSEN614-20 Environmental Law Report writing

BSEN606-20 Urban Ecosystem

BSEN615-20 Urban Ecosystem Practical

BSEN607-20 Disaster Management

BSEN616-20 Disaster Management Practical

List of Elective -IV

BSEN608-20 Remote Sensing and GIS

BSEN617-20 Remote sensing and GIS Practical

BSEN609-20 Environmental Geology

BSEN618-20 Environment Geology Practical

BSEN610-20 Water Resources Management

BSEN619-20 Water resources Practical

Eco-restoration and Development

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN601-20	Skill Enhancement Course-IV	Eco-restoration and Development	1	0	0	40	60	100	1

Unit I: Introduction: Concept of Ecological Restoration and Development, Historical development, Role in stewardship and Future needs.

Unit 2: Ecological Concepts: Ecological Succession: concepts of ecological succession, general process of succession, types of succession, structural and functional changes in succession; Ecosystem degradation and restoration - factors/threats of ecosystem, restoration of ecosystem, Reference conditions.

Unit 3: Restoration Process: Steps in the Process, Understanding Limitations: Biological Limitations, Physical Limitations, Chemical Limitations; Overcoming Limitations (a few examples): Revegetation, Mulching, Phytoremediation, Collaborative Restoration

Unit 4: Restoration in Various Settings: Restoration of Wetlands, Rivers, Wildlife, Temperate Forests, Grasslands, Tropical Forests, Case studies

Reference Books

1. Prakash G, Restoration of Nature, Ecological Society (2007).
2. Jelte VA and James A, Restoration Ecology the New Frontier, Wiley-Blackwell Publication (2012).
3. Stuart KA, Ecological Restoration and Environmental Change- Reviewing Damaged Ecosystems, Taylor & Francis Ltd (2014).
4. Donald AF, Margaret P, Joy Z, Richard JH, Foundations of Restoration Ecology (The Science and Practice of Ecological Restoration Series), Island Press (2016).
5. Kakade BK, Watershed Manual (BAIF and LEAD India Publication (2005).
6. Athavale RN, Water Harvesting and Sustainable Supply in India, Centre for Environment Education Rawat Publications (2003).

Environmental Biotechnology Techniques

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN602-20	Skill Enhancement Course Laboratory	Environmental Biotechnology Techniques	0	0	2	30	20	50	1

1. Sampling and enumeration techniques for microbes.
2. Determination of total microbial count in a water sample.
3. Determination of total count (MPN) of coliform in a water sample.
4. To prepare the Nutrient agar medium for culturing bacteria present in our surroundings.
5. Isolation of bacteria by the Pour- plate method.
6. Isolation of bacteria by the Spread - plate method.
7. Isolation of bacteria by the Streak- plate method.
8. To prepare the differential medium (MacConky) so as to grow the enteric bacteria.
9. Isolation of fungi from the given sample of Water.
10. Isolation of the *Lactobacillus* bacteria from the given sample of curd.
11. Working principle of molecular technique–PCR.

Reference Books

1. Evans GG & Furlong J, Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications (2000).
2. Jordening HJ and Winter J, Environmental Biotechnology: Concepts and Applications, John Wiley and Sons (2005).
3. Lodish HF, Baltimore D, Berk A, Zipursky SL, Matsudaira P & Darnell J, Molecular Cell Biology, Freeman WH (1995).
4. Nelson DL and Cox MM, Lehninger's Principles of Biochemistry, Freeman WH (2013).
5. Rittman BE and McCarty PL, Environmental Biotechnology. Principles and Applications. McGraw-Hill, New York (2001).
6. Scagg AH, Environmental Biotechnology, Oxford University Press (2005).
7. Snustad DP and Simmons MJ, Principles of Genetics (6th edition), John Wiley & Sons (2011).
8. Wainwright M, An Introduction to Environmental Biotechnology, Springer (1999).

Environmental policy and Economics

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN603-20	Open Elective-II	Environmental policy and Economics	3	1	0	40	60	100	4

UNIT 1: Environmental legislation: History and policy: ancient period: worship of water, air, trees; Mauryan period: Kautilya's Arthashastra, Yajnavalkyasmriti and Charak Samhita; Medieval period: forests as woodland and hunting resources during Mughal reign; British India: Indian Penal Code 1860, Forest Act 1865, Fisheries Act 1897; Independent India: Van Mahotsav, National Forest Policy 1952.

