FACULTY OF LIFE SCIENCES

SYLLABUS

FOR

Pre-Ph.D Course in Environmental Sciences
(Credit Based Evaluation & Grading System)

Examinations: 2019-20

GURU NANAK DEV UNIVERSITY AMRITSAR

Pre Ph.D. Course in Environmental Sciences
(Credit Based Evaluation & Grading System)

Programme Code: ESZ

Scheme of Course

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
LSL901	C	Research Methodology	3	1	-	4
Elective Courses (3 Credits)						
	E	Elective I	3	-	-	3
	E	Elective II	3	-	-	3
	E	Elective III	3	-	-	3
BSP901	C	Seminar	-	-	1	1
Interdisciplinary/ Optional Courses (3 Credits)						
	I	Interdisciplinary (students may do it from any other department)	3	-	-	3
		Total Credits	15	1	1	17

List of Elective Courses

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Elective Courses						
BSL961	E	Phytochemical Techniques	3	-	-	3
BSL962	E	Phytonanotechnology	3	-	-	3
BSL963	E	Cell Signalling	3	-	-	3
BSL964	E	Perspectives in Biodiversity	3	-	-	3
BSL966	E	Nutraceuticals and Herbal Remedies	3	-	-	3
ESL961	E	Disaster Management	3	-	-	3
ESL962	E	Phytoremediation	3	-	-	3
ESL963	E	Cancer: Genes and Environment	3	-	-	3
ESL964	E	Good Laboratory Practices	3	-	-	3
ESL965	E	Water Supply Engineering & Management	3	-	-	3
ESL966	E	Soil and Environment	3	-	-	3
ESL967	E	Design and Analysis of Experiments	3	-	-	3

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LSL-901 - Research Methodology

Credits 3-1-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: The course will be numerical oriented to train the students for the analysis of research data. Use of calculators will be allowed in the examination.

SECTION-A

1. **Descriptive statistics:** Statistical expressions, central tendency, dispersion of data (arithmetic and geometric), moments, skewness, kurtosis, sample size estimation.
2. **Probability**: Concept of probability, conditional probability, distributions: Normal, Poisson, binomial, 't', χ^2, F-distributions.

SECTION-B

3. **Testing of hypothesis**: Central limit theorem, null hypothesis and alternative hypotheses, Z-test, Student's t-test, χ-square, F-test, sample size, confidence intervals. odds ratio, index numbers, Probit analysis.
4. **Correlation and regression analysis**: Linear correlation and regression, exponential regression, logarithmic regression, reciprocal regression, Michael-Menten's regression, logistic regression, Gompertz regression, monomolecular regression.

SECTION-C

5. **Multiple correlation and regression**: MLR with 2 and 3 independent variables, quadratic and cubic polynomial regressions, Beta regression, sine curve, multiple correlation, partial correlation, path analysis, time series analysis.
6. **Experimental designs:** Experimental designs, central composite designs with 2 and 3 factors.

SECTION-D

7. **Analysis of Variance**: Assessing normality, one way and 2-way ANOVA, Tukey's multiple comparison test, HSD.
8. **Multivariate analysis**: Cluster analysis and dendrogram, principal component analysis, factor analysis, artificial neural networks.
9. **Non-parametric tests:** Wilcoxon's, Mann-Whitney's tests, Spearman's rank correlation, Kendall's Tau.
10. **Basic Greek and Latin words:** The students will learn Greek alphabet and more than 100 basic roots and words used in science.

Note: The students will be asked to submit an assignment of computer softwares designed by them on the basis of the Research methodology syllabus.

References:

1. Bailey, N.T.J. (1995). Statistical Methods in Biology. Cambridge University Press, Cambridge.
2. Kothari, C.R. (2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.

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BSL961-Phytochemical Techniques

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Production Processes for Herbals and Botanicals :
i Introduction ii. Cultivation iii. Collection from the Wild, iv. Cleaning, v. Drying vi. Packaging of Dried Plants

2. Selection of plant and plant parts for phytochemical analysis

3. Methods of extraction:
i. Organic Solvent Extraction :. Maceration, Percolation, Cold Percolation, Countercurrent Extraction
ii. Extraction with Supercritical Gases
iii. Steam Distillation
iv. Other Minor Extraction Methods
v. Extraction of Essential Oil, vi. Soxhlet Extractor
vii. Accelerated Solvent Extractor, viii. Schemes of Procedure for Extracting Plant Tissues

