GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

REVISED MINUTES

of the 5th Meeting of the Standing Committee of

X ACADEMIC COUNCIL

Day & Date

Tuesday, 14th February, 2023 & Thursday, 23rd February, 2023

Time

10.00 a.m.

Venue
Council Hall,
Administrative Block
Goa University

	under Generic Elective Course (GEC). 3. Number of hours to AGTE-522 Natural Hazards and Disaster Management Programme, Module 3 to be assigned. 4. Number of Credits for AGPE-530 Geological Field Training (Practical) (Skill based Course) to be changed to '4 Credits' and effective from A.Y. to be made as '2023-2024'. 5. Field Oriented Programmes to be included under Semester III/IV**.** **(Action: Assistant Registrar Academic-PG)**
D 3.21	**Minutes of the Board of Studies in Environmental Science meeting held on 11.11.2022.** The Standing Committee of the Academic Council approved the minutes of the Board of Studies in Environmental Science meeting held on 11.11.2022 with the suggestion to delete Research Specific Elective Course ESTE-533 Community Engagement for Sustainable Rural Development from the syllabus and Tutorials/Lectures (L-T-P) mentioned under Structure to be deleted. **(Action: Assistant Registrar Academic-PG)**
D 3.22	**Minutes of the Board of Studies in Sociology meeting held on 02.11.2022.** The Standing Committee of the Academic Council did not approve the minutes of the Board of Studies in Sociology meeting held on 02.11.2022. The Chairperson was requested to refer the matter back to the Board of Studies to rework on the following and thereafter to be placed before the Academic Council for consideration: 1. Detailed syllabus to be recommended for Course SOTG – 501 State, Refugees, and Displaced People, Generic Elective. 2. Number of hours of SOTR – 504 Ethnographic Research, Research Specific Elective Course to be revised to 60 hours. 3. PhD Course Work Course title to be titled as 'Research Methodology'. 4. PhD Course Work Programme, under content, point No.7 title to be named 'Issues in Social Research'. **(Action: Assistant Registrar Academic-PG)**
D 3.23	**Minutes of the Board of Studies in Hindi meeting held on 19.10.2022.** The Standing Committee of the Academic Council approved the minutes of the Board of Studies in Hindi meeting held on 19.10.2022 with the following suggestions: 1. Title of the Courses to be indicated in both Hindi and English languages. 2. Translation of titles/font in languages to be thoroughly verified before uploading on the website. 3. Terminology 'Optional Generic Course' under structure to be changed to 'Generic Elective Courses'. **(Action: Assistant Registrar Academic-PG)**

Std. Com. X AC-5
14.02.2023

GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

F I N A L A G E N D A

For the 5th Meeting of the Standing Committee of

X ACADEMIC COUNCIL

Day & Date

Tuesday, 14th February, 2023

Time

10.00 a.m.

Venue
Conference Hall
Administrative Block
Goa University

D 3.21

Minutes of the Board of Studies in Environmental Science meeting held on 11.11.2022.

Part A

i. Recommendations regarding courses of study in the subject or group of subjects at the undergraduate level:

ii. Recommendations regarding courses of study in the subject or group of subjects at the postgraduate level:

1. BOS members met on 11.11.2022 at 1000 hrs and took up the following agenda for discussion.

a) Approval of M.Sc./M.A. Environmental Sciences syllabus (Semester III and IV) as per OA35.

2. Members of the BOS deliberated on the above matter and approved the following:

The program structure and syllabus in M.Sc./M.A. in Environmental Sciences (Semester III and IV) was deliberated and few suggestions made by the Experts were incorporated and the same was approved. (Annexure I Refer page No. 781) and Annexure II (Refer page No. 823)

Part B

i. Scheme of Examinations at undergraduate level: Nil

ii. Panel of examiners for different examinations at the undergraduate level: Nil

iii. Scheme of Examinations at postgraduate level: Nil

iv. Panel of examiners for different examinations at post-graduate level: Nil

Part C

1. Recommendations regarding preparation and publication of selection of reading material in the subject or group of subjects and the names of the persons recommended for appointment to make the selection: Nil

Part D

i) Recommendations regarding general academic requirements in the Departments of University or affiliated colleges: Nil

ii) Recommendations of the Academic Audit Committee and status thereof: Nil

Part E

i. Recommendations of the text books for the course of study at undergraduate level: Nil

ii. Recommendations of the text books for the course of study at post graduate level: Nil

Part F

Important points for consideration/approval of Academic Council

i. The important points/recommendations of BOS that require consideration/approval of Academic Council (points to be highlighted) as mentioned below

(a) The program structure and syllabus in M.Sc./M.A. in Environmental Sciences (Semester III and IV) was deliberated and few suggestions made by the Experts were incorporated and the same was approved. This syllabus of M.Sc./M.A.

	Environmental Sciences (Semester III and IV) was prepared with introduction of eighteen new courses in view of the implementation of NEP guidelines by the University. ii. The declaration by the Chairperson that the minutes were readout by the Chairperson at the meeting itself. Date: 11.11.2022 Sd/- Place: Goa University Campus Signature of the Chairperson **Part G**. The Remarks of the Dean of the Faculty i. The minutes are in order. ii. The minutes may be placed before the Academic Council with remarks if any. iii. May be recommended for approval of Academic Council. iv. Special remarks if any. Date: 11.11.2022 Sd/- Place: Goa University Campus Signature of the Dean **(Back to Index)**
D 3. 22	**Minutes of the Board of Studies in Sociology meeting held on 02.11.2022.** **Part A** i. Recommendations regarding courses of study in the subject or group of subjects at the undergraduate level: Nil ii. Recommendations regarding courses of study in the subject or group of subjects at the postgraduate level: The Board approved the Courses to be taught for Semester III and IV from the Academic Year 2023-2024 **(Annexure I Refer page No.851)** The Board also approved the Ph. D. Course Work I syllabus (**Annexure II Refer page No. 870**) and the course on Research Ethics and Publication (**Annexure III Refer page No. 872).** **Part B** i. Scheme of Examinations at undergraduate level: Nil ii. Panel of examiners for different examinations at the undergraduate level:NIL iii. Scheme of Examinations at postgraduate level: NIL iv. Panel of examiners for different examinations at post-graduate level:NIL **Part C** i. Recommendations regarding preparation and publication of selection of reading material in the subject or group of subjects and the names of the persons recommended for appointment to make the selection: NIL **Part D** i. Recommendations regarding general academic requirements in the Departments of University or affiliated colleges: NIL ii. Recommendations of the Academic Audit Committee and status thereof: **Part E**

D 3.21 Minutes of the Board of Studies in Environmental Science meeting held on 11.11.2022.

Annexure I

M. Sc. Environmental Science Program Structure and Syllabus (2022 – 23)

Semester III

Research Specific Elective Courses

Course Code	Course Title	L–T–P (hrs/ week)	Credit(s)	Page Number
ESTE – 501	Research methodology in Environmental Science	4–0–0	4	3
ESPE – 502	Environmental Pollution Practical I	0–0–4	2	4
ESPE – 503	Environmental Pollution Practical II	0–0–4	2	5
ESPE – 504	Field work and Environmental Sampling Practical	0–0–2	1	7
ESPE – 505	Environmental Data Analysis	0–0–2	1	8
				Total = 08 credits

Generic Specific Elective Courses

Course Code	Course Title	L–T–P (hrs/ week)	Credit(s)	Page Number
ESTE – 506	Coral Ecosystem and Threats	3–0–0	3	9
ESTE – 507	Disaster Management	3–0–0	3	11
ESTE – 508	Ecotourism	3–0–0	3	13
ESTE – 509	Ecotoxicology	3–0–0	3	14
ESTE – 510	Environmental Biology	3–0–0	3	16
ESTE – 511	Environmental Chemistry	3–0–0	3	17
ESTE – 512	Environmental Implication of Marine Productivity	3–0–0	3	19
ESTE – 513	Environmental Microbiology	3–0–0	3	20
ESTE – 514	Green Chemistry	3–0–0	3	22
ESTE – 515	Marine Biodiversity and Conservation Practices	3–0–0	3	23
ESTE – 516	Marine Pollution	3–0–0	3	25
ESTE – 517	Microplastics in Environment	3–0–0	3	26
ESTE – 518	Polar Sciences	3–0–0	3	27
ESTE – 519	Water Resource Management	3–0–0	3	29

ESTE – 520	Industrial water and wastewater treatment technologies	3–0–0	3	31
ESTE – 521	Water and Wastewater: Monitoring and Treatment	3–0–0	3	32
ESPE – 522	Lab Course in Environmental Science	0–0–8	4	34
				Total = 12 credits

Semester IV

Research Specific Elective Courses

Course Code	Course Title	L–T–P (hrs/ week)	Credit(s)	Page Number
ESTE – 523	Environmental Impact Assessment I	1–0–0	1	37
ESTE – 524	Environmental Impact Assessment II	1–0–0	1	38
ESTE – 525	Sustainable Development	1–0–0	1	39
ESTE – 526	Solid Waste Management	1–0–0	1	40
ESTE – 527	Shrimp farming and Environmental Issues	1–0–0	1	41
				Total = 04 credits

Discipline Specific Dissertation / Internship

Course Code	Course Title	L–T–P (hrs/ week)	Credit(s)	Page Number
ESDC – 528	Discipline Specific Dissertation	0–0–4	16	
				Total = 16 credits

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Course Code: ESTE – 501

Title of the Course: Research methodology in Environmental Science

Number of Credits: 04

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To understand the methodology and techniques involved in conducting environmental research	
Content:	**Module I** Research and Scientific Methods, Types of Research, Significance of Research, Selecting a Research Problem, Research Design, Formulation of Hypothesis, Procedure for Hypothesis Testing, Null	15 hrs.

	hypothesis. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, types of sampling designs: Non-probability sampling, Probability sampling; Primary data, Secondary data, tools and methods of data collection, Sampling Distribution, data compilation, tools in data analysis, Graphical representation of Data, Processing of data. **Module II** Descriptive statistics: Measurement Scales, Sources of error in measurement. Measures of dispersion (range, mean deviation, standard deviation) Inferential statistics: Normal Probability Curve - Meaning, characteristics and applications. Standard error, Confidence Intervals, Type I and Type II errors, Concept of Variance. **Module III** Analysis of Variance (ANOVA), Testing the Significance of difference between means (z and 't' test), Non-Parametric Statistics: Sign Test, Mann-Whitney U Test, Kruskall-Wallis test, PCA, CCA, MDS, Cluster, Characteristics and applications, statistical software. Interpretation of results. **Module IV** Air Sampling: Objective and Criteria of Air Sampling, Selection of Sampling Location, Sampling Methods (Sedimentation, Filtration, Centrifugal and Impingement Method), Instrumental Techniques used in Estimation of Atmospheric Air Pollutant, Dust Fall Jar, SPM and RSPM using Respirable Dust sample/High Volume Air Sampler. Soil and Solid Waste Sampling: Collection and Preparation of Soil Samples for Analysis, Physico-Chemical Parameters and their Significance (Quality and Productivity). Water Sampling: Objectives, Selection of Sampling Site, Collection, Handling and Preservation, Sampling Equipment, Classification of Water Quality Parameters (Inorganic, Organic and Nutrient), Data Interpretation, Basic Concept, Significance, Measurement and analysis of DO, BOD, COD, Phenol, Pesticides and Polynuclear Aromatic Hydrocarbon (PAH) in Water and Wastewater.	15 hrs. 15 hrs. 15 hrs.
Pedagogy:	Discussions, tutorials, self-study, video lectures and presentations	

References/ Reading	1. Kothari, CR. (2004). *Research Methodology: Methods and Techniques* (Second edition), New Age International Publishers, New Delhi 2. Greenfield, T., Greener, S. (2016). *Research Methods for Postgraduates*, Third Edition, John Wiley & Sons, Ltd. 3. Gurumani, N. (2008). *Research Methodology for Biological Sciences*, MJP Publishers (Delhi) 4. Hawkins, DM. (2009). *Biomeasurement: a student's guide to biological statistics*, Oxford University Press, (New York). 5. Gupta, S.C. (1997). *Statistical Methods.* S. Chand & Sons Publishers, New Delhi	
Learning Outcome	On completion of this course, students will be able to prepare a research plan, methods for analysis of water, soil and air.	

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Course Code: ESPE – 502

Title of the Course: Environmental Pollution Practical I

Number of Credits: 02

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To understand the concentration of various pollutants in natural waters and their influence in biota. 2. The routine instruments used for analysis of different pollutants natural waters 3. Analyses of BOD and COD to understandthe impact organic pollution in water bodies.	
Content:	**Module I** 1. Determination of dissolved oxygen in coastal waters. (5 hrs;Ref.1) 2. Estimation of dissolved oxygen in polluted water (5 hrs.Ref. 2, 3) 3. Determination of biochemical oxygen demand in coastalwaters (5 hrs; Ref. 1) 4. Estimation of hydrogen sulfide in coastal waters (5 hrs. Ref.3). 5. Estimation of phosphorous in polluted water (5 hours. Ref.1) 6. Determination of fluoride in drinking water (5 hrs. Ref.1) **Module II** 1. Determination of chemical oxygen demand in coastal waters by $KMnO_4$ method (5 hrs; Ref. 2) 2. Pre-concentration of sea water by solvent extraction methodfor analysis of trace metals by AAS (5 hrs; Ref 5, 6, 7). 3. Estimation of Cu in coastal waters by AAS method (5 hrs; Ref 5, 6, 7). 4. Estimation of Pb in coastal waters by AAS method (5hrs; Ref 5, 6, 7). 5. Determination of Zn in polluted water by AAS method (5 hrs. Ref. 5,6,7) 6. Determination of Fe in sea water by AAS method (5 hrs. Ref. 5,6,7)	30 hrs. 30 hrs.