UNIT 2: International Environmental laws and policy: Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Convention on Biological Diversity, Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits.

UNIT 3: Environmental economics: Main characteristics of environmental goods; marginal analysis; markets and market failure; social benefit, costs and welfare functions; meaning and types of environmental values; measures of economic values; tangible and intangible benefits; Pareto principle or criterion; Hardin's Thesis of 'The Tragedy of Commons'; prisoner's dilemma game; methods of abatement of externalities; social cost benefit analysis; cost-effectiveness analysis.

UNIT 4: Economic solutions to environmental problems: Social costs and benefits of environmental programs: marginal social benefit of abatement, marginal social cost of abatement; pollution control: policies for controlling air and water pollution, disposal of toxic and hazardous waste- standards vs. emissions charges, environmental subsidies, modelling and emission charges; polluter pay principles; pollution permit trading system; Natural resource economics: Economics of non-renewable resources; economics of fuels and minerals; Hotelling's rule and extensions; taxation; economics of renewable resources; economics of water use, management of fisheries and forests; introduction to natural resource accounting.

Reference Books

1. Divan S and Rosencranz A, Environmental Law and Policy in India, Oxford University Press (2001).
2. Venkat A, Environmental Law and Policy, PHI Learning Private Ltd (2011).
3. Hanley N, Shogren, JF and White B, Environmental Economics: In Theory and Practice, Palgrave Macmillan (2007).
4. Kolstad CD, Environmental Economics, Oxford University Press (2010).
5. Agarwal VK, Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238 (2005).
6. Divan S and Rosencranz A, Environmental Law and Policy in India: Cases, Materials and Statutes (2nd edition), Oxford University Press (2002).
7. Gupta KR, Environmental Legislation in India. Atlantic Publishers and Distributors (2006).
8. Perman R, Natural Resource and Environmental Economics, Pearson Education (2003).

Environmental Management System

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN604-20	Elective-III	Environment Management System	3	1	0	40	60	100	4

Unit I: Introduction to Environmental Management Systems (EMS): Introduction to Environmental Management System basic definitions and terms, Framework for Environmental Management Systems, Approach for developing an Environmental Management System.

Unit II: Introduction and Implementation of ISO 14001

The introduction and implementation of ISO 14001: environmental policy, planning, implementation and operation, checking, management review, EMS certification.

Unit III: Applications of EMS

Applications EMS in terms of Process flow chart, effluent Generation, composition and treatment of effluents from following industries – sugar, pulp and paper, electroplating, dairy, oil refineries.

Unit IV: Environmental Auditing

Introduction to Environmental Auditing, Category “A” & “B” types of projects. Procedures and Guidelines to conduct Environmental Audit.

Reference Books

1. Kuhre WL, ISO 14001 Certification - Environmental Management Systems: A Practical Guide for Preparing Effective Environmental Management Systems, Prentice Hall, Management System Standards, Book 1(1995).
2. Rao MN, Waste Water Treatment, Oxford and IBH publishing Co. Pvt Ltd (2007).
3. Peavy HS, Rowe DR, & George T, Environmental Engineering, New York: McGraw Hill, (1987).
4. Christopher Sheldon and Mark Yoxon, Installing Environmental management Systems – a step by step guide, Earthscan Publications Ltd, London (1999).
5. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organization for Standardization, (2004).
6. ISO 19011: 2002, “Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, (2002).
7. Paul L Bishop, Pollution Prevention: Fundamentals and Practice, McGraw- Hill international, Boston (2000).