SECTION-B

4. Qualitative phytochemical screening :
i. Detection of Alkaloids **ii.** Detection of Carbohydrates and Glycosides, **iii.** Detection of Saponins **vi.** Detection of Proteins and Amino Acids **v**. Detection of Phytosterols, **vi**. Detection of Fixed Oils and Fats, **vii**. Detection of Phenolic Compounds and Tannins **viii.** Detection of Gum and Mucilages **ix**. Detection of Volat

5. Qualitative/Quantitative estimation of phytochemicals :

i. Chromatography : Introduction **:** Theoretical Principles
ii. Paper Clromatography : Introduction, Theoretical Principles **,** Instrument, Sample Handling, Detection and of Components
iii. Thin layer Chromatography: Introduction, Theoretical Principles, Instrument, Sample Handling, TLC Plate Visualization by Spraying and Dipping
iv. Column Chromatography: Introduction, Theoretical Principles, Instrument, Sample Handling.
v. Gas Chromatography: Introduction, Theoretical Principles, Instrument, Sample Handling, Chromatogram

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vi. Liquid Chromatography: Introduction, Preparative Chromatography.
vii. High Performance Liquid Chromatography: Introduction, Principles High Performance Liquid Chromatography, HPLC Instrument, Sample Handling, Identification, Qualitative and Quantitative Analysis,
viii. High Performance Thin Layer Chromatography: Introduction, Theoretical Principles, Instrument, Sample Handling Chromatogram Evaluation

SECTION-C

VIII. Methods of identification:

i. Introduction
ii. Physical Characteristics: Introduction, Colour, Odour, Acid or Base character, Solubility, Melting Point, Boiling Point,
iii. Spectroscopy : Introduction,
iv. Ultra Violet pectroscopy : Introduction, Theoretical Principles, Instrument, Sample Handling, Interpretation of Spectrum.
v. Infrared Absorption Spectroscopy: Introduction, Theoretical Principles, Instrument, Sample Handling, Interpretation of Spectrum
vi. Near-Infrared Absorption Spectroscopy (NIR) Introduction , Instrument.
vii. Mass Spectroscopy: Introduction, Theoretical Principles, Equipment, Sample Handling, Mass Spectrum, Interpretation of a Mass Spectrum, Determination of Molecular Formula,Calculation of Molecular Weight, Combinations of Mass Spectrometry.
viii. Nuclear Magnetic Resonance Spectroscopy: Introduction, Theoretical Principles, Carbon-13 NMR(13C NMR), Hydrogen-1 NMR (1H NMR), Instrument, Sample Handling, Interpretation of NMR Spectra, Different Techniques of NMR.
ix. CHN Analysis: Introduction, Estimation of Elements, Determination of Molecular Weight, Calculation of Empirical and Molecular Formula.
x. X-Ray Crstallography: Introduction, Theoretical Principles, Instrument, Sample Handling.

SECTION-D

IX. Categories of Phytochemicals:

1 Introduction
2 Terpenoids: Introduction, General Properties of Terpenoids, Classification of Terpenoids, Determination of Structure of Terpenoids, Monoterpenoids, Sesquiterpenoids, Diterpenoids, Triterpenoids, Pentaterpenoids, Essential Oils
3 Steroids: Introduction, Stereochemistry of Steroids, Sterols, Steroidal Alkaloids
4 Phenolic Compounds : Introduction. Phenylpropanoids, Flavonoids
5 Alkaloids: Introduction, Distribution, Properties, Test for Alkaloids, Extraction of Alkaloids, Structure and Classification
6 Glycosides
7 Carbohydrates: Introduction, Classification, Monosaccharides, Disaccharides Trisaccharides, Polysaccharides, Structural Polysaccharides, Food Storage Polysaccharides.
8 Lipids and Related Compounds: Introduction, Classification of Lipids, Fats and Oils, Waxes, Phospholipids
9 Plant Pigments: Introduction, Chlorophylls, Carotenoids, Phycobilins, Anthocyanins
10 Vitamins: Introduction, Classification of Vitamins, Sources of Vitamins, Structures of Vitamins.

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BSL962 – Phytonanotechnology

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Nanoparticles in Biological Systems. Nanomaterials and Effects on Biological Systems: Development of Effective Regulatory Norms.

SECTION-B

2. Toxicology of nanoparticles. Environmental Nanoparticles Interactions with Plants:Morphological, Physiological, and Genotoxic Aspects.