Pedagogy:	Demonstrations/ Lab experiments/Operation of different instruments for analysis of pollutants in natural waters.	
References/ Reading	1. Martin, D. F. (1972). *Marine Chemistry*. (Second Edition). M. Dekker (Ed.). New York. 2. Standard methods for the examination of water and wastewater analysis. (22nd Edition). 3. Rice, E. W. and Bridgewater, L. (2012). *Standard Methods for the Examination of Water and Waste Water Analysis*. Washington DC: American Public Health Association. 4. Grasshoff, K., Kremling, K., Ehrhardt, M., editors (1999). *Methods of Seawater Analysis*. (Third Edition). Weinheim: Wiley-VCH. 5. Strickland, J. D. H., & Parsons, T. R. (1972). *A practical hand book of seawater analysis*. (Second Edition). Fisheries Board of Canada bulletin. 6. Riley, J. P. and Skirrow, G. (1975). *Chemical Oceanography*. Academic Press. 7. Allen, S. E., Grimshaw, H. M., Parkinson, J. A., Quarmby, C., & Roberts, J. D. (1976). (eds) Chapman S. B, Chapter 8. Chemical analysis. In *Methods in Plant Ecology*. Blackwell Scientific Publications.	
Learning Outcome	1. Student will be in position to use different techniques for qualitative and quantitative estimation of environmental samples. 2. These studies would help to regulate the release of a particular pollutant in the marine environment.	

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Course Code: ESPE – 503
Title of the Course: Environmental Pollution Practical II
Number of Credits: 02

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).
Objectives:	1. Introduction of basic laboratory techniques for analysis of environmental samples. 2. Evaluate the utility of various analytical techniques as a qualitative and quantitative tool.

Content:	**Module I** 1. To prepare standard solution of different concentrations; Molarity, Normality, Parts per million, percentage (W/W, W/V, V/V). (3 hrs; Ref.1,2) 2. Procedures of water and wastewater sample collection from natural reservoirs and industries and preservation techniques. (3 hrs; Ref.1,3,4) 3. Calibration of glass electrode and determination of pH of different water samples (surface water, ground water and sea water). (3 hrs; Ref.7) 4. Calibration of conductivity meter and determination of conductivity of different water samples (surface water, ground water and sea water). (3 hrs;Ref.7) 5. Determination of pH and conductivity of soil samples. (3 hrs;Ref.7) 6. Standardisation of titrimetric reagents for acid base and complexometric titrations. (3 hrs; Ref.2) 7. Determination of alkalinity of surface, ground and sea water sample using titrimetric analysis. (3 hrs;Ref.3,4,7) 8. Determination of acidity of surface, ground and sea water sample using titrimetric analysis. (3 hrs;Ref.3,4,7) 9. Estimation of total solids, dissolved solids, suspended solids of surface, ground and sea water samples (3 hrs;Ref.3,4) 10. Determination of moisture content of soil using gravimetry. (3 hrs; Ref.3,4) **Module II (Any 5 experiments)** 1. Determination of nitrite in water sample using colorimetry (6 hrs; Ref.1,2,3) 2. Demonstration of UV-visible spectrophotometer and determination of nitrate in water. (6 hrs;Ref.1,2,3) 3. Determination of chromium in water sample by UV-Visible spectrophotometry. (6 hrs; Ref.1,2,3) 4. Estimation of total residual chlorine and hardness of water samples. (6 hrs; Ref.1,2,3) 5. Determination of Pb/Cd in water samples by MP-AES. (6 hrs; Ref. 2,3,4). 6. Determination of chemical oxygen demand in given water sample (6 hrs; Ref.3,4). 7. Estimation of phosphate in water by colorimetry (6 hrs; Ref.3,4) 8. Determination of elements (Fe/Mn/Zn/Pb/Cd etc) in air using high volume sampler. (6 hrs; Ref.2,3,4). 9. Determination of adsorption capacity of activated charcoal for various coloured water samples. (3 hrs;Ref.2,4). 10. Estimation of sulphate in water samples (tap water) by turbidimetry. (6 hrs;Ref.3,4).	30 hrs. 30 hrs.
Pedagogy:	Pre-lab and post-lab assignments or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	

References / Reading	1. Christian, G. D. (2013). *Analytical Chemistry* (Sixth Edition) Wiley. 2. Jeffery, G.H., Bassett, J., Mendham, J., Denney R.C. (1989). *Vogel's textbook of quantitative chemical analysis* (Fifth Edition) Longman Scientific & Technical, U.K. 3. Dey, A. K. (2010). *Environmental Chemistry* (Seventh Edition). New Age International Publishers. 4. Rice, E.W., Baird, R. B., Eaton, A, D., Clesceri, L. S. (2012) *Standard methods for the examination of water and wastewater analysis.* (Twenty Second Edition). Amer Public Health Assn. 5. Sawyer, C. N., McCarty, P. L., and Parkin, G. F. (2002). *Chemistry for Environmental Engineering and Science*. (Fifth Edition). McGraw-Hill Education 6. Moore, J. W., and Moore, F. A. (2012). *Environmental Chemistry* Academic Press, New Delhi. 7. Hota R. N. (2021). *Geochemical Analysis* (Second Edition) CBS Publisher.	
Learning Outcome	1. Student will be able to use different techniques for qualitative and quantitative estimation of environmental samples. 2. Students will be in a position to determine an unknown concentration of pollutant in given sample (water and soil).	

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Course Code: ESPE – 504
Title of the Course: Field work and Environmental Sampling Practical
Number of Credits: 01

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To understand the techniques in environmental sampling and get firsthand experience in field sample collection.	
Content:	**Module I** 1. Sampling methods for collection of soil and water. (5 hrs; Ref. 2, 3) 2. Determination of pH and Electrical conductivity of water and soil sample (5 hrs;Ref.1, 3). 3. Estimation of organic matter in soil (5 hrs;Ref. 3). 4. Estimation of available phosphates and total nitrogen in soil and water (5 hrs; Ref.3). 5. Determination of Total Dissolved Solids in water samples (5 hrs;Ref.1, 2). 6. Determination of Total hardness, calcium hardness and magnesium hardness by EDTA complex metric method (5 hrs;Ref.1, 2).	30 hrs.
Pedagogy:	Hands on practical demonstrations	

References / Reading	1. Lakshmi, G. S. (2010). *Environmental Science: A practical manual*. (First Edition)). BS publications. 2. Strickland, J. D. H., & Parsons, T. R. (1972). *A practical hand book of seawater analysis* (Fisheries Board of Canada bulletin) (Second Edition). 3. Aery, N.C. (2016). *Manual of Environmental Analysis*. New Delhi: Ane Books.	
Learning Outcome	On completion of this course, students will be able to carry out sampling of water, soil and air.	

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Course Code: ESPE – 505
Title of the Course: Environmental Data Analysis
Number of Credits: 01

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science) and have basic knowledge of operating computers.	
Objective:	The objective of the course is to enable students to analyze environmental data using appropriate statistical tools.	
Content:	**Module I** 1. Graphical analysis of data. (02 hrs, Refs. 1-3) 2. Preparation of Contour maps. (08 hrs, Ref. 4) 3. Statistical analysis of data: analysis of normality, parametric analysis (ANOVA, Tukey's/Dunnett's post-hoc test); non-parametric analysis (Kruskal-Wallis test). (10 hrs, Refs. 3, 5-7) 4. Multivariate analysis – construction of dendograms and Nonmetric Multi-Dimensional Scaling (NMDS) ordination diagrams. (06 hrs, Ref. 8) 5. Principal Component Analysis/Canonical Component Analysis. (04 hrs, Refs. 9-10).	30 hrs.
Pedagogy:	Data processing/computation	
References/ Reading	1. Basic Tasks in Excel - https://support.microsoft.com/en-us/office/basic-tasks-in-excel-dc775dd1-fa52-430f-9c3c-d998d1735fca 2. Grapher User's Guide (2020). Golden Software, LLC USA, www.GoldenSoftware.com 3. Statistica for Windows, Data Analysis Software System, www.statistica.com 4. Surfer 12 Full User's Guide (2014). Golden Software, LLC USA, www.GoldenSoftware.com 5. Christian, H. & Michael, S. (2016). Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R. Springer Publications.	

	6. Kothari, C. R. (1992). Quantitative Techniques, Vikas Publishing House. 7. Arora, P.N. & Malhan, P.K. (2012). Biostatistics, Himalaya Publishing House, New Delhi. 8. PRIMER: User Manual/Tutorial. PRIMER-E. Plymouth. 9. Kovach, W. (1998). Multi-Variate Statistical Package. Ver.3.01, Pentraeth. 10. ter Braak, C.J.F. (1995). Ordination. In: Jongman, R.H.G., ter Braak, C.J.F. & van Tongeren, O.F.R. (eds.), Data Analysis in Community and Landscape Ecology. Cambridge University Press, Cambridge, pp. 91e173.	
Learning Outcome	1. The students will be able to understand the type of analysis to be carried out for different types of data. 2. Students will able to perform environmental data analysis.	

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Course Code: ESTE – 506

Title of the Course: Coral Ecosystem and Threats

Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To understand the reef formation, distribution and biological/ecological processes of coral reefs. 2. To explore the coral biome and its ecological interactions. 3. To study the climate change adversities, conservation and restoration of coral habitats.	
	Module I Coral reef distribution, evolution and significance: Types of coral reefs and their global distribution with special emphasis to Indian waters. Salient features of the ecosystem: Habitat characteristics, reef biodiversity and nursery grounds, interactions with seagrass ecosystem and migratory corridors, natural barriers. Paleoecology of corals. Theories of evolution: Subsidence theory, Glacial Control Theory, Stand Still Theory, Cycle of Erosion theory. Coral reef formation, morphology and functional zones, Ocean chemistry and aragonite saturation. Hydrodynamics and lagoon circulation. Economic Importance: Fisheries and marine products, tourism and recreational activities. **Module II** Factors influencing coral biome: Environmental factors (pH, temperature, salinity, sedimentation, waves, ocean currents, weather, nutrients, aerial exposure, light) and their impact. Competitors, Microbial infections, predators, parasites. Coral communities and trophic structure: Primary producers, consumers,	15 hrs. 15 hrs.

	food webs, productivity in coral reefs. Symbiotic associations: Algal-coral associations, bacterial symbiosis, multi-partner symbiosis. Internal nutrient cycling, Energy transfer/trophodynamics, Adaptive bleaching hypothesis, Coral probiotic hypothesis, Rosenberg's hologenome hypothesis. **Module III** Threats to corals, disease spread assessment and prophylactic measures: Anthropogenic threats: Tourism and its impact, pollution, overfishing, habitat destruction. Global warming, thermal bleaching, ocean acidification, sea level rise and its effect on coral health. Coral disease survey and monitoring protocols. Disease response plan and outbreak management. Ex-situ treatment measures: Use of antibiotics, anti-oxidants and Phage therapy. Cultivation and conservation of corals: Coral Restoration and Health Consortium (CRHC), Global Coral Reef Conservation Project, Resilient Reef Initiative Project, Mithapur Coral Reef Recovery Project. Traits of climate change resilient clades. Laws and policies for conservation and management of corals in Indian seas/waters.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/self-study/case-studies	
References/ Reading	1. Sheppard, C., Davy, S., Pilling, G., & Graham, N. (2018). *The Biology of Coral Reefs (Biology of Habitats Series)* (2nd ed.). Oxford University Press. 2. Dubinsky, Z., & Stambler, N. (2014). *Coral Reefs: An Ecosystem in Transition* (1st ed.). Springer. 3. van Oppen, M. J. H., & Blackall, L. L. (2019). Coral microbiome dynamics, functions and design in a changing world. *Nature Reviews Microbiology*, *17*(9), 557–567. https://doi.org/10.1038/s41579-019-0223-4 4. van Oppen, M. J. H., Oliver, J. K., Putnam, H. M., & Gates, R. D. (2015). Building coral reef resilience through assisted evolution. *Proceedings of the National Academy of Sciences*, *112*(8), 2307–2313. https://doi.org/10.1073/pnas.1422301112 5. Harvell, D., Jordán-Dahlgren, E., Merkel, S., Rosenberg, E., Raymundo, L., Smith, G., Weil, E., & Willis, B. (2007). Coral Disease, Environmental Drivers, and the Balance Between Coral and Microbial Associates. *Oceanography*, *20*(1), 172–195. https://doi.org/10.5670/oceanog.2007.91 6. Chakravarti, L. J., & van Oppen, M. J. H. (2018). Experimental Evolution in Coral Photosymbionts as a Tool to Increase Thermal Tolerance. *Frontiers in Marine Science*, *5*. https://doi.org/10.3389/fmars.2018.00227 7. Contardi, M., Montano, S., Liguori, G., Heredia-Guerrero, J. A., Galli, P., Athanassiou, A., & Bayer, I. S. (2020). Treatment of Coral Wounds by Combining an Antiseptic Bilayer Film and an	

	Injectable Antioxidant Biopolymer. *Scientific Reports*, *10*(1). https://doi.org/10.1038/s41598-020-57980-1 8. Laurie J. R., Courtney S. C., Drew Harvell. C. (2021). Coral Disease Handbook Guidelines for Assessment, Monitoring & Management. ISBN-13 978-1921317019.	
Learning outcome	1. The coral ecosystem function and its economic implications. 2. Awareness of impact of anthropogenic activities on coral health. 3. Conservation and management strategies of damaged corals and their recovery.	