Environment Management Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN613-20	Elective-III Lab	Environment Management System Practical	0	0	4	60	40	100	2

Project Report preparation on:

1. ISO 14001 and OHSAS 18001 and its comparison.
2. Guiding principles, Codes and Present scenario of Responsible Care
3. Carbon footprint
4. Various International Conventions
5. Methods and challenges involved in applying life cycle assessment.
6. Six steps methodology for Cleaner Production.
7. Sustainable Development Goals and status of India
8. Institutional Framework of Environmental Regulations in India
9. Comprehensive Environmental Pollution Index (CEPI)

Reference Books

1. Kuhre WL, ISO 14001 Certification - Environmental Management Systems: A Practical Guide for Preparing Effective Environmental Management Systems, Prentice Hall, Management System Standards, Book 1(1995).
2. Rao MN, Waste Water Treatment, Oxford and IBH publishing Co. Pvt Ltd (2007).
3. Peavy HS, Rowe DR, & George T, Environmental Engineering, New York: McGraw Hill, (1987).
4. Christopher Sheldon and Mark Yoxon, Installing Environmental management Systems – a step by step guide, Earthscan Publications Ltd, London (1999).
5. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organization for Standardization, (2004).
6. ISO 19011: 2002, “Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, (2002).
7. Paul L Bishop, Pollution Prevention: Fundamentals and Practice, McGraw- Hill international, Boston (2000).

Environment Law

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN605-20	Elective-III	Environmental Law	3	1	0	40	60	100	4

Unit 1: Introduction: Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and municipal bodies; National Green Tribunal. Role of Ministry of Environment, Forests & Climate Change in environmental law and policy making; role of central and state pollution control boards in environmental law and policy making.

Unit 2: Environmental legislation: Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties). The Indian Forest Act 1927;; The Wildlife (Protection) Act 1972, The Forests (Conservation) Act 1980, The Biological Diversity Act 2002, The Schedule Tribes and other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010, Wetland conservation and management rules 2020.

Unit 3: Legislative Instruments: The Water (Prevention and Control of Pollution) Act 1974; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988 (Environment related Provisions); The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; scheme and labeling of environment friendly products; Ecomark scheme.

Unit 4: Case studies and International Laws: National Green Tribunal: Aditya N Prasad vs. Union of India & Others; Ganga Tanneries Case: M.C. Mehta vs. Union of India 1988; environmental education case: M.C. Mehta vs. Union of India, WP 860/1991. Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio Declaration Agenda 21; Vienna Convention, Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits; CITES. Ramsar Convention on wetlands, Convention on Biological Diversity (CBD) and Convention on Migratory Species (CMS).

Reference Books

1. Agarwal VK, Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238(2005).
2. Divan S and Rosencranz A, Environmental Law and Policy in India: Cases, Materials and Statutes (2nd edition), Oxford University Press (2002).
3. Gupta KR, Environmental Legislation in India, Atlantic Publishers and Distributors (2006).
4. Leela krishnan P, Environmental Law in India (3rd edition), Lexis Nexis India (2008).
5. Naseem M, Environmental Law in India Mohammad, Kluwer Law International (2011).
6. Venkat A, Environmental Law and Policy, PHI Learning Private Ltd (2011).

Environmental Law Report Writing

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN614-20	Elective-III Lab	Environmental Law Report Writing	0	0	4	60	40	100	2

Report writing on

1. Emergence of Environmental Law
2. Provisions under Water (Prevention and Control of Pollution) Act, 1974
3. Provisions under Air (Prevention and Control of Pollution) Act, 1981
4. Provisions under Environmental Protection Act, 1986
5. Provisions under The Hazardous Waste (Management and Handling) Rules, 2016
6. Provisions under The Biomedical Waste (Management and Handling) Rules, 2016
7. Provisions under The Plastics Waste Management Rules, 2016
8. Provisions under The Noise Pollution (Regulation and Control) Rules, 2016
9. Provisions under Coastal Regulation Zone, 2019
10. Case Studies on recent environmental court cases

Reference Books

1. Agarwal VK, Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238(2005).
3. Divan S and Rosencranz A, Environmental Law and Policy in India: Cases, Materials and Statutes (2nd edition), Oxford University Press (2002).
3. Gupta KR, Environmental Legislation in India, Atlantic Publishers and Distributors (2006).
7. Leela krishnan P, Environmental Law in India (3rd edition), Lexis Nexis India (2008).
8. Naseem M, Environmental Law in India Mohammad, Kluwer Law International (2011).
9. Venkat A, Environmental Law and Policy, PHI Learning Private Ltd (2011).