SECTION-C

3. A biophysical perspective of understanding nanoparticles at large. Current in vitro methods in nanoparticle risk assessment: Limitations and challenges.

SECTION-D

4. Hazardous potential of manufactured nanoparticles identified by *in vivo* assay. Induction of programmed cell death in *Arabidopsis* and rice by single-wall carbon nanotubes. Nanomaterials and the environment: A review for the biennium 2008–2010.

References:

1. Chun Ke and Lamm (2011). *Physical Chemistry Chemical Physics*. **13:** 7273–7283.
2. Elsaesser and Howard (2011). *Advanced Drug Delivery Reviews*. doi:10.1016/j.addr.2011.09.001
3. Kroll *et al*. (2009). *European Journal of Pharmaceutics and Biopharmaceutics*. doi:10.1016/j.ejpb.2008.08.009
4. Manchikanti and Bandopadhyay (2010). *Nanoethics*. **4:**77–83.
5. Peralta-Videa *et al*. (2011). *Journal of Hazardous Materials.* **186:** 1–15.
6. Remedios *et al*. (2012). *Journal of Botany*. doi:10.1155/2012/751686
7. Shen *et al*.(2010). *American Journal of Botany*.**10:** 1602–1609.
8. Valant *et al*. (2009). *Journal of Hazardous Materials*. **171:** 160–165.
9. W.J. Stark (2011). . Reviews Nanomedicine. *Angewandte Chemie International*. 50: 1242 -1258.

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BSL963 - Cell Signalling

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. **Aspects of cellular signalling:** Introduction, the main principles of cell signalling Different ways in which cells signal to each other: Electrical and synaptic, Endocrine, Paracrine, Autocrine, Direct cell- Cell signalling, Receptor-ligand signalling, Gap junctions and plasmodesmata, Coordination of signalling, Domains and modules, Oncogenes
2. **The techniques in the study of cell signalling components**: Labeling techniques, The use of probes, Pharmacological tools; Structure and protein interactions. Molecular genetic techniques; Microarrays and proteomics; Computer networks
3. **Extracellular signals: hormones, cytokines,and growth factors**: Small water-soluble molecules. Peptide hormones lipophilic molecules which are detected by cell-surface receptors lipophilic molecules which are detected by intracellular receptors.
   Plant hormones: Auxin, Cytokinins, Gibberellins. Abscisic acid, Ethylene, Other plant hormones, Cytokines, Interleukins, Interferons, Tumour necrosis factors, Other cytokines, chemokines, and receptors.
   Growth factors: Platelet -derived growth factors, Epidermal growth factor, Fibroblast growth factor, Neurotransmitters, ATP as an extracellular signal, Pheromones.

SECTION-B

4. **Detection of extracellular signals the role of receptors**: Types of receptor: G protein-linked receptors, Ion channel-linked receptors, Receptors containing intrinsic enzymatic activity, Receptors linked to separate tyrosine kinases, Intracellular receptors of extracellular signals. Ligand binding to their receptors, Receptor sensitivity and receptor density
5. **Protein phosphorylation, kinases and Phospha**tes: Serine/threonine kinases, cAMP-dependent protein kinase, cGMP-dependent protein kinase, Protein kinase C, Ca^{2+}/calmodulin-dependent protein kinases, G protein-coupled receptor kinases, Protein kinase B, AMP-activated protein kinase, Haem-regulated protein kinase, Plant -specific serine/ threonine kinases.

   Tyrosine kinases: Receptor tyrosine kinases, Cytosolic tyrosine kinases, Mitogen-activated protein kinases, Histidine phosphorylation, Phosphatases: Serine/threonine phosphatases, Tyrosine phosphatases.

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SECTION-C

6. **Cyclic nucleotides, cyclases, and G proteins**: cAMP, Adenylyl cyclase, Adenylyl cyclase control and the role of G proteins, The heterotrimeric G protein family, The roles of theβ/γ complex , Other roles of the heterotrimeric G proteins.

   Guanylyl cyclase: Soluble guanylyl cyclase, Membrane-bound guanylyl cyclase, Phosphodiesterases

7. **Inositol phosphate metabolism and roles of membrane lipids**: The breakdown of the inositol phosphate lipids Phospholipase C, Inositoll.4.5-trisphosphate and its fate The role of diacylglycerol, Inositol phosphate metabolism at the nucleus, Other lipids involved in signalling, Phosphatidylcholine and arachidonic acid metabolism, Phospholipase-D, Sphingolipid pathways, Related lipid-derived signalling molecules.