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Course Code: ESTE – 507

Title of the Course: Disaster Management

Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To provide basic conceptual understanding of disasters, understand approaches of Disaster Management and build skills to respond to disasters	
Content:	**Module I** Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management. Natural and Man-made disasters, Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters – The Refugee Problem. Types, trends, causes, consequences and control of disasters - Geological Disasters (earthquakes, volcanic eruptions, landslides, tsunami, land subsidence); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves). Biological Disasters (epidemics, pest attacks, forest fire); and Anthropogenic Disasters (building collapse, mining mishaps, rural and urban fire, road and rail accidents, oil spills, nuclear, radiological, industrial, chemicals and biological disasters, terrorism). **Module II** Disaster management cycle and framework, and applications of science and technology to disaster management: Disaster Management Cycle and the Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation, Disaster Communication, Search and Rescue, Emergency Operation Centre, Incident Command System, Relief and Rehabilitation. Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery, Reconstruction and Redevelopment	15 hrs. 15 hrs.

	Geo-informatics in Disaster Management (RS, GIS, GPS). Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations. Disaster Safe Designs and Constructions. Structural and Non Structural Mitigation of Disasters. S&T Institutions for Disaster Management in India **Module III** International organisations, NGOs, best practices and disaster management in India: International organisations: Red Cross, Sphere, Oxfam, World Relief, CBM International, UNDRO, UNDDR. Yokohama Strategy, Hyogo Framework of Action, UNISDR. Critical analysis of NGO experience. Community Based Disaster Risk Reduction (CBDRR). Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism. National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	1. Coppola, D. P. (2007). *Introduction to International Disaster Management*, Elsevier Science (B/H), London. 2. Gupta, M. C., Sharma. K., Gupta, L. C. & Tamini, B. K. (2001). *Manual on natural disaster management in India*. National centre for disaster management, Govt. of India. 3. Lopez-Carresi, A., Fordham, M., Wisner, B., Kelman, I. & Gaillard, J.C. (2014). *Disaster Management: International Lessons in Risk Reduction, Response and Recovery.* Routledge. 4. Goyal, S. L. (2006). *Encyclopaedia of disaster management, Vol I, II and III.* Deep & Deep, New Delhi. 5. Gunn, A.M. (2008). *Encyclopaedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2.* Greenwood Press. 6. Kapur, A. (2005). *Disasters in India: studies of grim reality*. Jaipur: Rawat Publications. 7. Srivastava H. N. & Gupta, G.D. (2006). *Management of Natural Disasters in developing countries.* Daya Publishers, Delhi. 8. Alexander, D. (1999). *Natural Disasters.* Kluwer Academic London. 9. Rubin, C. B., Cutter, S. L. (2020). *U.S. Emergency Management in the 21st Century*. *From Disaster to Catastrophe.* Routledge. 10. UNISDR. (2002). *Natural Disasters and Sustainable Development: Understanding the links between Development, Environment and Natural Disasters*, Background Paper No. 5.	

	11. Gupta A. K., Niar S. S & Chatterjee S. (2013). *Disaster management and Risk Reduction, Role of Environmental Knowledge*. Narosa Publishing House, Delhi. 12. Modh, S. (2010). *Managing Natural Disasters.* Mac Millan publishers India LTD. 13. *Disaster Management Act 2005*. Govt. of India. 14. *Disaster Management Guidelines* (2009)–(2020), GOI-UN Disaster Risk Program. 15. *World Disasters Report*, (2009)–(2020). International Federation of Red Cross and Red Crescent, Switzerland. 16. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management.	
Learning Outcome	1. Students will acquire a comprehensive understanding of natural and man-made disasters. 2. To analyse and evaluate the relationship of disasters with development.	

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Course Code: ESTE – 508
Title of the Course: Ecotourism
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To understand ecotourism potential, resources and management issues.	
Content:	**Module I** Definition, history, scope, principles, and characteristics of ecotourism. Tourist motivation, tourist interaction, and intensity of interaction with nature. Ecotourist, eco-sensitivity, ecocentrism, ethics of ecotourism, local participation benefits, and conservation. Resource potentials: Flora and fauna of Wildlife Sanctuaries, Bird Sanctuaries, National Park, sacred grooves, mangroves, backwater, waterfalls, springs, beaches, hill stations, deserts, butterfly parks, spice plantations. Taxonomy and ecology of aquatic faunal resources (Dolphin, crocodile, corals, mollusca) and terrestrial faunal resources (birds, butterflies, other insects). **Module II** Ecotourism Management: Marketing of ecotourism, Economic impact, development, governance and policy, programme planning, codes of practice carrying capacity, resource management and impact of ecotourism, impact assessment and management analysis. Visitor activity and impact management, role of interpretation centre. Safety measures on field and first aid. **Module III**	15 hrs. 15 hrs. 15 hrs.

	Designing ecotourism projects: Designing, interpretation centres, ecotourism websites, portals and documentaries, Identification of site-specific flora and fauna.	
Pedagogy:	Use of conventional, online and ICT methods. Field visit, case study/ ecotourism project proposal/project/self-study. Lecture/tutorials/assignments.	
References/ Readings	1. Bhatia, A.K. (2014). *Tourism development: principles and practices*, New Delhi: Sterling Publishers Pvt. Ltd. 2. Cooper, Chris (1994). *Tourism Principles and practice*. Great Britain Pitman publishing. 3. Fennell David, S. (2004). *Ecotourism* 4th edition Routledge Taylor & Francis group 4. Fennell, David A. (2007). *Ecotourism policy and planning*. CABI Publishing, Wallingford, Oxon, UK 5. Hill, J., Gale, T. (2009). *Ecotourism and Environmental sustainability Principles and practice*, Aghgate ebook. 6. Raju, Aluri J. S. (2007). *A Textbook of Ecotourism Ecorestoration and Sustainable Development* by New Central Book Agency (P) Ltd, Kolkata. 7. Sinha, P. (2003). *Encyclopaedia of ecotourism*, Anmol Publications, New Delhi. 8. Singh, R. (2003). *Indian Ecotourism: Environmental Rules and Regulations* Kaniskha Publishers, New Delhi. 9. Trivedi, Priya R. (2006). *Encyclopaedia of the Ecotourism (Vol. 1): Introduction to the Ecotourism*, Jnanada Prakashan, New Delhi. 10. Wearing, S. Neil, J. *Ecotourism, impacts, potentials and possibilities* 2nd edition Elsevier.	
Learning Outcome	1. To identify ecotourism potential sites and assess resources. 2. Design and execute visitor management plan and promotional material for ecotourism.	

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Course Code: ESTE – 509
Title of the Course: Ecotoxicology
Number of Credits: 03

Prerequisites for course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	Students will be able to understand the basic concepts of toxicology, bio-monitoring and application of microbes for bioremediation.	
Content:	**Module I** Introduction: Important concepts of ecotoxicology, Routes by which pollutants enter ecosystems; Major classes of pollutants, their sources and Eco toxicological effects, permissible levels of toxicants in the environment. Concepts of toxicology: Acute and chronic toxicity**,** dose response, bioaccumulation**,** bio magnification**,** bioavailability**,** biodegradation; Toxicokinetics: Absorption, Distribution, Metabolism,	15 hrs.

	Biotransformation and Elimination of Toxicants, Physiological and biochemical effects of toxic substances: Genotoxic, neurotoxic compounds, endocrine disruptors; Effects at the molecular level, cellular level, organism level (physiological, reproduction, behaviour). **Module II** Biomonitoring: Eco-toxicity tests (lab-based and field tests) in air, water and soil, biosensors, molecular biology assays, Use of model organisms for ecotoxicology: fish, helminthes, molluscs, mice, Environmental Risk Assessment. Environmental bio-indicators of eco-toxicity with faunistic studies. **Module III** Microbial Ecotoxicology and Biotechnology for mitigating environmental toxicity: Interaction between microorganisms and pollutants; Role of microorganisms in detoxification and degradation of environmental pollutants, Metagenomic techniques to study microbial diversity in polluted environment. Biological consortia to degrade or sequester in situ toxic materials. Primary, secondary and tertiary treatment of wastewater. Ameliorating nutrient toxicity (Nitrates and Phosphates), Handling sludge toxicity, Microbial and Phytoremediation (wetlands), Treatment of domestic wastewater using wetlands – a case study.	15 hrs. 15 hrs.
Pedagogy:	In class/online lectures, assignments, group activities, presentations.	
References/ Readings	1. Walker, C. H., Sibly, R. M., Hopkin, S. P., & Peakall, D. B. (2012). *Principles of Ecotoxicology. 4th Edition*. CRC Press, Taylor and Francis. 2. Jorgensen, S. E. (2010). *Ecotoxicology: A derivative of encyclopedia of ecology.* Academic Press. 3. Moriarty, F. (1999). *Ecotoxicology: The study of pollutants in ecosystems. 3rd Edition.* Academic Press. 4. Peakall, D. (2012). *Animal Biomarkers as Pollution Indicators.* Chapman and Hall. 5. Hayes, W. A. (2014). *Principles and Methods of Toxicology.* CRC Press, Taylor and Francis. 6. Naik, M. M., & Dubey, S. K. (2017). *Marine pollution and Microbial remediation.* Springer. 7. Cravo-Laureau, C., Cagnon, C., Duran, R., & Lauga, B. (2017). *Microbial Ecotoxicology*. Springer. 8. Scragg, A. (2005). *Environmental Biotechnology*. Oxford University Press. 9. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2017). *Prescott's Microbiology*. *10th Edition.* McGraw-hill Education. 10. Munn, C. (2020). *Marine Microbiology: Ecology and applications. 3rd edition*. Garland science.	

	11. Satyanarayana, T., Johri, B., & Anil, T. (2012). *Microorganisms in Environmental Management*. Springer.	
Learning Outcome	1. Students will be able to understand the toxic effects of pollutants on ecosystem function. 2. Apply concepts of ecotoxicology using model organisms for assessing environmental risk. 3. Suggest mitigation strategies using micro-organisms.	

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Course Code: ESTE – 510
Title of the Course: Environmental Biology
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To understand the role of biota in ecosystem function and to conserve and restore affected habitats.	
Content:	**Module I** Definition & principle of environmental science and ecology, interface between man and environment, physico-chemical and biological factors affecting the environment, concept and principles of ecosystems, components and functions of ecosystems, ecological pyramids, energy flow, consequences and disruption of food chain, ecological succession, modern conception of ecosystem classification (terrestrial and aquatic ecology), types of major biomes, population ecology- fundamentals, characteristics, growth and regulations, community ecology. **Module II** Terrestrial: Impact of forests on climate regulation, wildlife habitat protection, soil erosion, forest fires and its consequences on ecosystem, hydrology and moisture conservation, green belt and its implications on urban environment, carbon sequestration, Kyoto convention. Aquatic: species-specific interactions (parasitic, mutualisms, symbiosis, inquilism), predator-prey relationship, ecological sub-divisions of aquatic environment and their floral & faunal inhabitants. **Module III** Concept of biodiversity, taxic, genetic and phylogenetic, measurement of biodiversity (species richness, dominance, species diversity); biodiversity hot spots of India, National parks and sanctuaries, biosphere reserves, marine protected areas, keystone species, IUCN red list of threatened and endemic species. Eco-restoration and sustainable development at local, National and International levels, habitat degradation and fragmentation,	15 hrs. 15 hrs. 15 hrs.

	endangered species, conservation and restoration with advanced technologies.	
Pedagogy:	Lecture/tutorials/assignments.	
References/ Reading	1. Ramesh, V. K. (2005). *Environmental Microbiology*. MGP Publishers, Chennai. 2. Kormondy, E. J. (1962). *Concepts of Ecology*, Prentice Hall. 3. Singh, H.R. (1989). Animal Ecology and Environmental Biology. 4. Eiseth, G. D. & Baumgardener, K.D. (1981). *Population biology*, Van Nos Strand Co., N.Y. 5. Owen, O. S., & Chiras, D. D. (1990). *Natural resource conservation: an ecological approach* (No. Ed. 5). Macmillan Publishing Company. 6. Daniel, D. C. (1994). Environmental Science, 4th Ed., The Benjamin/Cummings Publishing Co., Inc. 7. *Conservation and Sustainable Use: A Handbook of Techniques*. Oxford University Press. 8. Hilleman, T. B. (2009). *Environmental Biology*. CRC Press. 9. Stachowicz, J.J. & Tilman, D. (2005). *Species invasions and the relationships between species diversity, community saturation and ecosystem function. In species Invasions, Insights into Ecology, Evolution and Biogeography* (Sax, D.F. et al. eds.), Sinauer Associates, Sunderland, MA.	
Learning Outcome	The students will be able to understand the key aspects of ecology, ecosystem, biodiversity, threats, and management plans for restoration of the affected ecosystem.	