URBAN ECOSYSTEM

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN606-20	Elective-III	Urban Ecosystem	3	1	0	40	60	100	4

Unit 1: Introduction: Introduction to urbanization; urban sprawl and associated environmental issues; Environment in an urban setting: Man as the driver of urban ecosystem; commodification of nature; metros, cities and towns as sources and sinks of resources; resource consumption and its social, cultural, economic and ecological perspectives; urban transformation; increasing challenges posed by modernity for the environment; urban pollution (air, water, soil).

Unit 2: Urban dwelling: Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure.

Unit 3: Urban interface with the environment: Management of urban environment; alternative resources; policy and management decisions; urban settings as loci of sustainability; challenges associated with sustainability and urban future. Natural spaces in a city: Concept of ‘controlled nature’; scope, importance and threats to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; urban natural forest ecosystem as green lungs.

Unit 4: Planning and environmental management: Urban planning and its environmental aspects from historical and contemporary perspectives; benefits of environmental management; introduction to green buildings; urban governance; political complexity of applying ecological science to urban policy and planning, smart cities.

Reference Books

1. D'Monte Darryl, Industry versus Environment Temples or Tombs. Three Controversies, Delhi, CSE (1985).
2. Gaston KJ, Urban Ecology, Cambridge University Press, New York (2010).
3. Grimm NB, Faeth SH, et al. Global Change and the Ecology of Cities. Science 319:756-760 (2008).
4. Hinchliffe S & Whatmore S, Living cities: Towards a politics of conviviality. Science as Culture 15: 123–138(2006).
5. McIntyre NE, Urban ecology as an interdisciplinary field: differences in the use of ‘urban’ between the social and natural sciences. Urban Ecosystems 4: 5-24(2000).
6. Montgomery MR, Urban Transformation of the developing world. Science 319: 761-764 (2009).
7. Richter M & Weiland U. (ed.), Applied Urban Ecology. Wiley-Blackwell, UK (2012).
8. Alesso Russo, Giuseppe T. Cirella, Urban Ecosystem services, MDPI (2021).

URBAN ECOSYSTEM PRACTICAL

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN615-20	Elective-III Lab	Urban Ecosystem Practical	0	0	4	60	40	100	2

1. Integrated plan for urban region, including 2 weeks field survey.
2. Theories and principles of urban development plan and preparation for survey and data collection.
3. Field survey of the study area.
4. Analysis of data and information
5. Planning for urban area and its region (structure plan / Development plan) with emphasis on:
 - Land use and transportation network
 - Infrastructure plan
 - Action area programs and urban renewal plan
 - Capital budget and financing
 - Administrative and management backup for implementation

Reference Books

1. D'Monte Darryl, Industry versus Environment Temples or Tombs. Three Controversies, Delhi, CSE (1985).
2. Gaston KJ, Urban Ecology, Cambridge University Press, New York (2010).
3. Grimm NB, Faeth SH, et al. Global Change and the Ecology of Cities. Science 319:756-760 (2008).
4. Hinchliffe S & Whatmore S, Living cities: Towards a politics of conviviality. Science asCulture 15: 123–138(2006).
5. McIntyre NE, Urban ecology as an interdisciplinary field: differences in the use of 'urban' between the social and natural sciences. Urban Ecosystems 4: 5-24(2000).
6. Montgomery MR, Urban Transformation of the developing world. Science 319: 761-764 (2009).
7. Richter M & Weiland U. (ed.), Applied Urban Ecology. Wiley-Blackwell, UK (2012).
8. Alesso Russo, Giuseppe T. Cirella, Urban Ecosystem services, MDPI (2021).

Disaster Management

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN607-20	Elective-III	Disaster Management	3	1	0	40	60	100	4

Unit 1: Fundamentals of Disaster and Disaster Management: Definition, types of disaster and need for disaster management. Natural disasters: Hydrological, wind related, geophysical and climate related

Man-made disasters: Nuclear disaster, Industrial, Environmental (forest fire), rail, road, air and sea accidents

Unit II: Disaster preparedness: concept, nature, plan and mitigation, Disaster response: Plan, communication, logistic management, stress and panic movement, integration of multiple stakeholders, Disaster medicine (Prevention, preparedness, response and recovery of health problems).