SECTION-D

8. **Intracellular calcium**: its control and role as an intracellular signal: Calmodulin, The plasma membrane and its role in calcium concentration maintenance, Intracellular stores: Endoplasmic reticulum stores, Mitochondrial calcium metabolism. Nerve cells, Gradients, waves, and oscillations, Sphingosine l-phosphate, CyclicADP-ribose, Nicotinate adenine-dinucleotide phosphate.

9. **Reactive oxygen species, reactive nitrogen species, and redox signalling**: Nitric oxide: Other enzymatic sources of NO. Reactive oxygen species: superoxide and hydrogen peroxide, Evidence for superoxide and hydrogen peroxide acting as a signal.The NADPH oxidase complex, Chronic granulomatous disease, non-phagocytes, and plants, Other sources of superoxide. Redox signalling and molecular mechanisms of hydrogen peroxide signalling, Measuring ROS and RNS. Carbon monoxide

10. **Insulin and the signal transduction cascades it invokes :** The insulin signalling system

11. **Life, death and apoptosis**: An overview of apoptosis, Caspases, The intrinsic pathway, The extrinsic pathway:' Death receptors, Signalling from death receptors.

References:

1. Nelson, J. (2008). Structure and function in Cell Signalling. Wiley, John and Sons
2. Hancock, J. (2005). Cell Signalling. Oxford University Press, USA

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BSL964 - Perspectives in Biodiversity

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Concept of biosphere and biodiversity, relation between biodiversity, biogeography, physiography and stratigraphy. A review of the theories of continental drift and plate tectonics, glaciations of the geological past and effects on the living world. The phytogeographic provinces and districts of the world.
2. Biodiversity through time, major events in the evolution of living beings through the geological past, rates of diversification and phylogenetic splitting, geological and ecological causes of extinction, lifespan of species, background rates and mass extinctions.

SECTION-B

3. Within-habitat (alpha) level, species counts, species richness and species heterogeneity, probability theory and entropy theory based indices of species heterogeneity, equitability and evenness of distribution, SHE analysis.
4. Between-habitat directionless beta diversity (heterogeneity) of habitats, directional (turnover) diversity through gradients of time (diachronic) and space (synchronic). Changes in species and composition along altitudinal and depth gradients of terrestrial and aquatic habitat, comparative study, indices after Jaccard, Sorensen, Whittaker, Cody, Wilson and Schmida, Colwell and Coddington.

SECTION-C

5. Landscape (gamma) level, exhaustive species count, the use of models of species area relationships in estimating landscape level diversity, scale dependence, homogenization and SAR curves. The evolutionary (historical) causes of biodiversity in specific areas.
6. Relative density, frequency, abundance and dominance of species in community. Ranked abundance and importance value. Concepts and models of dominance diversity relationship, methods of fitting data to various models.
7. Concept and significance of functional and taxonomic diversity of habitats and landscapes, species-specific and community-specific indices of diversity. Taxonomic v/s taxic diversity, weighting schemes of taxic diversity, species centric v/s rank based indices.

SECTION-D

8. Ecological uses of biodiversity, relation with stability, productivity and invasibility of ecosystem. Invasive species and the factors of their success, elements of landscape ecology, indices of diversity, core and edge species, rare and generalist species, effect of patch shape on diversity, perimeter area ratio effects.
9. Biodiversity as a resource for human welfare, conservation status of habitat and species, conservation efforts, important conventions and treaties.
10. Current extinction rates, causes and consequences, differential extinction rates in taxonomic groups, mass extinctions, evolutionary causes and significance of endemism.

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References:

1. Dombois, D.M & Ellenberg, H. (1974). Aims and methods of vegetation ecology. John Wiley and Sons Inc, New York.
2. Gaston, K.J & Blackburn, M.J. (2000). Pattern and Process in Macroecology. Blackwell Sciences Limited, Oxford, UK.
3. Gaston, K.J. and Spicer J.I. (2004). Biodiversity: *An Introduction.* 2nd Edition. Blackwell Science Limited, U.S.A.
4. Hubbel, S.P. (2001). The unified neutral theory of biodiversity and biogeography. Princeton University Press, Princeton NJ.
5. Huston, M.A. (1994). Biological Diversity. Cambridge University Press, Cambridge, U.K.

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BSL966 – Nutraceuticals and Herbal Remedies

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Introduction to herbs and ayurveda: Concept of tridosha, role of pancha karma in ayurveda, origin of Charka samhita, comparison of ayurveda with other systems of healing likes unani, siddha, homeopathy and yoga.