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Course Code: ESTE – 511
Title of the Course: Environmental Chemistry
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To introduce fundamentals of environmental chemistry and environmental pollution. 2. Awareness of harmful effects of pollutants and control measures.	
Content:	**Module I** Introduction: Environmental segments (Lithosphere, Hydrosphere, Atmosphere, and Biosphere). Biogeochemical cycles (hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulphur). Introduction to Air, Water and Soil Pollution. Air pollution: Air pollutants (primary and secondary), photochemical reaction, Acid rain, Ozone layer depletion, global warming. Carbon monoxide, nitrogen oxides, sulphur dioxide and hydrocarbons (sources, harmful effects, analysis and control measures). Particulate matters (inorganic, organic and radioactive), health hazards, analysis, control devices (Gravitational settlings, particulate air filters,	15 hrs.

	centrifugal separators, wet scrubbers). Case study: London smog and Los Angeles smog. **Module II** Water pollution: Water analysis (salinity, hardness, pH BOD, COD, colour, turbidity, taste and odour); Water pollutants: nitrates, phosphates, phenols, cyanides, heavy metals (Cd, Hg) and analysis methods. Lake and river water treatment, municipal waste water treatment and industrial effluent treatment (from pesticides, pharmaceutical and electroplating). Case study - DDT, Kepone, Minamata. Soil pollution: Inorganic and organic components in soil, Reactions in soil, waste pollutants in soil. Excess usage of agrochemicals, soil contamination with pollutants Pesticides (toxicity, biochemical effects and control measures). **Module III** Introduction to Environmental Hazards: Plastics (harmful effects, preventive measures and control measures), Microplastics and Nanoplastics, E-waste (impact on environment, harmful effects and control measures) Radioactivity (contamination of radioactivity, radiation hazards, control measures). Waste Management: Waste Management (sources and types of solid wastes, disposal techniques, collection methods, waste management approach). Energy Resources and Conservation of energy resources: Energy Resources and Conservation Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, composition. Principle of generation and conservation of conventional and non-conventional energy. Energy from biomass and biogas, energy conservation policies.	15 hrs. 15 hrs.
Pedagogy:	Lectures/tutorials/seminars/assignments/presentations/self-study.	
References / Reading	1. De, A. K. (2005). *Environmental Chemistry* (Third Edition). New Age International Publishers, New Delhi, 2. Salker, V. (2017). *Environmental Chemistry* (First Edition). Narosa Publishing House, New Delhi. 3. Sharma, K. (2003). *Environmental Chemistry* (First Edition). GOEL Publishing House, Meerut. 4. O'Neill, P. (2009). *Environmental Chemistry* (Third Edition). Blackie Academic and Professional, London. 5. Khopkar, S. M. (2005). *Environmental Pollution Analysis* (First Edition). New Age International Publishers, New Delhi.	
Learning Outcome	Students will be able to understand the basic environmental chemical processes and explain the origin and harmful effects of toxic chemicals in the environment.	

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Course Code: ESTE – 512

Title of the Course: Environmental Implication of Marine Productivity
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To describe the role of plankton communities in marine ecosystem function. 2. To understand the factors responsible for marine productivity and its implication on the health of marine environment.	
Content:	**Module I** Marine environment zonation, coastal and open ocean, significance of oceans and its diversity to humans, importance of planktonic biota to the health of oceans, distribution of plankton in the Tree of Life, major groups of virioplankton (viruses), picoplankton, phytoplankton and zooplankton, their biology and role. Diatom/dinoflagellate index as an indicator for ecosystem change, haptophytes (prymnesiophytes), prasinophytes, zooplankton (holoplankton, meroplankton): chaetognaths, cnidarians, molluscs, radiolarians, foraminiferans, crustaceans, larvaceans, multiple marine protistan lineages in seven supergroups of eukaryotic tree of life, factors affecting primary production: light, nutrients, mixed layer depth, chelating agents, tides, turbulence, grazing, mixotrophy, interactions within and across trophic levels (allelopathic interactions). **Module II** Significance of plankton in marine ecosystem functioning: Planktonic food web structure and trophic transfer, microbial food webs, viral shunt, phytoplankton C:N:P ratios, stoichiometric plasticity, phenotypic plasticity, role in biogeochemical cycles, carbon Sequestration, biological carbon pump (soft and hard), ecological success of diatoms, blooms, Harmful Algal Blooms (HABs) and biotoxins, morphological and physiological characteristics of HAB species, HAB dynamics, implications of climate change on plankton (global warming, ocean acidification). **Module III** Quantitative observations of planktonic ecosystems: Primary productivity measurements: oxygen technique, chlorophyll extraction method, Radiocarbon technique, Satellite colour scanning, techniques and instruments used in plankton studies: advances in automated technology to observe and measure plankton, pigment composition, optical and acoustical methods (Optical Plankton Counter, Zooglider), quantitative imaging devices (Flow Cytometry, FlowCAM, FlowCytoBot), molecular phylogenetic approaches, high throughput 'omics' data, monitoring plankton in oceans through various international projects: Continuous Plankton Recorder (CPR), Global Alliance of CPR Surveys (GACS), The Scientific Committee on Oceanic Research (SCOR), Global Ocean Observing System (GOOS), Global Ocean Ecosystem Dynamics (GLOBEC), Integrated Marine Biosphere Research (IMBeR), TARA Oceans, GEOHAB .	15 hrs. 15 hrs. 15 hrs.

Pedagogy:	Lectures/tutorials/assignments/self-study/Moodle/Videos	
References/ Reading	1. Morrissey, J.F, Sumich, J. L (2018). Pinkard-Meier DR (Eds) *Introduction to the Biology of Marine Life*. 11th Ed. Jones & Bartlett Learning. 2. Sardet, C., Rosengarten R. D., (Eds) (2015). *Plankton: wonders of the drifting world*. The University of Chicago Press, Chicago. 3. Lalli, C. M, Parsons TR (Eds) (2010). *Biological Oceanography: an introduction*. 2nd Ed. Elsevier, Amsterdam. 4. Nybakken, J.W, Bertness, M.D (Eds) *Marine Biology: an Ecological Approach*. Pearson Education, San Francisco. 5. Mitra, A., Banerjee, K., Gangopadhyay, A., (Eds) (2004) *Introduction to marine plankton*. Daya Publishing House, Delhi. 6. Levinton, J. S., (Ed) (2011) *Marine Biology: Function, biodiversity, ecology*. Oxford University Press, New York. 7. Ormond, R, (Ed) (1997) *Marine Biodiversity: Patterns and Processes*. Cambridge University Press. 8. Jungblut, S., Liebich, V., Bode, M. (Eds) (2018) YOUMARES 8 – Oceans Across Boundaries: Learning from each other. Springer Open.	
Learning Outcome	1. Students will get acquainted on the role of plankton in the marine ecosystem and food web dynamics. 2. Students will have an overview on global monitoring systems with respect to HABs and their consequences.	

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Course Code: ESTE – 513

Title of the Course: Environmental Microbiology

Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	This course focuses on microbial diversity in different ecosystems, their role in habitat functioning and microbial remediation towards sustainable habitats.	
Content:	**Module I** Introduction to the microbial world and a brief history of microbiology; microbial groups (archaea, bacteria, protists, fungi, viruses) from diverse terrestrial and aquatic environments; classical and molecular methods to study microbial diversity; microbial associations- mutualism, protocooperation, commensalism, syntrophism, predation, competition, amensalism and parasitism. **Module II** Impacts of microorganisms on environment and humans: role of microorganisms in food web, biogeochemical cycling of carbon, nitrogen	15 hrs. 15 hrs.

	and phosphorus. microorganisms and climate change, range extension of species; disease outbreaks and epizooitics; antibiotic-resistant bacteria and their implications; ballast water and bio-invasion - concept, implications and preventive measures, ballast water management convention, bio-fouling and corrosion associated with shipping industry - progression, impacts and preventive measures. **Module III** Environmental microbiology in sustainable development microorganisms in agriculture - nitrogen-fixing bacteria, Mycorrhizae, phosphate solubilizing bacteria, plant growth promoting Rhizobia, biocontrol agents. Microorganisms for food security, clean energy, bioremediation of oil spills, heavy metals, xenobiotics and wastewater treatment.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/case study.	
References/ Reading	1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2017). Prescott's Microbiology. McGraw-hill Education. 10th Edition. 2. Medigan, M. T., Bender, K. S., Bukley, D. H., Sattley, W. M., & Stahl, D. A. (2019). *Brock Biology of Microorganisms*. Pearson. 15th Edition. 3. Munn, C. (2020). *Marine Microbiology: Ecology and applications*. Garland science. Third edition. 4. Naik, M. M., & Dubey, S. K. (2017). *Marine pollution and Microbial remediation.* Springer. 5. Satyanarayana, T., Johri, B., & Anil, T. (2012). *Microorganisms in Environmental Management*. Springer. 6. King, R. B., Sheldon, J. K., & Long, G. M. (2019). *Practical Environmental Bioremediation*: The Field Guide. CRC Press. second edition. 7. Meena, S. M., & Naik, M. M. (2019). *Advances in Biological Science Research:* a practical approach. Elsevier. 8. Bertrand, J. C., & Coumette, P. (2015). *Environmental Microbiology: Fundamentals and Applications*. Springer. 9. Yates, M., Nakatsu, C. H., Miller, R. V., & Pillai, S. D. (2016). Manual of Environmental Microbiology. ASM press. 10. Cavicchioli, R., Ripple, W. J., Timmis, K. N., Azam, F et al. (2019). *Scientists' warning to humanity: microorganisms and climate change*. Nature reviews microbiology, 17, 569- 586.	
Learning Outcome	1. The students will be able to understand the distribution of microbes in diverse environments. 2. Student will be able to understand the significance of microbes in mediating biogeochemical cycles and their role in bioremediation.	

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Course Code: ESTE – 514
Title of the Course: Green Chemistry
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To learn basic knowledge and principles involved in green chemistry and create awareness. 2. To understand energy saving and making green processes in chemical reactions. 3. To develop social concern for waste generated from various processes.	
Content:	**Module 1** Introduction to Green Chemistry: Need for Green Chemistry; Overview of twelve green chemistry principles as proposed by Paul Anastas and John Warner; Explanation with examples under each principle. New trends in green chemistry, Basic principles, Atom economy concept and its environmental importance, Green reagents and Green solvents. Waste Production, Problems and Prevention: Problems caused by waste; Sources of waste from the chemical industry; Waste minimization techniques; On-site waste treatment; physical treatment; Chemical treatment; Biotreatment; Degradation; Rules for degradation; Polymer recycling.	15 hrs.
	Module II Chemicals from Renewable Raw Materials: Carbohydrates; Ethanol; Lactic acid; Indigo-natural colour; Riboflavin; Ascorbic acid; Fats and Oils; Biodiesel; Fatty acid esters; Terpenes; Green Polymers from Renewable Raw Materials. Alternative energy sources for greener processes: Design for Energy Efficiency; Photochemical Reactions; Advantages of and Challenges Faced by Photochemical Processes; Examples of Photochemical Reactions; Chemistry Using Microwaves; Microwave Heating; Microwave-assisted Reactions; Sonochemistry; Electrochemical Synthesis. Designing greener approaches - Successful Industrial Case Studies: Safer designs for the target molecule, Minimization, Simplification, Substitution, Moderation, Limitations, Replacement of Toxic Reagents, Use of Alternative Solvents (suitable examples in each case). Process Improvement- Acetic Acid Manufacture; Vitamin C; Leather Manufacture; Dyeing; Polyethene; Eco-friendly Insecticides.	15 hrs.
	Module III Sustainable Development and Regulation: Introduction to sustainable development; Why regulation is required to achieve sustainable development; Environmental policy and innovation; Future trends and challenges in sustainable development. Bio-inspired Green Nanomaterials: Bio-inspired Green Nanomaterials – microbial synthesis of nanoparticles – Biosynthesis of Nanoparticles by bacteria and Fungi – Biosynthesis of nanoparticles using plant extracts – Advantage of biosynthesis. Future Trends in Green Chemistry: Introduction to solid acid catalysts and their significance in industrial applications; phase-	15 hrs.

	transfer catalysis, Biocatalysis: basic principles, enzyme catalysed reactions, Photocatalysis: Introduction and significance with examples.	
Pedagogy:	Lectures/tutorials/seminars/assignments/presentations/self-study	
References/ Reading	1. Lancaster, M. (2002). *Green Chemistry-An Introductory Text, Royal Society of Chemistry* 2. Sheldon, R. A., Arends, I., Hanefeld U. (2007). *Green Chemistry and Catalysis*, WILEY-VCH 3. Afonso, C. A. M. & Crespo, J. G. (2005) *Green Separation Processes*, WILEY-VCH, 4. Matlack, S. (2001). *Introduction to Green Chemistry*, Marcel Dekker, Inc., 5. Ahluwalia, V. K., Kidwai, M., (2004). *New Trends in Green Chemistry, Anamaya Publishers.* 6. Basiuk, V. A., Elena, V., Basiuk (2015). Springer *Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials.*	
Learning Outcome	1. Student will be able to apply the basic principles of Green chemistry in daily life. 2. Students will understand control measures of waste, and green Industrial processes.	

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Course Code: ESTE – 515
Title of the Course: Marine Biodiversity and Conservation
Number of Credits: 03

Prerequisites for the Course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. Addresses basic concepts of marine biodiversity at all levels, 2. IPR, life patenting and its implications on the environment and human life.	
Content:	**Module 1** Biodiversity, definition, concept, types; Biodiversity measurements - taxic, phylo-genetic and molecular approaches. Intra-specific Genetic variance and factors affecting, biodiversity and intra-specific variations, dominance and over-dominance hypothesis, adaptive polymorphism, genetic variations, loss and increase dynamics of biological diversity, conceptual models, hypothesis proposed in deep sea biodiversity. **Module II** Marine Biodiversity and ecosystem functions, competition, predation and heterogeneity as biodiversity determinants; ecosystem approach, functions and keystone species, engineer organisms, diversity-stability, rivet, drivers and passenger, idiosyncratic hypothesis, co-operative relations, top down and bottom up theories, cascade effects and fishing through the food webs. **Module III**	15 hrs. 15 hrs.