Unit III: Post Disaster Management: Relief camps, role of voluntary organizations and armed forces Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action,

Unit IV: Rehabilitation, Reconstruction and Recovery: Reconstruction and rehabilitation as a means of development, Damage assessment, Role of various agencies in disaster management, Development of physical and economic infrastructure, Information management structure, Education and awareness, Constraint in monitoring and evaluation, Long term recovery and counter disaster planning.

Reference Books

1. Schneid, TD and Collins L, Disaster Management and Preparedness. Lewis Publishers, New York, NY (2001).
2. Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster, Routledge Press (2001).
3. Coppola DP, Introduction to International Disaster Management, Butterworth Heinemann (2007).
4. Cutter SL, Hazards Vulnerability and Environmental Justice, Earth Scan, Routledge Press (2012).
5. Keller EA, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey (1996).
6. Pine JC, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group (2009).

Disaster Management Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN616-20	Elective-III Lab	Disaster Management Lab	0	0	4	60	40	100	2

1. Preparation of project report based on field study:

- (i) Flood & Water logging
- (ii) Cyclone
- (iii) Earthquake
- (iv) Fire hazards
- (v) Industrial accidents

Reference Books

1. Schneid, TD and Collins L, Disaster Management and Preparedness. Lewis Publishers, New York, NY (2001).
2. Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster, Routledge Press (2001).
3. Coppola DP, Introduction to International Disaster Management, ButterworthHeinemann (2007).
4. Cutter SL, Hazards Vulnerability and Environmental Justice, Earth Scan, Routledge Press (2012).
5. Keller EA, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey (1996).
6. Pine JC, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group (2009).

Remote Sensing and GIS

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN608-20	Elective-IV	Remote Sensing and GIS	3	1	0	40	60	100	4

Unit I: Fundamentals of Remote Sensing

Principles and Process of Remote Sensing, Electromagnetic Radiations (EMR) and Electromagnetic Spectrum, Interaction between Matter and EMR, Types of Remote Sensing Sensors, Types of Remote Sensing Platforms, Types of Resolution, Remote sensing data acquisition mechanism, Microwave and LiDAR remote sensing, Thermal and Hyperspectral Remote sensing.

Unit II: Image Analysis: Digital Image processing, Image Preprocessing, Enhancement, Image Classification, Visual Interpretation, Image Fusion and change detection, Microwave and LiDAR data Processing, Applications of Remote Sensing in the field of Agriculture, Forestry, Geology, Hydrology, Sea Ice Land Cover Mapping, Oceans and Coastal.

Unit III: Introduction to GIS: Definition, Components, Functions and advantages of GIS Process of GIS, Spatial data analysis, Integration of spatial and non-spatial data. **Geospatial Analysis:** Introduction, Geospatial data analysis methods, Database query Geospatial measurements, Overlay Operations, Network Analysis, Surface Analysis, Geo-visualization, Multi-criteria analysis, Map composition, Geo-web services.

Unit IV: Modern Trends of GIS: Integration of GIS and Remote Sensing, Integration of GIS and Multimedia, Mobile GIS, Collaborative GIS (CGIS).

Reference Books

1. Anji Reddy M, Textbook of Remote Sensing and Geographical Information Systems Third Edition (2008)
2. Norman K, Lucas LFJ, Gerrit CH, Principles of Remote Sensing An Introductory Textbook. ITC Educational Textbook Series (2004).
3. Bhatta B, Remote Sensing and GIS, Oxford University (2008).
4. Lillesand TM and Keifer, RW, Remote Sensing and Image Interpretation, John Wiley and Sons, New York (1990).
5. Joseph G, Fundamentals of Remote Sensing, Universities Press, Hyderabad (2003).
6. Heywood, Sarah C, Steve C, An Introduction to Geographical Information Systems, Pearson, (2011).
7. Chang, Kang-Taung, Introduction to Geographic Information Systems, TataMcGraw-Hill (2002).
8. Burroughs PA, Principles of Geographical Information Systems for Land Resource Assessment, Oxford University Press (1986).
9. Gupta RP, Remote Sensing Geology, Springer, New York (2003).
10. Barrett EC and Curtis LF, Introduction to Environmental Remote Sensing (1999).