SECTION-B

2. Nutraceuticals: General introduction, classification of nutraceuticals, inorganic mineral supplements, vitamin supplements, dietry fibres, antioxidants, health drinks, natural sweeteners, cereals and grains, polyunsaturated fatty acids. Herbal product formulations for skin and healthcare, brain tonics and anti- aging products; their manufacturers and suppliers; export market hub of herbs.

SECTION-C

3. Herbal cosmetics: Formulation and manufacturer of hair dyes, face wash and soaps, skin care creams and lotions, anti- aging creams, shampoos, perfumes, mouthwash, toothpastes. Herbal medicines for diseases like asthma, Alzheimer's disease, dengue fever, diarrhoea, epilepsy, goitre, gout, hypertension, jaundice, leukemia, obesity, and ulcer of stomach, eczema and diabetes.

SECTION-D

4. Herbal pesticides: General introduction, methods of pest control, manufacturer and exporter of eco guard crop protector - biodegradable pest control products, natural organic pesticides and insecticides and their benefits over chemical pesticides.

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References:

1. Leyel, C. F. 2004. Types of Herbs. Srishti Book Distributors, New Delhi (India).
2. Singh, M. P. and Panda, Himadri 2005. Medicinal herbs with their formulations. Volume 1 & 2. Daya Publishing House, Delhi.
3. Murthy, N. A. and Pandey, D. P. 1998. Ayurvedic Cure for Common Diseases. Orient Paperbacks, Delhi.
4. Rangari., V. D. 2003. Pharmacognosy and Phytochemistry. Vol. II. Career Publications, Nashik.
5. Ojha D. and Kumar, A. 1978. Pancha Karma Therapy in Ayurveda. Chaukhamba Amarabharti Prakashan, Varanasi.
6. Sharma, S. 1983. The System of Ayurveda. Neeraj Publication House, Delhi.
7. Verma, H. K. 1998. A Comprehensive Book of Ayurvedic Medicine for General Practitioners. Kalyani Publishers, New Delhi.
8. Nadkarni, K.M. 1998. India Materia Medica Vol. II. Popular Book Depot, Bombay 7, Dhootapapeshwar Prakashan Ltd. Panvel.

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ESL961 - Disaster Management

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Introduction to disasters, common terminologies. Management acts, policies & institutions in India.
2. Earthquakes
   - Damage Prevention and Rehabilitation by Retrofitting
   - Dos and Don'ts While Constructing Buildings
   - Case study-Bhuj Earthquake 2001

SECTION-B

3. Floods
   - Standard Operating Procedure for Administration
   - Standard Operating Procedure for Individuals
   - Case study-Assam Floods 2004
4. Cyclones
   - Case study-Orissa Super Cyclone 1999
5. Droughts

SECTION-C

6. Landslides
7. Fire disasters-Forest Fires
   - Case study-Peerchu Lake – A Disaster in Being Kumbakonam School Fire Tragedy
8. Avalanches
9. Tsunami
   - Case study-Tsunami 2004

SECTION-D

9. Nuclear Disasters
   - Dos and Don'ts While Commercial Nuclear Disaster
10. Chemical and industrial Disasters
    - Chemical and Industrial Disaster Mitigation
    - Case study-Bhopal Gas Tragedy 1984

Note: Related Case Studies can be included as per the topic.

Reference:

1. Khanna B K (2005). All you wanted to know about Disasters. New India Publishing Agency, New Delhi. pp.1-219.
2. Singh Jagbir (Ed.) (2007). Disaster Management: Future challenges and opportSECTIONies. I.K. International publishing house. pp. 1-351.
3. Singh Sarthak (2010). Disaster Management. Oxford Book Company. pp. 1-277.
4. Kumar Nitish (Ed.) (2013). Text Book of Disaster Management. Satish Serial Publishing House. pp. 1-211.
5. Khanna B K and Khanna Nina (latest). Disaster strengthening commSECTIONy mitigation and preparedness. New India Publishing Agency, New Delhi.

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ESL962 - Phytoremediation

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Mechanism and Applications of Phytoremediation: Phytodegradation Phytoextraction, Rhizodegradation, Phytostablization,, Phytovolatilization, Rhizofiltration and root exudation and root turnover.