	Biodiversity and Intellectual Property Rights (IPR) and bio-piracy, life patenting and implications, impact of GATT/WTO on farmer's right, indigenous, traditional knowledge. Biodiversity conservation - Biological diversity Act, sanctuaries, marine parks, protected areas, hotspots and marine biosphere reserves of India.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/self-study.	
References/ Readings	1. Hiscock, K. (2014). *Marine biodiversity conservation: A practical approach*. Routledge Taylor & Francis Group. 2. Kumar, A. (2004). *Biodiversity & environment*. A.P.H. Pub. Corp. 3. Ormond, R., Gage, J. D., & Angel, M. V. *(1997). Marine biodiversity: Patterns and processes. Cambridge University* Press. 4. Queiroga, H. (2006). *Marine biodiversity: Patterns and processes, assessment, threats, management and conservation*. Springer. 5. Shiva, V. (1994). *Cultivating diversity: Biodiversity conservation and the politics of the seed*. Research Foundation for Science, Technology & Natural Resource Policy.	
Learning Outcome	The students will be able to gain a holistic view of the marine biodiversity with emphasis on ecosystem functions and conservation policies.	

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Course Code: ESTE – 516

Title of the Course: Marine Pollution
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).
Objectives:	1. To characterize the potential exogenous material added to the sea, their effects on marine and human life. 2. Remedial measures adopted to reduce undesirable effects.

Content:	**Module I** Introduction: Introduction to Environment, Objectives of environment, Marine pollution definition, Some questions, Categories of additions, Nature of inputs, and Sources of inputs. Gross chemical composition of seawater, Sources of dissolved and particulate matter in the sea, Geochemical balance and residence times of elements in seawater. Organic wastes: Biochemical oxygen demand, the dilution factor, Settlement, Oxygen budget, Consequences of organic discharges into Thames and Mersey estuaries. Decomposition of organic matter in oxic and anoxic environments. Sewage and sewage treatment, Disposalof sewage sludge, Industrial wastes and treatment processes with reference to wastes from paper and pulp and soap manufacturing industries. Oil spills and Consequences of oil pollution: Introduction, Inputs, major accidental spills, fate of spilled oil at sea and Treatment of spilled oil.	15 hrs.
	Module II Conservative pollutants: Measures of contamination, Toxicity, Acute, Chromic exposure and detoxification. Trace metal pollution in coastal waters (Hg, Cd, Pb, Cu and Fe), and Radioactive pollution: Sources, classification, effects of radiation,MPD concept, protection and control from radiation, Beneficial aspects of radiation and Disposal of royal wastes. Halogenated hydrocarbons; Low molecular weight compounds, High molecular weight compounds, Inputs to sea, fate in the sea, Biological effects, environmental impact, mode of poisoning of pesticides.	15 hrs.
	Module III Pollution indicators: Criteria for selection of indicator organism, Quantification of pollution load, basic pre requisites, Response to different pollution load and Time integration capacity. Macro algae and Mollusc as indicators to monitor trace metal pollutionin coastal waters. Monitoring strategies of Marine pollution: Critical pathway approach and Mass balance approach. Marine corrosion: Definition, Corrosion theory, Effects, classification, factors affecting corrosion of metal in seawater and control of marine corrosion. Standards in water quality and instrumental techniques, Pollution status of the North Sea. Present status of coastal pollution in India and Future strategies. Assessment of pollution damage: The need, serious ness of damage and assessment of damage.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/self-study	

References/ Reading	1. Riley, J. P., & Skirrow, G. (Eds.). (1975). Chemical oceanography. Academic Press Vol: 3 2. Goldberg, E. D. (1976). *The health of the oceans*.UNESCO Press. 3. Clark, R. B. (1986). *Marine pollution*. Oxford Science Publications. 4. Phillips, J. D. H. (1980). *Quantitative aquatic biological indicators.* Applied Science Publishers. *5.* Sharma, B. K., & Kaur, H. (1994). *Thermal and radioactive pollution*. Krishna Prakasham Mandir. *6.* Sharma, B. K., & Kaur, H. (1994). *Water pollution.*Krishna Prakasham mandir, Meerut. 7. Chandler, K. A. (1985). *Marine and offshorecorrosion.* Butter Worths, London.	
Learning Outcome	1. Understand the impact of various pollutants on marine ecosystem. 2. Adopt corrective measures to prevent degradation of the marine environment. 3. To provide advisory and technical service to government and industry for pollution abatement.	

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Course Code: ESTE – 517
Title of the Course: Microplastics in Environment
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	This course introduces to the concept of microplastics as a pollutant and its impact on the environment and human.	
Content:	**Module I** Introduction to microplastics: Introduction to Plastics and microplastics: Types of plastics: PET, HDPE, PVC, LDPE, PP, PS, Other; and microplastics types: fibres, microbeads, fragments, nurdles, foam. Primary and Secondary, microplastics and its formation. Distribution of microplastics: Global occurrence, sources of microplastics. Distribution and fate of plastic in the environment. Microplastics pollution in Land, Water- Freshwater and Marine waters, Air, Snow. *Module II* ***Impacts of microplastics: Potential impacts on the environment and human health. Microplastics as carriers of trace and heavy metals and its role as pollutant. Microplastic in plants, animals and humans.*** **Module III**	15 hrs. 15 hrs.

	Sampling and characterization: Methods used for sampling, quantification of microplastics. Instrument for identification of microplastics- FTIR and Raman Spectroscopy. Mitigation: Mitigation methods for microplastics and role of Blue Flag certification- international eco-level tag Foundation for Environmental Education. G20 and United Nations Environment Assembly resolution on marine litter and microplastics. Case studies: Microplastics pollution studies in India-Case studies with special reference to Goa.	15 hrs.
Pedagogy:	Case studies will be discussed and seminar topics other than from the syllabus will be given to students.	
References/ Reading:	1. Crawford, B. C & Quinn, B. (2016). *Microplastic Pollutants* (1st ed.). Elsevier Science. 2. Rocha-Santos, T., Costa, M. & Mouneyrac, C., (Eds.). (2022). *Handbook of Microplastics in the Environme*nt (1st ed.). Springer. 3. Rocha-Santos, T.A.P. & Duarte, A.C. (Eds.). (2017). *Characterization and Analysis of Microplastics* (1st ed.). Elsevier Science.	
Learning Outcome	1. Understanding the formation of microplastics and its impact on environment. 2. Create awareness among students about microplastic pollution. 3. Suggest mitigation strategies for overcoming such problems.	

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Course Code: ESTE – 518
Title of the Course: Polar Sciences
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. The students will gain information on Polar regions and biota. 2. The course would include the significance of the Polar Regions in context of atmospheric circulation and energy exchange. 3. The students will understand the role of Polar regions in influencing circulation in the Southern Ocean and its sensitivity to global climate change.	
Content:	**Module I** Introduction: Delimitation of Arctic and Antarctic, their basic differences, discovering, exploitation and scientific utilizability. Astronomic factors and their reflexion in polar regions. Ecology of polar region: Climate of polar regions - energy balance of the ground surface, water balance, baric field and atmospheric circulation, air temperature and air humidity, precipitation. Climate change and climate variation and their consequences i.e. polar regions (glacials and interglacials and their influence on the hydrosphere, geosphere, cryosphere and biosphere). Freshwater hydrology and oceanology. Surface water and ground water. Polar oceans - submarine relief,	15 hrs.

	systems of sea currents, water substitution with the lower latitudes and its energy consequences. **Module II** Glaciology: Glaciology of polar regions - reasons of glaciation and its development, glaciation of continents and of sea surface, ice mass balance. Cryosphere as a stabilizer of Earth climate. Development of earth surface in polar regions, glacial and periglacial geomorphologic processes - permafrost and its energy roots, regional structure, active layer of permafrost, frost weathering, slope dynamics. Soil in polar regions. **Module III** Flora and fauna: Vegetation in polar regions - limiting by abiotic factors (microclimate, nutrients, water), soil flora, space structure of polar vegetation (subpolar, polar, polar deserts and semideserts, polar wetlands). Origin of polar (alpine) plants, vascular plants and their adaptation and acclimatization on the polar environment. Cryptogams in polar regions. Stress physiology of polar plants. Fauna of polar regions - invertebrates, evolution and space structure, physiological adaptation on polar conditions, nutrient succession. Microbial diversity - Anthropogenic impacts on polar ecosystems - heat pollution of planetary geosystem, changes in chemical composition of atmosphere and their consequences (global transport of pollutants, anthropogenic change in greenhouse effect, ozone depletion and its consequences), changes in biodiversity.	15 hrs. 15 hrs.
Pedagogy:	Lectures/tutorials/assignments/visit to research laboratory	
References/ Readings	1. Holdgate, M.W. (1970). Antarctic Ecology. *Academic Press, London*, New York. 2. King, J.C. & Turner, J. (1997). Antarctic meteorology and climatology. *Cambridge University Press.* xi, 409. 3. Oke, T. R. (1987). Bounrady Layer Climates. *Routledge, London and New York*, 435. 4. Przybylk, R. (2003). The climate of the Arctic. *Dordrecht: Kluwer Academic Publishers,* 270. 5. Richard, S., Per, M. (2006). Buffalo A complete guide to Arctic wildlife. *N.Y.: Firefly Books*, 464. 6. Stonehouse, B. (1989). Polar Ecology. *Blackie, Glasgow – London*. 7. Thurman, H.V. & Alan, P.T. (2005). Oceánografie: [tajemnýsvětmořĭaoceánů]. *Praha: Computer Press*, viii, 479. 8. Warwick, F., Johanna, V., Parry, L. (2008). Polar lakes and rivers: limnology of Arctic and Antarctic aquatic ecosystems. *Oxford: Oxford University Press*, xviii, 327.	
Learning Outcome	The student will get a detailed understanding of polar ecosystem functioning.	

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Course Code: ESTE – 519

Title of the Course: Water Resource Management
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To understand occurrence and circulation of water in nature. 2. To study the functioning, problems and measures for sustainable development of water resource.	
Content:	**Module I** Hydrological Cycle and Aquifer: Traditional methods of water management. Hydrological cycle: Evaporation, evapotranspiration, precipitation, runoff and infiltration**.** Classification of aquifers and confining layers, hydraulic properties of aquifers, water table and piezometric surface. Water control and crop production. Construction and technology of water control system. Problems related to overexploitation and groundwater mining. Saline water intrusion in coastal aquifers and its control. Fresh-salt water interface.	15 hrs.
	Module II River flooding and rain water harvesting: Nature, extent, magnitude and frequency of floods, urbanization and flooding. Availability of water in Lakes, ponds, streams and rivers Impact of climate change on water availability. Subsurface investigation of groundwater. Classification of rocks based on water bearing capacity. Drilling methods, construction, development and maintenance of wells. Rainwater harvesting and water conservation techniques and its importance. Concept of artificial recharge: methods, wastewater recharge for reuse.	15 hrs.
	Module III Pollution and water governing laws: Pollution of surface and groundwater: Municipal sources, industrial sources, agricultural sources. Case studies of water pollution in India. Physical, chemical, biological properties of water. Quality criteria for different uses. Concept of Groundwater flow lines and flow net. Water Governance: Salient features of The Water (Prevention and control of pollution) Act, 1974 and Goa water (Prevention and Control of Pollution) Rules, 1988.	15 hrs.
Pedagogy:	Lectures/assignments/seminars/group discussion/self-study	

References/ Reading	1. Arakeri, H. R., & Donahue, R. (1984). *Principles of soil conservation and water management*. Rowman & Allanheld, Publishers. 2. Fetter, C. W. (2018). *Applied hydrogeology*. Waveland Press. 3. Grafton, R. Q., & Hussey, K. (Eds.). (2011). *Water resources planning and management*. Cambridge University Press. 4. Jain, S. K., Agarwal, P. K., & Singh, V. P. (2007). *Hydrology and water resources of India* (Vol. 57). Springer Science & Business Media. 5. Johnson, W. (1982). *Environmental Geology-Coates*, *DR.* 6. Keller, E. A. (2007). *Introduction to environmental geology*. Prentice-Hall, Inc. 7. Kumar, R., Singh, R. D., & Sharma, K. D. (2005). Water resources of India. *Current science*, 794-811. 8. Nitya, J. (2008). *Jalatra: exploring India's traditional water management systems.* 9. Pennington, K. L., & Cech, T. V. (2009). *Introduction to water resources and environmental issues*. Cambridge University Press. 10. Todd, D. K., & Mays, L. W. (2004). *Groundwater hydrology*. John Wiley & Sons. 11. Vaidyanathan, A. (1999). *Water resource management: institutions and irrigation development in India*. Oxford University Press.	
Learning Outcome	To understand and develop knowledge with respect to occurrence and circulation of water in nature and find solutions to water related problems.	