Remote Sensing and GIS Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN617-20	Elective-IV Lab	Remote Sensing and GIS Practical	0	0	4	60	40	100	2

1. GPS handling and acquisition of data
2. Rectification and Georeferencing using toposheet/satellite image/GPS
3. Subsetting and masking to get required image from whole image
4. Image Classification and Post Classification Processing
5. Spectral Signature Collection using Spectro-radiometer and Spectral Analysis
6. Visual analysis and interpretation of satellite data (preparation spatial data: Point, line, polygon)
7. Preparation of multi-thematic layers i.e. land use/land cover, forest types, wetlands, ground water prospects map, wastelands, agriculture and horticulture cropped area mapping and Creation of Geodatabase
8. Ground truthing using GPS & DGPS: field visit
9. Analysis of Google Earth for environmental sciences
10. Map Composition

Reference Books

1. Anji Reddy M, Textbook of Remote Sensing and Geographical Information Systems Third Edition (2008).
2. Norman K, Lucas LFJ, Gerrit CH, Principles of Remote Sensing An Introductory Textbook. ITC Educational Textbook Series (2004).
3. Bhatta B, Remote Sensing and GIS, Oxford University (2008).
4. Lillesand TM and Keifer, RW, Remote Sensing and Image Interpretation, John Wiley and Sons, New York (1990).
5. Joseph G, Fundamentals of Remote Sensing, Universities Press, Hyderabad (2003).
6. Heywood, Sarah C, Steve C, An Introduction to Geographical Information Systems, Pearson (2011).
7. Chang, Kang-Taung, Introduction to Geographic Information Systems, TataMcGraw-Hill (2002).
8. Burroughs PA, Principles of Geographical Information Systems for Land Resource Assessment, Oxford University Press (1986).
9. Gupta RP, Remote Sensing Geology, Springer, New York (2003).
10. Barrett EC and Curtis LF, Introduction to Environmental Remote Sensing (1999).

Environment Geology

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN609-20	Elective-IV	Environment Geology	3	1	0	40	60	100	4

Unit I: Fundamentals of Environmental Geology and Earth System: Fundamental concepts of environmental geosciences, its scope and necessity, Origin and geological evolution of Earth, Physiography, drainage, climate, soils and natural resources of India.

Unit II: Formation and structure of the Earth; Plate tectonics, rocks and their classification, Brief account of relationship among various geospheres-lithosphere, hydrosphere and biosphere, Energy budget of the Earth, Earth's thermal environment and seasons

Unit III: Earth's Processes and Geological Hazards:

Earth's processes: Concept of residence time and rates of natural cycles, catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche, Tsunami, ice sheets and fluctuations of sea levels, marine pollution by toxic wastes, Prediction and perception of the hazards and adjustments to hazardous activities,

Unit IV: Environmental Geochemistry and Land use Planning: Concept of major, trace and REE (Rare Earth Elements), Classification of trace elements, mobility of trace elements, Human use, trace elements and health, possible effects of some trace elements, Weathering and soil formation, soil profile, soil classification, soils of India, Land use planning: Soil surveys in relation to land use planning, methods of site selection and evaluation

Reference Books

1. Barbar WM et al., Environmental Geology, John Wiley & Sons, New York (1996).
2. Edward AL, Introduction to Environmental Geology, Pearson Education publisher (2011).
3. Valdiya KS, Environmental Geology, McGraw-Hill Education (India) (2013)
4. Collins Larry R and Schneid Thomas D, Disaster Management and Preparedness, Taylor and Francis (2000).
5. Graham T and Jon T, Earth Science and the Environment, Thomson and Brooks/Cole (2007).
6. Goel SL and Kumar Ram, Disaster Management, Deep and Deep Publications (2001).

Environment Geology Lab

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN618-20	Elective-IV Lab	Environment Geology Lab	0	0	4	60	40	100	2

1. Study of natural resource map of India.
2. Physiographic divisions of India.
3. Study of distribution of major climatic regimes of India on map.
4. Study of major geomorphic features.
5. Distribution of major wind patterns on the world map.
6. Preparation of paleogeographic maps (distribution of land and sea) of India during specific geological time intervals.
7. Plate tectonics map
8. Preparation of Hazard zonation maps for India and the World eg; Earthquake, landslides, cyclones and other natural disasters
9. Types of geochemical data analysis and interpretation of common geochemical plots.
10. Geochemical variation diagrams, rare earth elements (REE), and spider diagrams and their interpretations.
11. Soil Map of India and specific regions in detail.