SECTION-B

2. Soil Plant Microbe Interaction: Mycorrhizal Fungi as helping agents in "phytoremediation of degraded and contaminated soils; The Rhizosphere Ecology; Rhizoremediation potential for selective plant microbe pairs.
Role for chelates and enzymes in phytoremediation: Heavy metal removal Glucosyltransferase and Glutathione S-transferase in Phytoremediation.

SECTION-C

3. Applications of Phytoremediation: Containment strategies: groundwater hydraulic barriers, covers for infiltration control, erosion control and soil/sediment stabilization; Treatment strategies: surface soil clean up, treatment wetlands for sediment/surface water cleanup. Containment and treatment strategies; riparian buffers for surface water protection, in-situ groundwater/subsurface soil treatment, ex-situ rhizofiltration.

SECTION-D

4. Phytoremediation of Pollutants: Organic and Inorganic pollutants; Phytoremediation of Polychlorinated Biphenyls, Volatile Organic Compounds and Heavy metals from soil; Exploitation of fast growing trees in metal remediation.
Regulatory Evaluation and Acceptance Issues for Phytotechnologies: Assessing risks and Containing or mitigating gene flow of phytoremediating plants.

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References:

1. D.T. Tsao. (2003) Phytoremediation (Advances in Biochemical Engineering Biotechnology). 151 edition, Springer.
2. Todd A. Anderson. (1994) Bioremediation through Rhizosphere Technology. 15th Edition, An American Chemical Society Publication.
3. Mackova, Martina; Dowling, David; Macek, Tomas. (2006) Phytoremediation and Rhizoremediation. Springer.
4. Peter.A. Kulakow, Valentina V.Pidlisnyuk (2007) Application of Phytotechnologies for Cleanup of Industrial, Agricultural and Wastewater Contamination, Springer.
5. A. Singh, O.P. Ward (2004) Applied Bioremediatiion and Phytoremediation, Springer.
6. Ellen L. Kruger, Todd A. Anderson, Joe R. Coats (1997). American Chemical Society, Division of Agrochemicals and Environmental Chemistry.
7. UNEP International Environment Technology Center, SECTIONed States, Environment Protection Agency,Canada (2002) Phytoremediation: An Environmentally Sound Technology for Pollution Prevention, Control and Remediations: An Introductory Guide for Decision Markers.

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ESL963 - Cancer: Genes and Environment

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Common Types of Cancer: Terminology, bladder cancer, brain cancer, breast cancer, leukemia, lung cancer, prostate cancer, skin cancer. Cancer cells: Cancer cells are immortal, broken chromosomes a failure to communicate, they go where they please, one mutation is not enough.

SECTION-B

2. The road to oncogenesis: Cancer and the cell cycle, a disease of the gene, tumor suppressor genes, oncogenes and photo-oncogenes, a dangerous mix. Cancer Progression: Cancers Develop from a Single Bad Cell, The Switch from Benign to Malignant Tumors, The Role of Sex Hormones, Aging and the Incidence of Cancer, Carcinogens.

SECTION-C

3.Cancer Therapies: Angiogenesis Blockers, Biotherapies, Bone Marrow Transplants, Chemotherapy, Cryosurgery, Gene Therapy, Laser Therapy, Photodynamic Therapy, Radiotherapy, Stem Cell Therapy. Cancer Around the World: The Magnitude of the Problem. Developed Countries Have the Highest Cancer Rates. Cancer and the North American Diet, Cancer and Lifestyle. Cancer and the Environment, Summary.

SECTION-D

4. Clinical Trials: The Four Phases, Breast Cancer, Chemotherapy, Colon Cancer, Lung Cancer, melanoma, metastasis. Resource centre: Eukaryote cell primer, recombinant DNA primer, gene therapy primer matching tissues, the human genome project.

References:

1. Panno, J(2007). Cancer: The Role of Genes Lifestyle and Environment. Viva Books Pvt Ltd., New Delhi
2. Ackerman, L.V. and DelRegato, J.A. (1970) Cancer Diagnosis Treatment and Prognosis. 4th Ed. The C.V. Morby Co. St. Louis, USA

Pre Ph.D. Course in Environmental Sciences
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ESL964 - Good Laboratory Practices

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. **Introduction to chemical analysis:** Nature of analytical chemistry, general directions of chemical analysis: Cleanliness in the laboratory, Recording and planning data. Data quality: Bias, Precision, Uncertainty, Method detection limit, Checking correctness of analysis, Expression of results, Significant figures, Collection and preservation of sample,

SECTION-B

2. **Laboratory hazards**: Chemical, Fire, Careless habits, Handling of compressed gases, Stockroom safety rules, Laboratory safety rules. Quality assurance of chemical measurements: Quality assurance, quality control, Quality assessment, Sampling, Sampling custody, Sample preparation, Analytical methodology with case studies, Calibrations, Detection limits, Statistics in chemical analysis, Quality control charts.