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Course Code: ESTE – 520
Title of the Course: Industrial water and wastewater treatment technologies
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. Explain the sources and effects of water pollution from various industries. 2. Understand the principles and processes in wastewater treatment technologies. 3. Identify suitable technologies for wastewater treatment.	
Content:	**Module I** Introduction: Types of industrial pollutants, Industrial wastewater characterization, Categorization of industries - green, orange and red industries, Standards of industrial waste disposal, Minimum National Standards (MINAS) and Goa State Regulatory Framework for effluents and trade waste. Industrial wastewater treatment: Primary, secondary and tertiary/polishing treatment such as equalisation, neutralisation, precipitation. Physico-chemical and biological treatment processes: Sedimentation, Oil separation, Floatation, Coagulation, Filtration, Ion exchange membranes. Biological oxidation**:** Removal of organics (Sorption, Stripping, bio-degradation), Unit operations and electromechanical equipment used in the treatment	15 hrs.

	processes. **Module II** Advance wastewater treatment process: Removal of specific pollutants – nitrification, denitrification/anammox process, SHARON-ANAMMOX process for treatment of ammonium rich wastewater, Biological Phosphate Removal (BPR). Membrane processes: Fundamentals, Membranes – Types, classifications, Microfiltration, Ultrafiltration, Nanofiltration and reverse osmosis, Electrodialysis, Ion exchange. Advance oxidation process: Photocatalysis, Ozonation –Ozone / UV, Ozone / Hydrogen peroxide, Hydrogen peroxide/ UV applications and other significant proven technologies. **Module III** CETP and DWT: Requirement and objectives Planning andmanagement of CETP and DWT, facilities for small scale industries. Energy recovery from wastewater: Microbial fuel cells,microbial electrolysis cell, microbial desalination cell, biohydrogen production and combination of technologies.	15 hrs. 15 hrs.
Pedagogy:	Lectures/ video/ Powerpoint presentation/ Industrial visit / documentaries and discussion / research article analysis / mini projects / survey and mapping projects.	
References/ Reading	1. De, A. K. (2019). *Environmental Chemistry*. (9th Ed.).New Age International Publishers. 2. Bennett, M. R. & Doyle, P. (2016). *Environmental Geology. In, Geology and the Human Environment*. Wiley India Pvt. Ltd. 3. Patwardhan, A.D. *Industrial Wastewater Treatment*. (2ndEd.). Eastern Economy Edition. 4. Karia, G. L. & Christian, R. A. *Wastewater Treatment: Concepts and Design Approach*, Eastern Economy Edition. 5. Bratby, J. (2006). *Coagulation and flocculation in water and wastewater treatment*. (2nd Ed.). London, UK:IWA Publishing. 6. Grady, C. P., Daigger, G.T. & Lim H.C. (1999). *Biological wastewater treatment*. (2nd Ed). New York: Marcel Dekker, Inc. 7. Abbasi, S.A. (1998). *Environmental pollution and its control*. Pondicherry: Cogent. 8. Abbasi, S.A. (1998). *Water Quality Sampling and Analysis. Discovery*, New Delhi. 9. Aery, N.C. (2016). *Manual of Environmental Analysis*. NewDelhi: Ane Books. 10. Droste, R. L. & Gehr, R. L. (2018). Theory and Practice of Water and Wastewater Treatment. (2nd Ed). 11. Kumar, R. & Singh, R.N. *Municipal water and wastewater treatment. Environmental Engineering Series*. ISBN: 9788179931882 12. Lal, B. & Sarma, P.M. *Wealth from waste: trends and technologies*.	

	(3rd Ed). TERI press. 13. Lin, S. D. (2014). *Water and Wastewater Calculation Manual*. McGraw-Hill Education. ISBN: 9780071819817 14. Asiwal, R.S., Sar, S.K., Singh, & S., Sahu, M. (2016). *Waste Water treatment by effluent treatment plants*. SSRG International Journal of Civil Engineering, 3 (12).	
Learning Outcome	1. The student will be able to identify different pollutants from various industries. 2. Suggest suitable technologies for the wastewater treatments depending on type of pollutants. 3. Design the suitable process for wastewater treatment plants. 4. Manage and supervise the maintenance of treatment plants.	

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Course Code: ESTE – 521

Title of the Course: Water and Wastewater: Monitoring and Treatment
Number of Credits: 03

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).
Objectives:	1. Understand the water quality criteria and standards of water for domestic, industry and agriculture consumption. 2. Learn the causes and effects of water pollution and quality deterioration. 3. Learn the principles and instrumentation for water quality control and monitoring. 4. To enable students to design innovative methodologies in monitoring and treatment of water and wastewater.

Content:	**Module 1** Water balance and benchmarks: Earths waterbudget, Hydrological cycle, Demand - supply situationand global benchmarks for major water dependent industries. Water quality: water quality standards, Standards for Package Drinking water and mineral water, Water quality standards and parameters (ISI-BIS and USPH), Water pollution: Sources and types of water pollution, Causes and impacts on Environment. Water pollutants: Organic (Pesticides, oil spill, tar balls and toxic organic chemicals, antibiotics), Inorganic, Sediments, Marine, Radioactive, Eutrophication, trace and heavy elements in water, Bioindicators. Water and wastewater: Characteristics, Classification of wastewater Sampling techniques: Separation scheme for organic compounds in water. Preservation techniques for sample. Monitoring techniques and methodology: Physical, Chemical and biological analysis of water and wastewater parameters such as pH, Conductance, Turbidity, Temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), TKN, Dissolved Oxygen(DO), Acidity and Alkalinity, Ammonia, Chlorides, Fluoride, Nitrate and Nitrite, Cyanide, sulphide, Sulphate, Phosphate, Total Hardness, Boron, Silica, Metal and Metalloids, Heavy metals and other pollutants, Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD).	15 hrs.
	Module II Water treatment - Treatment of water: Conventional and modern methods of treatment, Flowchart of the Water Treatment Plant, Treatment Methods (Theory and Design). Treatment processes: Screening, Oil Separation, Sedimentation, Coagulation-Flocculation, Settling tanks, Aeration and Gas transfer, Precipitation, Softening, Filtration- Sand, Charcoal, Multimedia etc., Reverse Osmosis technology, Membrane processes, Ultrafiltration. Disinfection System: chemical based and other disinfection methods such as Chlorination, Ozonation, UV, Adsorption and Ion exchange, Electrochemical and other methods.	15 hrs.
	Module III Biological treatment - Types of treatment processes: attached and submerged, aerobic and anaerobic, facultative etc., Aerobic processes: Activated Sludge Process andvarious modified processes, SBR, MBR, UA-SBR, FAB etc, Oxidation ponds and Rotating Biological Contactors Anaerobic processes: Up flow Anaerobic Sludge Blanket, Anaerobic digesters, Anaerobic filters. Sludge treatment: Preliminary operation, thickening, conditioning, Dewatering, Filtration, Digesting andDrying of sludge, Sludge disposal Modular Sewage Treatment Plant: Water reuse and recycling (Industry / Site visit for Water treatment plant and STP).	15 hrs.
Pedagogy:	Lectures/case studies /workshops/industrial visit /documentaries and discussion/ research article analysis /mini projects / survey or mapping projects.	

References/ Reading	1. De, A.K. (2019). *Environmental Chemistry* (9th Ed.) New Age International Publishers. 2. Bennett, M. R. & Doyle, P. (2016). *Environmental Geology. In, Geology and the Human Environment*. Wiley India Pvt. Ltd. 3. Pipkin, B.W., & Trent, D.D. *Geology and the environment*. 3rd Edition. ISBN 0-534-51383-2 4. Patwardhan, A.D. *Industrial Wastewater Treatment*. (2nd Ed.). Eastern Economy Edition. 5. Karia, G. L., & Christian, R.A. *Wastewater Treatment: Concepts and Design Approach*, Eastern Economy Edition. 6. Bratby, J. (2006). *Coagulation and flocculation in water and wastewater treatment*. (2nd Ed.). London: IWA Publishing, 7. Grady, C. P. L. Jr., Daigger, G.T., & Lim, H.C. (1999). *Biological wastewater treatment*. (2nd Ed.). New York: Marcel Dekker, Inc. 8. Abbasi, S. A. (1998). *Environmental pollution and its control*. Pondicherry: Cogent. 9. Abbasi, S.A. (1998). *Water Quality Sampling andAnalysis*. New Delhi: Discovery. 10. Aery, N. C. (2016). *Manual of Environmental Analysis*.New Delhi: Ane Books. 11. Ahluwalia, V. K. (2008). *Environmental Chemistry*. (2nd Ed). Ane, New Delhi. 12. Chand, A. (1989). *Environmental pollution and protection*. (1st Ed.). H.K. Publishers, New Delhi. 13. Droste, R. L., & Gehr, R. L. (2018). *Theory and Practiceof Water and Wastewater Treatment*. (2nd Ed). 14. Kumar, R. & Singh, R.N. *Municipal Water and Wastewater Treatment. Environmental Engineering Series*. ISBN: 9788179931882 15. Lal, B. and Sarma P.M. *Wealth from Waste: Trends and technologies*. (3rd Ed.), New Delhi: TERI press. 16. Lin, S.D. (2014). *Water and wastewater calculation manual*. McGraw-Hill Education. ISBN:9780071819817	
Learning Outcome	After successful completion of the course student will be able to: 1. Explain the causes and effects of water pollution. 2. Analyze the water as per BIS and international standards. 3. Identify suitable technologies for the treatment of waterand wastewater. 4. Design, operate and manage water and wastewater treatment plants.	

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Course Code: ESPE – 522
Title of the Course: Lab Course in Environmental Science
Number of Credits: 04

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).

Objectives:	1. To introduce students to basic instruments in chemistry laboratory, significance of standardization and calibration of reagents and instruments respectively. 2. To acquaint students with analysis of various pollutants including trace metals in water, soil and air. 3. Develop analytical skills for water and wastewater analysis.	
Content:	**Module I** 1. Demonstration of instruments (colorimeter, pH meter, conductivity meter, Karl Fischer titrator) & Calibration of glass electrode and conductivity meter. (4 hrs; Ref.7, 8, 10) 2. Determination of pH and conductivity of surface, ground and sea water. (4 hrs;Ref.7, 8, 4) 3. Determination of alkalinity and acidity of surface, ground and sea water sample using titrimetric analysis. (4 hrs;Ref.7, 8, 6) 4. Estimation of total solids, dissolved solids, suspended solids of a given water sample (river/lake/pond/seawater). (4 hrs;Ref.7, 8) 5. Estimation of total residual chlorine of water samples. (4 hrs; Ref.7, 8, 3) 6. Estimation of salinity of a given water sample by Molar Knudsen chlorinity titration method. (4 hrs; Ref.7, 8, 9) 7. Estimation of sulfate in water samples (tap water) by turbidimetry. (4 hrs;Ref.7, 8, 11)	28 hrs. 24 hrs.
	Module II 1. Determination of pH and conductivity of soil samples. (4 hrs; Ref.7, 8) 2. Determination of moisture content of soil samples. (4 hrs;Ref.7, 8, 1) 3. Estimation of hardness of water samples by complexometric method. (4 hrs; Ref.7, 8, 6) 4. Determination of pH, conductivity and Turbidity of water and wastewater samples (pH meter, conductometer, and nephelometer). (4 hrs; Ref.7, 8, 5) 5. Determination of nitrite in water sample using colorimetry. (4 hrs;Ref.7, 8, 9) Determination of chromium in water sample by colorimetry. (4 hrs; Ref.7, 8, 10)	24 hrs.
	Module III 1. Determination of dissolved oxygen in coastal waters. (4 hrs; Ref.7, 8, 11) 2. Estimation of dissolved oxygen in polluted water. (4 hrs;Ref.7, 8) 3. Determination of dissolved oxygen and total hardness of (Ca and Mg) of wastewater sample. (4 hrs;Ref.7, 8, 3) 4. Determination of biochemical oxygen demand in coastal waters. (4 hrs;Ref.7, 8, 4) 5. Determination of BOD of wastewater samples. (4 hrs;Ref.7, 8) 6. Estimation of hydrogen sulfide in coastal waters. (4 hrs;Ref.7, 8)	44 hrs.

	Module IV 1. Determination of chemical oxygen demand in given water samples. (4 hrs;Ref.7, 8) 2. Determination of chemical oxygen demand in coastal waters by KMnO4 method. (4 hrs;Ref.7, 8, 3) 3. Determination of COD of wastewater samples. (4 hrs;Ref.7, 8) 4. Estimation of Metals and metalloids using spectrophotometry. (4 hrs;Ref.7, 8) 5. Estimation of ammonia from wastewater samples (Nessler's Method). (4 hrs;Ref.7, 8) 6. Determination of chromium in given water sample using UV-VIS spectrophotometer. (4 hrs;Ref.7, 8, 2) 7. Nitrate and nitrite using spectrophotometric method. (4 hrs; Ref.7, 8) 8. Determination of fluoride using spectrophotometer. (4 hrs;Ref.7, 8) 9. Determination of phosphates in wastewater using spectrophotometric method. (4 hrs;Ref.7, 8) 10. Estimation of total cyanide in wastewater using titrimetric and spectrophotometric method. (4 hrs;Ref.7, 8). 11. Estimation of tannin and lignin and surfactants from Wastewater. (4 hrs; Ref.7, 8, 1)	
Pedagogy:	Pre-lab and post-lab assignments or a combination of some of these.	
References/ Reading	1. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2002). *Chemistry for Environmental Engineering and science.* (5th Ed.). McGraw-Hill. 2. Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's Textbook of quantitative chemical analysis.* (5th Ed.). Longman Scientific and Technical, U.K. 3. Mitra, S., Patnaik, P., & Kebbekus, B. (2019). *Environmental chemical analysis: Laboratory Experiments in Environmental Chemistry.* (2nd Ed.). CRC Press. 4. Rice, E. W., & Bridgewater, L. (2012). *Standard methods for the examination of water and waste water analysis.* (22nd Ed.). American Public Health Association. 5. Grasshoff, K., Ehrhardt, M., & Kremling, K. (1983). *Methods of Seawater analysis*. Verlag Chemie, Weinneim. 6. Kaur, K. (2007). *Handbook of Water and wastewater Analysis*. Atlantic. 7. Maiti, S.K. (2011). *Handbook of Methods in Environmental Studies: Water and Wastewater Analysis*. Oxford Book Company. 8. De, A. K. (2019). *Environmental Chemistry*. (9th Ed.). New Age International Publications. 9. Das, A. K. & Das, M. (2015). *Environmental Chemistry with Green Chemistry.* Books & Allied (P) Ltd. 10. Kudesia, V. P. (2008). *Water Pollution*. (8th Ed.). Pragati Prakashan. Sharma, B. K. (2018). *Industrial Chemistry*. (21st Ed.). Goel publishing House.	