Reference Books

1. Barbar WM et al., Environmental Geology, John Wiley & Sons, New York (1996).
2. Edward AL, Introduction to Environmental Geology, Pearson Education publisher (2011).
3. Valdiya KS, Environmental Geology, McGraw-Hill Education (India) (2013)
4. Collins Larry R and Schneid Thomas D, Disaster Management and Preparedness, Taylor and Francis (2000).
5. Graham T and Jon T, Earth Science and the Environment, Thomson and Brooks/cole (2007).
6. Goel SL and Kumar Ram, Disaster Management, Deep and Deep Publications (2001).

Water Resource Management

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN610-20	Elective-IV	Water Resource Management	3	1	0	40	60	100	4

Unit 1: Introduction: Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapo- transpiration; classification of water resources (oceans, rivers, lakes and wetlands).

Properties of water: Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.

Unit 2: Surface and subsurface water: Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings.

Unit 3: Wetlands and their management: Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of Punjab. **Marine resource management:** Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approach, construction techniques and monitoring of coastal zones).

Unit 4: Water resource in India and Conflicts: Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management. Water resources and sharing problems, case studies on Kaveri and Krishna river water disputes; Multi-purpose river valley projects in India and their environmental and social impacts; case studies of dams-Narmada and Tehri dam – social and ecological losses versus economic benefits; International conflicts on water sharing between India and her neighbours; agreements to resolve these conflicts. Indus water treaty; Ganges water treaty; Teesta water treaty; National River linking plan: ecological and economic impacts.

Reference Books

1. Bansil PC, Water Management in India. Concept Publishing Company, India (2004).
2. Brebbia CA, Water Resources Management VII. WIT Press (2013).
3. CEA, Water Resources and Power Maps of India. Central Board of Irrigation & Power (2011).
4. Grumbine, RE and Pandit MK, Threats from India's Himalaya dams. Science 339: 36-37 (2013).
5. Loucks DP, Stedinger JR and Haith DA, Water Resource Systems Planning and Analysis. Englewood Cliffs, NJ, Prentice Hall (1981).

6. Mays LW, Water Resources Sustainability, The McGraw-Hill Publications (2006).
7. Schward and Zhang, Fundamentals of Groundwater, John Willey and Sons (2003).
8. Souvorov AV, Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management, Elsevier Publications (1999).
9. Vickers A, Handbook of Water Use and Conservation, Water Plow Press (2001).

Water Resource Management Practical

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BSEN611-20	Elective-IV Lab	Water Resource Management Practical	0	0	4	60	40	100	2

1. Analysis of Chloride in water.
2. Measurement of nitrate in water.
3. Report on water conservation techniques.
4. Visit of a nearby Sewage/waste water treatment plant.
5. Hydrological properties of water bearing strata
6. Different treatment technologies for groundwater treatment and restoration
7. Case study related to the groundwater pollution problems in India.
8. Case study of restoration of a River Kali Bein
9. Report on restoration of nearby Pond of Punjab

Reference Books

1. Bansil PC, Water Management in India. Concept Publishing Company, India (2004).
2. Brebbia CA, Water Resources Management VII. WIT Press (2013).
3. CEA, Water Resources and Power Maps of India. Central Board of Irrigation & Power (2011).
4. Grumbine, RE and Pandit MK, Threats from India's Himalaya dams. Science 339: 36-37 (2013).
5. Loucks DP, Stedinger JR and Haith DA, Water Resource Systems Planning and Analysis. Englewood Cliffs, NJ, Prentice Hall (1981).
6. Mays LW, Water Resources Sustainability, The McGraw-Hill Publications (2006).
7. Schward and Zhang, Fundamentals of Groundwater, John Willey and Sons (2003).
8. Souvorov AV, Marine Ecogonomics: The Ecology and Economics of Marine Natural Resource Management, Elsevier Publications (1999).
9. Vickers A, Handbook of Water Use and Conservation, Water Plow Press (2001).

Mentoring and Professional Development

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
BMPD602-18		Mentoring and Professional Development	0	0	1	25	--**	25	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B. Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.