3. **Laboratory apparatus and glassware**: Labware materials, soft vs. heat resistant glassware, plastic, porcelain, platinum, nickel labware. Volumetric flask, pipette, burette, cleaning of volumetric glassware. Types of balances: Analytical balances, Desiccators.

SECTION-C

4. **Chemical reagents and standards:** Grade and purity of chemicals, Proper storage of chemicals and standards, Laboratory pure water, Preparation of reagent grade water, Reagent water quality.

5. Reagents and solutions. Stock standardization solutions, Preparation and standardization of common standard solutions,

SECTION-D

6. **Filtration:** Gravity, Vacuum, Centrifugation, Distillation: Simple, Fractional, Vacuum, Refluxing, Ion exchange, Drying and ashing sample, Liquid liquid extraction by separating funnel, Soxhlet extraction.

7. Software's for stock room management, Role of computers in Laboratory occupational health and safety, Waste minimization and disposal.

References:

1. Csuros, M., Environmental Sampling and Analysis, Lewis Publications.
2. Standard methods for the examination of water and wastewater, American Public Health Association, 19th ed., Washangton D.C.

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ESL-965 Water supply Engineering and Management

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. **Concepts of water supply Engineering:** Roman and Indus valley civilizations, five year plans of India, Appointment of Environmental Hygiene Committee, Importance of water, Necessity of water supply scheme, Importance and reliability of water works, objectives of water supply scheme/system.

2. **Quantity of Water:** Quantity of water required, design period, factors affecting design period, types of demand, per capita consumption demand, domestic demand, commercial and industrial demand, fire demand, public use demand, factors affecting demand: Variation/fluctuations, fore-casting population: Arithmetical increase method, geometrical increase method, incremental increase method, decreasing rate of growth method, graphical method.

SECTION-B

3. **Sources of water:** Types: surface sources; impound reservoirs, rainfall, measurements of rainfall: Symon's rain guage, Runoffs and their measurement: Guaging method; empirical formulae method: Dicken's formulae, Ryve's formulae, Inglish formulae, Burge's formulae, Rational methods, ground water sources: infiltration galleries, porous pipe galleries, Wells and types: infiltration wells, open or dug wells, driven wells, tube wells etc.

4. **Collection and conveyance of water:** Selection of site, Types and designs of water intake, means of conveyance of water, Types of pipes and joints, testing of pine lines, back filling.

5. **Quality of water:** wholesome water, impurities of water; physical, chemical, bacteriological examination of water, Standards of quality of water, water borne diseases, prevention of water borne diseases.

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SECTION-C

6. **Water Treatment:** Water treatment SECTIONs, impurities removed by various treatment processes, location of treatment plants, important consideration of public water supply, Public health laboratory, types of disinfection: boiling, long storage, ozone, potassium permagnate, excess lime, UV rays, iodine and bromine, chlorination, Softening of water and its methods: lime soda process, zeolite or Base Exchange method.

7. **Distribution of water:** Appurtenances used for controlling the flow of water, fire hydrants scour, safety valves, reflux and check valves, layout of distribution systems: dead end system, grid iron system, ring system, radial system; methods of distributions; pumping method, gravity flow method, typical layout of water supply, service reservoirs.

SECTION-D

8. **Building Water Supply:** Layout of water supply arrangement for a building, water supply fixtures and fittings, service connections.

9. **Maintenance of Water Supply Systems:** leakage and wastage of water, factors affecting loses and wastes locations of underground pipes, replacement of damage pipes, records of whole water supply system.

References

1. Bijlani, H.U. and Rao, P.S.N. (1990). Water supply and sanitation in India. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Gupta, N.L. (1994). Urban Water Supply, Rawat Publications, New Delhi.
3. McGhee, T. J. (1991). Water Supply and Sewerage. McGraw-Hill, New York.
4. Modi, P. N. (2003). Water Supply Engineering and Wastewater Engineering, Volume I & II, Standard Book House, Delhi.
5. Raju, B. N. S. (1995) Water Supply and Wastewater Engineering, Tata McGraw Hill Company Ltd, New Delhi.
6. Shah, C.S. (1998). Water supply and Sanitation. Golgotia Publishing Company, New Delhi.
7. Sharma, J.L. (2000). Public health Engineering, Satya Prakashan, New Delhi.
8. Standard Methods for Examination of Water and Wastewater, Edition 21st (2005). American Public Health Association, USA.