Learning Outcome	1. The students will be able to explain the origin and harmful effects of toxic chemicals in the environment. 2. Students will be able to use different techniques for qualitative and quantitative estimation of various environmental pollutants.	

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Semester IV

Course Code: ESTE – 523

Title of the Course: Environmental Impact Assessment I

Number of Credits: 02

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	To understand the Environmental Impact Assessment processes through the study of EIA reports available for various kinds of projects.	
Content:	**Module I** EIA guidelines Cost-benefit analysis, Detailed project report, Feasibility report. Terms of Reference (TOR), Generic structure of EIA document and description of the project. Public consultation, Environmental Clearance (EC) processes, validity, extension, monitoring, transfer compliance report, Role of statutory agencies in environmental clearance. EIA consultant accreditation process in India. Components of EIA-Physical, Biological and Socio-cultural environment. EIA methods – Checklist & matrices. **Module II** Comparative Evaluation of Alternatives Selecting a Preferred Alternative. Conceptual Basis for Trade-Off Analysis. Importance Weighting of Decision Factors. Plans and Monitoring. Elements of Mitigation. Environmental Management Plan (EMP), elements, structure and examples of various projects. Objectives of EIA implementation and follow up. Tools of EM & performance review. Environmental auditing. Evaluation of EIA effectiveness and performance.	15 hrs. 15 hrs.
Pedagogy:	Lectures/tutorials/ laboratory work /field work/outreach activities/ project work/ vocational training/ viva /seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these.	
References/ Reading	1. Yerramilli, A., & Manickam, V. (2020). *Environmental impact assessment methodologies* (Third Edition). BS Publications/British Society of Periodontology Books. 2. Glasson, J., & Therivel, R. (2019). *Introduction to environmental impact assessment* (Fifth Edition). Routledge. 3. Khandeshwar, S.R., N.S. Raman and A.R. Gajbhiye. Environmental Impact Assessment. 2019. Dreamtech Press. EIA manuals available at: http://environmentclearance.nic.in/writereaddata/Form 1A/HomeLinks/ommodel3.html	

	3. Sectoral Manuals under EIA Notification, 2006: http://environmentclearance.nic.in/writereaddata/Form 1A/HomeLinks/ommodel2.html 4. Anonymous. Environmental Impact Assessment Training Manual. 2016. International Institute for Sustainable Development. 5. http://www.iisd.org/learning/eia/wp content/uploads/2016/06/EIA-Manual.pdf, EIA Online Learning Platform www.iisd.org/learning/eia	
Learning Outcome	The students will be able to understand how to work and write EIA reports for each of the major sectors.	

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Course Code: ESTE – 524
Title of the Course: Environmental Impact Assessment II
Number of Credits: 02

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	The students will be trained to conduct EIA studies of mining and industrial projects in view of EIA notification 2006.	
Content:	**Module I** EIA of mining potential sites, brief description of the project, identification, nature of mineral, Quality and quantity, resource available, geology, types of mining, carrying capacity, Blasting - Rules and Guidelines, Dust and noise pollution, transportation, Biodiversity assessment, Impact on human settlement, restoration, reclamation and mitigation measures, hydrology, safety and prevention measures. EIA and development EIA with reference to land-use pattern, centralized land-use, procedures and methodologies, EIA plans (state and central legislation), EIA (waste management), guidelines for the preparation of EIA document, Quality Management System for EIA. **Module II** EIA for specific projects Industrial setup and establishment - infrastructure, operation and management, effluent and waste, practices, effectiveness, practices. Biodiversity assessment, inventorization of flora and fauna, impact on migratory population and existing settlement, strategic mitigation measure. EIA rules and notifications Legal, policy and regulation framework- Global and Indian context. Policy and legislation: Environmental Protection Acts & Rules. EIA notification 1994 and 2006 and amendments. EIA 2020 draft notification and objections. Public hearing guidelines. Case studies and reports.	15 hrs. 15 hrs.
Pedagogy:	Lectures/assignments/workshops/street play/brain storming sessions/outreach programmes/campus walks/documentaries and discussion/ presentations	

References/ Reading	1. Glasson, J., Therivl, R., & Chadwick, A. (2005). *Introduction to environmental impact assessment*. Routledge, Taylor & Francis Group. 2. Arts, J., & Morrison-Saunders, A. (Eds.). (2012). *Assessing impact: Handbook of EIA and SEA follow-up*. Routledge, & Francis Group. 3. Abaza, Taylor H., Bisset, R., & Sadler, B. (2004). *Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated approach*. UN Environmental Program. 4. Therivel, R., & Wood, G. (Eds.). (2017). *Methods of environmental and social impact assessment*. Routledge, Taylor & Francis Group. 5. Morris, P., & Therivel, R. (Eds.). (2001). *Methods of environmental impact assessment*, *2*. Taylor & Francis. 6. Yerramilli, A., & Manickam, V. (2020). *Environmental impact assessment methodologies* (Third Edition). BS Publications/British Society of Periodontology Books.	
Learning Outcome	The students will be able to understand the EIA process and the provisions involved to prepare EIA reports.	

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Course Code: ESTE – 525
Title of the Course: Sustainable Development
Number of Credits: 01

Prerequisites for the Course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To create awareness of sustainable development and adopt various practices used in urban, industrial and agricultural fields. 2. To understand the role of policies and strategies towards sustainable development at local and global scale.	
Content:	**Module 1** Definition, history, goals and principles of sustainability, domains of sustainability, ecological footprints, waste recycling, environmental management and innovative strategies - crop rotation, organic farming, agroforestry, designer ecosystem, sustainable habitats - green spaces, green buildings, satellite towns and cities, zero waste concept; global policies, policies and programs adopted in India, role of Government and NGOs, eco-consciousness and awareness.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments.	
References/ Reading	1. Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2012). An introduction to sustainable development. Routledge. 2. Keeble, B. R. (1988). *The Brundtland report: 'Our common future'*. Medicine and war, 4(1), 17-25. 3. Kilcher, L. (2007). How organic agriculture contributes to sustainable development. Journal of Agricultural Research in the Tropics and Subtropics, Supplement, 89(1), 31-49.	

	4. Vidal, D. G., Barros, N., & Maia, R. L. (2020). Public and green spaces in the context of sustainable development. In Sustainable cities and communities, 479- 487). Cham: Springer International Publishing. 5. Hamid, S., Skinder, B. M., & Bhat, M. A. (2020). *Zero waste: A sustainable approach for waste management. In Innovative Waste Management Technologies for Sustainable Development*,134-155`. IGI Global. *6.* Jabareen, Y. (2008). *A new conceptual framework for sustainable* 7. *development.* Environment, development and sustainability, 10(2), 179-192. 8. Zoeteman, K. (Ed.). (2012). *Sustainable Development drivers: The role of leadership in government, business and NGO performance.* Edward Elgar Publishing. 9. Krishnan, S. A., & Sujith, K. M. (2021). *Understanding the need of satellite towns in India. In IOP Conference Series: Materials Science and Engineering,* 1114 (1) 012043. IOP Publishing. 10. Ross, M. R., Bernhardt, E. S., Doyle, M. W., & Heffernan, J. B. (2015). Designer ecosystems: incorporating design approaches into applied ecology. Annual review of environment and resources, 40, 419-443	
Learning Outcome	Students will be able to understand the concept of sustainable development and its propagation in the urban, agricultural, and industrial fields.	

Course Code: ESTE – 526

Title of the Course: Solid waste Management
Number of Credits: 01

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objectives:	1. To understand the concept of solid waste, its types, classification, characterization and disposal. 2. To probe the effect of solid waste on environment and public health.	
Content:	**Module I** Solid waste: Introduction and type of solid waste (domestic waste, commercial waste, industrial waste, market waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste), Sources of solid waste - classification (hazardous and non-hazardous). Characteristics of municipal solid waste (physical, chemical and biological); waste prevention and waste reduction techniques; storage, collection and transportation of municipal solid waste; disposal of Municipal solid waste – landfilling, site identification, investigation and characterization, planning and design, construction and operational practices; quality check and control measures; types of composting - vermicomposting, biogas production from municipal solid waste; Incineration of waste.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/case study.	

References/ Reading	1. Sasikumar, K., & Krishna, S. G. (2009). Solid waste management. PHI Learning Pvt. Ltd. 2. WHO Manual on solid waste management. 3. CPHEEO Manual on solid waste management. 4. Hosetti, B. B. (2006). Prospects and perspective of solid waste management. New Age International. 5. Gordon, A. T. (2000). Solid waste management. MC Graw Hill, New York. 6. Ayilara, M. S., Olanrewaju, O. S., Babalola, O. O., & Odeyemi, O. (2020). Waste management through composting: Challenges and potentials. Sustainability, 12(11), 4456. 7. Tchobanoglous, G., & Kreith, F. (2002). Handbook of solid waste management. McGraw-Hill Education.	
Learning Outcome	The students will learn various techniques of solid waste, management and disposal.	

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Course Code: ESTE – 527
Title of the Course: Shrimp farming and Environmental issues
Number of Credits: 01

Prerequisites for the course:	Students who have undergone M. Sc. Part I (Environmental Science).	
Objective:	The students will be trained on the various technologies available for pond based shrimp cultivation along with the associated environmental issues.	
Content:	**Module I** Shrimp aquaculture, types of culture practices, traditional, modified traditional, extensive, modified extensive, semi intensive and intensive, critical requirements, affected habitats, mangroves, mudflats, low lying areas, alterations in water flow, environmental costs, problems associated with conservation of mangroves. Salinization of ground water, water quality deterioration, Eutrophication, dynamics of bloom formation and collapse, ecosystem function, CRZ Act and Coastal Aquaculture Authority.	15 hrs.
Pedagogy:	Lectures/ tutorials/assignments/self-study	
References/ Reading	1. Allen, R. and Steene, R.C. (1987). Reef Fishes of Indian Ocean by Gerald TFH Publication, USA. 2. Bal, D.V., and Rao, V, K. (1990). Marine Fisheries of India, Tata McGrawHill, 472 p. 3. Jhingran, V. G. (1991). Fish and Fisheries of India, Hindustan Pub. Corp. (India), ISBN 9788170750178., 727 p. 4. Kurian, C.V., and Sebastian, V.O. (1976). Prawn and Prawn Fisheries of India. Hindustan Pub. Corp., Delhi. 5. Modayil, M. J. and Jayaprakash, A. A. (2003). Status of Exploited Marine Fishery Resources of India, CMFRI, Kochi. Morgan, R. 1956. 6. Chandra, P. (2007). Fishery Conservation Management and Development. SBS Publ.	

	7. Michael, R.R. (2005). Fisheries Conservation and Management. Prentice Hall. Pascoe, S.	
Learning Outcome	Students will gain knowledge on the problems associated with the semi-intensive type of shrimp culture and its management.	

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Annexure II

M.A. Environmental Sciences Program Structure and Syllabus (2022 – 23)

Semester III

Research Specific Elective (RSE) Courses

CourseCode	Course Title	L-T-P (Hrs/ week)	Credit(s)	Page Number
ESTE - 531	Research Methodology in Economics	4-0-0	04	2
ESTE - 532	Environmental History of the World	4-0-0	04	4
ESTE - 533	Community Engagement for Sustainable Rural Development	4-0-0	04	6
ESTE - 534	Doing Feminist Research	4-0-0	04	8
ESTE - 535	Technology Enabled Solutions forSustainable Development	4-0-0	04	10
ESTE - 536	Research Methodology in International Relations	4-0-0	04	12
Total = 08 Credits				

Generic Elective (GE) Courses

Course Code	**Course Title**	**L-T-P (Hrs/week)**	**Credit(s)**	**Page Number**
ESTE - 537	Environmental Economics	4-0-0	04	15
ESTE - 538	Environmental History of India	4-0-0	04	18
ESTE - 539	Environmental Politics	4-0-0	04	20
ESTE - 540	Gender, Environment and Ecology	4-0-0	04	22
ESTE - 541	Eco-criticism	4-0-0	04	24
ESTE - 542	Environmental Security: Dimensions and Perspectives	4-0-0	04	27
ESTE - 543	Global Environmental Governance	4-0-0	04	29
				Total = 12 Credits

Semester IV

Research Specific Elective (RSE) Courses

Course Code	Course Title	L-T-P (Hrs/week)	Credit(s)	Page Number

ESTE - 544	Academic Writing in English	4-0-0	04	32
ESTE - 545	Idea of Nature in Eastern and Western Traditions	4-0-0	04	34
				Total = 04 Credits

Discipline Specific Dissertation / Internship

Course Code	Course Title	L-T-P (Hrs/Week)	Credit(s)	Page No.
ESDC - 546	Discipline Specific Dissertation	0-0-4	16	
				Total = 16 Credits

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Semester – III

Course Code: ESTE - 531
Title of the Course: Research Methodology in Economics**Number of Credits:** 4