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ESL966 - Soil and Environment

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. **Introduction:** Soil as component of ecosystems, Soil and man, soil pollution Soil components: Texture and structure, bulk density, pore space, soil water, soil air, mineral, organic and chemical components of soil, Interactions between soil components.

2. **Development of soils:** Rock and their weathering, addition and decoposition of organic matter, processes of soil formation, soil horizons, soil classification and characteristics.

3. **Sorptive properties of soil:** Electrically charged surfaces, Exchangeable cations and cation exchange capacity, Diffuse layer, Selectivity of cation adsorption, Anion retention, sorption of gases.

SECTION-B

4. **Organisms and soil processes:** Organic materials sources and decoposition, Soil fauna, soil microorganisms, biological nitrogen fixation, Ammonification, nitrification, denirification, Oxidation and reduction.

5. **Soil as a medium for plant growth:** Plant development and growth, Restrictions to root growth, Requirements of water and nutrients, rhizosphere and mycorrhizas, cultivations, fertilizers, organic manures.

SECTION-C

6. **Soil acidification:** pH and buffering, Percentage base saturation, Processes of soil acidification, Effects of acidity on plants, Acid rain, Acidification of ecosystems Heavy metals and radionuclides in soil: Hazardous elements in soil, Accumulation in soil, Treatment of contaminated land, Radionuclides in soils and their effects on growth of plants.

7. **Soil erosion and conservation:** Natural erosion, Anthropogenic factors responsible for soil erosion, soil conservation methods.

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SECTION-D

8. **Soil related problems and solutions:** Nitrates, Eutrophication, pesticides, degradation of soils, drought, organic farming and sustaining soil fertility.

9. **Soil analysis:** Analysis of particle size, water holding capacity, temperature, pH, conductivity, exchangeable calcium and magnesium, sodium, potassium, Available phosphates, nitrogen, alkalinity, chlorides, sulphates, organic matter, calcium carbonate, boron, standard plate count, microbial activity, heavy metals, pesticides.

References

1. Bohn, H.L., MCNeal, B.L. and O'Connor, G.A. (1979). Soil Chemistry. Wiley Interscience, New York.
2. Trivedy R.K. and Goul, P.K.(1987). Practical methods in ecology and Environmental Sciences. Enviro Media Publications, India.

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ESL967 - Design and Analysis of Experiments

Credits 3-0-0

Time: 3 Hrs. **Max. Marks : 100**

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Strategy of experimentation, Basic principle, Guidelines for designing experiments. Experiments with single factor: ANOVA, Model adequacy checking, Interpretation of results, Use of computers in analysis.

SECTION-B

Randomized complete block design, Latin square design, factorial design, two factor factorial design with design example, Fitting response curve and surfaces, Blocking in factorial design. Two level fractional factorial design: One half fractional 2^k design, One-quarter fraction of 2^k design, Resolution III, IV, and V designs.

SECTION-C

Fitting regression models: Linear regression models, Estimates of parameters in linear regression models, Hypothesis testing, Confidence intervals, regression model diagnostic, Scaled residuals and PRESS, Testing of lack of fit.

SECTION-D

Response surface methods and process optimization: Method of steepest ascent, Analysis of second order response surface, Mixture experiments, Robust design.

References:

1. Box, G.E.P. and Draper, N.R. (1987) Empirical Model Building and Response Surfaces, 2nd Ed., Wiley, New York.
2. Cochran and Cox. Experimental Design, 2nd ed., Wiley, Singapore.
3. Draper N.R., Smith H. (2004) Applied Regression Analysis, 3rd ed., Wiley, New York.
4. Montgomery D.C., Peck E.A. (1992) Introduction to Linear Regression Analysis, 2nd ed., Wiley, New York.
5. Montgomery, D.C. (2004) Design and Analysis of Experiments, 5th ed., Wiley, Singapore.
6. Myers R.H., Montgomery D.C. (1995) Response Surface Methodology: Process and Product Optimization Using Designed Experiments, Wiley, New York.
7. Ravindran A., Ragsdell K.M., Reklaitis G.V. (2006) Engineering Optimization: Methods and Applications, 2nd ed., Wiley, Singapore.