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objectives:	1. Expose students to the methodological approaches to research. 2. Help formulate research problem. 3. Scientific methods for sampling and data collection. 4. Writing a research report/thesis/paper.	
Content:	**Module I** The meaning of research - types of research - importance of research- research and policy- Deductive and Inductive Reasoning – Steps of scientific methods in research – Qualitative and Quantitative Approach - Mixed Methods.	15 hrs.
	Module II The Research Process: Formulation of a Research problem – Guiding principles in the choice of a Research topic and Formulation of Research Questions –Writing a Proposal - Review of Literature and identification of research gap –Theoretical and Conceptual Framework-Formulation of Research Design – Hypothesis; concept, definition, formulation and testing.	15 hrs.
	Module III Sampling Techniques - field survey - Primary Data Collection - Tools – Observation, Schedule, Questionnaire – principles underlying construction of a questionnaire – data processing and Analysis – Use of Statistical packages.	15 hrs.
	Module IV Writing a Research report - research paper – Bibliography - reference styles - Ethics in Research - Plagiarism - Writing a thesis - Do's and Dont's.	15 hrs.
Pedagogy:	Lectures/ case analysis/assignments/class room interaction	

References/ Reading	1. Kothari C.R., Garg, Gaurav; Research Methodology, Fourth Edition, New Age International, New Delhi, 2020. 2. Wilkinson T. S. and Bhandarkar P.L.: (2016) *Methodology and Techniques of Social Science Research*, Himalaya Publishing House, New Delhi. 3. Panneerselvam, R., (2013) *Research Methodology*, Prentice Hall of India Pvt Ltd. 4. Young P.V., (2012) *Scientific Social Surveys and Research*, Prentice Hall of India Pvt Ltd. 5. Parsons C.J., (2006) *Thesis and Project Work*, Allen &Unwin. 6. Babbie, Earl. R. (2013). "*The Practice of Social Research*."	
	Cengage Learning, Canada. 7. John W. Creswell. (2014). "*Research Design: Qualitative, Quantitative and Mixed Methods Approaches.*" Sage Publication, Washington, USA. 8. Kate L. Turabian. (2006). "*A Manual for Writers of Term papers, Theses and Dissertations*." The University of Chicago press, Chicago. 9. Blaug, Mark. (2009). "*The Methodology of Economics.*" Cambridge University Press, Cambridge. 10. Daniel M. Hausman. (2007). "*The Philosophy of Economics: An Anthology*." Cambridge University Press, Cambridge	
Learning Outcome	1. The students will be able to define a research problem and prepare the appropriate research design for theresearch problem. 2. Develop the most appropriate methodology for the research studies in social sciences. 3. Interpret and write research reports.	

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Course Code: ESTE - 532
Title of the Course: Environmental History of the World**Number of Credits:** 4

Prerequisites for thecourse:	Students who have undergone M. A. Part I.	
Objective:	To learn environmental history of the world focusing on human interactions with nature.	
Content:	**Module I** Humans and nature in a time-dimension: Ibn Khaldun; Montesquieu; George Perkins Marsh; Fernand Braudel. Historicizing climate; Early humans; Early Agriculture; the Metal Ages. **Module II** Biological and cultural consequences. Industrial world, Environmental Relationships.	15 hrs. 15 hrs.

	Module III Environment and empire—Imperialism and environmental change; Significance of *Silent Spring*; science and the discourse of ecological crisis; the ideology of scientific conservation, the environmental debate, green capitalists, environmental justice. **Module IV** Energy, population, urbanisation, 'world hunt'—commodification of animals, environmentalism and political economy, shape of the future.	15 hrs. 15 hrs.
Pedagogy:	Lecture method/project-based learning/collaborative learning/field-work.	
References/ Readings	1. Anker, P. (2002) *Imperial Ecology*. Cambridge, MA. 2. Arnold, D. and R. Guha (1995). *Nature, Culture, and Imperialism: Essays on the Environmental History of South Asia*. Delhi. 3. Beinart, W. and L. Hughes (2009). *Environment and Empire*. Oxford. 4. Crosby, A. (1972). *The Columbian Exchange: Biological and Cultural Consequences of 1492.*Westport. 5. Crosby, A. (1986). *Ecological Imperialism*: The Biological Expansion of Europe, 900–1900. New York. 6. de Melo, Cristina Joanaz EstelitaVaz and Lígia M. Costa Pinto., eds (2016). *Environmental History in the Making.Volume I: Explaining*. New York. 7. de Melo, Cristina Joanaz EstelitaVaz and Lígia M. Costa Pinto., eds (2017). *Environmental History in the Making. Volume II: Acting*. New York. 8. Diamond, Jared. (1997). *Guns, Germs, and Steel: The Fates of Human Societies*. New York. 9. Diamond, Jared. (2005). *Collpase: How Societies Choose to Fail or Succeed*. New York. 10. Grove, R. (1995). *Green Imperialism*. New York. 11. Guha R. (2000). *Environmentalism: A Global History.* New York. 12. Hornborg, Alf., J. R. McNeill and John Martínez–Alier. (2007). *Rethinking Environmental History*. New York. 13. Hughes J. D. (2001). *An Environmental History of the World*. London. 14. Khaldun, Ibn. (1967). *The Muqaddimah: An Introduction to History.* Princeton. 15. Marks, R. (2002). *The Origins of the Modern World*. Lanham. 16. Marsh G. P. (1864). *Man and Nature*. Cambridge. 17. McNeill J. R. (2003). 'Observations on the Nature and Culture of Environmental History', *History and Theory*, Vol. 42 (4), pp. 5–43. 18. McNeill, J. R and Peter Engelke. (2015). *An Environmental History of the Anthropocene since 1945*. London.	

	19. McNeill, William H. (1980). *The Human Condition: An Ecological and Historical View*. Princeton. 20. Ponting, C. (1991) *A Green History of the World*. London. 21. Radkau, J. (2008). *Nature and power: a global history of the environment*. Cambridge, UK. 22. Richards, J. F. (2014). *The world hunt: an environmental history of the commodification of animals*. Berkeley. 23. Simmons, I. G. (2008). *Global Environmental History 10,000 BC to AD 2000*. *24*. Tucker, R and E. Russell. (2004). *Natural Enemy, Natural Ally*. Corvallis.	
Learning Outcome	Upon the successful completion of this course, the student would be able to: 1. Understand the historical relationship between humans and theenvironment; 2. Learn about the ways in which humans modified and adapted nature; 3. Engage with the nature of environmental change that world has gone through historically and how they have impacted nations and different segments of society; 4. Understand the role of the modern states in regulating and extracting natural resources; 5. Attain the ability to apply academic knowledge to a critical analysis of environment in the local context. 6. Understand an ethic which applies to the whole of nature, including humans.	

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Course Code: ESTE - 533
Title of the Course: Community Engagement and Rural Development
Number of Credits: 4

Prerequisite forthe course:	Students who have undergone M. A. Part I.
Objectives:	1. To enable students to understand rural society. 2. To familiarize students with community development programmes and train themto prepare proposals for community development. 3. To train students in participatory research methods. 4. To enable students to understand rural institutions and their functioning byengaging with these institutions. 5. To enable students to understand Human Rights based approach to rural development.

Content:	**Module I** Meaning and Characteristics of Rural Society and Rural Development, Distinction between rural and urban. Participatory Rural Appraisal Methods & Techniques – Transect Walk, Seasonal Calendar, Venn Diagram, Daily Routine Charts, Timeline, Flow Diagram, Interviewing,Preference ranking, Mapping and Modelling (Social, Resource and Topical Mapping & other methods). Rural Resilience in relation to Environmental and Livelihood issues: Climate Change, Habitat degradation, Water conservation and Waste management. Local Bodies:Panchayats, Gram Sabhas, Village Committees; Gram Panchayat Development Plan (GPDP). **Module II** Institutions in Rural Development: Schools, Health Centres, Self Help Groups, Cooperatives, Farmers Clubs. Human Rights and Rural Development; Rural Poverty – nature and extent. Community Development: Introduction, Objectives, Approaches, Programmes. **Module – III** Field Component: Planning for Community Development, Gram Panchayat Development Plan (GPDP), Situational Analysis, Participatory Rural Appraisal (PRA). **Module – IV** Visits to model Panchayats, attending and reporting on Gram Sabha meeting and other activities as planned from time to time.	15 hrs. 15 hrs. 15 hrs. 15 hrs.
Pedagogy:	Lectures/ assignments/field visits/learning by engaging with the rural community	
References/ Reading:	1. Chatterjee, Shankar (2011)., *Implementation of Rural Development, New Delhi*: Serials Publication Pvt. Ltd. 2. Desai, A.R. (2009). *Rural Sociology in India*, Mumbai: Popular Prakashan. 3. Desai, Vasant (2012). *Rural Development in India*, Mumbai: Himalaya Publishing House. 4. M.J. Vinod and Meena Deshpande (2013). *Contemporary Political Theory*, NewDelhi: Axis Publications. 5. Mukerjee, Neela (2003). *Participatory Rural Appraisal*, New Delhi: ConceptPublisher 6. Narayanaswamy, N. (2009). *Participatory Rural Appraisal: Methods and Application,* New Delhi: Sage Publication 7. Rani, K.S. (2011). *Peoples Participation in Development*, New Delhi: DiscoveryPublishing House. 8. Singh, Preeti (2010). *Panchayati Raj Institution andRural Development*, Delhi: Axis Publication 9. Somesh Kumar (2002). *Methods for Community Participation: A complete guidefor practitioners*. Vistaar 10. Sudharshu, Shekhar (ed.) (2003), *Regional Planning in India*, vol-Iand II, New Delhi: Anmol Publications. *11*. Vijayakumar, K. (2011). *Empowerment of weaker section future planning*	

	and strategies for Rural Development in India, New Delhi: Serials Publication Pvt. Ltd. 12. Government Reports on Rural Development of Goa and India 13. EPW Issue on Rural Affairs Vol. 53, Issue No. 51, 29 Dec, 2018 ParticipationPays by Praxis (http://www.praxisindia.org/PARTICIPATIONPAYS.php) 14. The Human Rights based approach to development in the era of globalisation, (https://www.ohchr.org/Documents/Issues/Development/RTDBook/PartIIChapter8.pdf) Rural Community Engagement, National Council of Rural Institute, Department of Higher Education, MHRD
Learning Outcome	Students will be able to: 1. Understand theoretical and practical aspects of rural planning and development. 2. Prepare community development plans. 3. Carry out research on rural development and engage with rural Institutions

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Course Code: ESTE - 534
Title of the Course: Doing Feminist Research
Number of Credits: 4

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objectives:	1. This course will aim at equipping students with knowledge of research methods andtechniques. 2. The student will be introduced to the nature and purpose of doing feminist research,the politics of knowledge and knowledge creation and the different ways of knowing. 3. They will be taken through the theoretical foundations of feminist research and acritique of conventional research. 4. Feminist research positions both epistemological and methodological will bediscussed.	
Content:	**Module I** What is research? Steps in social science research. A critique of conventional research, limitations of methodology of social science, feminist empiricism vs positivism Research methods and methodology, Feminist standpoint, situated knowledge. **Module II** Qualitative Research Methods: feminist ethnography narratives, oral history, discourse analysis, participatory and action research, focus groupdiscussions, grounded theory, self-reflexivity, etc. Reviewing literature on a selected topic. Reference management software (Zotero, Mendeley, etc.) **Module III**	15 hrs. 15 hrs. 15 hrs.

	Using unconventional data sources. Research designs, sampling and qualitative data collection methods (case studies, survey, exploratorystudies, diagnostic, experimental and action research). **Module IV** Proposal writing, conducting a pilot study and writing a report, Feminist research ethics, Research writing, academic writing skills, use of writing assistance software	15 hrs.
Pedagogy:	Lectures/assignments/self-study/ documentaries and discussion/ group readings anddiscussions/ presentations	
References/ Readings:	1. Biber Sharlene Nagy Hesse. (2007), *Feminist Research Practice.* Thousand Oaks: Sage. 2. Brooks, Abigail. (2007). *Feminist Standpoint Epistemology: Building knowledge and empowerment through women's lived experience*, in Sharlene J. Nagy Hesse-Biber andPatricia Lina Leavy (eds.) *Feminist Research Practice: A Primer*, London: Sage Pub. 3. Code, Lorraine. (1995). *How do we know? Questions of method in feminist practice*, in Sandra Burt and Lorraine Code (eds.) *Changing Methods: Feminist Transforming Practice,* 13-44, Canada: Broadview Press. 4. Delamont Sara and Paul Atkinson. (2008). *Gender and Research*. Los Angeles: Sage. 5. Denscombe Martyn. 2003. *The Good Research Guide for small scale Social Research Projects*. Second Edition. Philedelphia: Open University Press. 6. Haraway, Donna, J. (1988). *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective*. Feminist Studies, Vol.14, No.3 (Autumn), 575-599 7. Harding, Sandra. (1987). Is there a Feminist Method*?* In *Feminism and Methodology*. Bloomington and Indianapolis: Indiana University Press. p 1-14 8. Hughes Christina. (2002). *Key Concepts in Feminist Theory and Research.* London: Sage. 9. Jarvlluoma Helmi. (2003). *Gender and Qualitative Methods*. London: Sage. 10. Kannabiran K & Padmini Swaminathan (eds.). (2017). *Re-Presenting Feminist Methodologies: Inter-Disciplinary Explorations*. NY: Routledge. 11. Kleinman, Sherryl. (2007). *Feminist Fieldwork Analysis.* Los Angeles: Sage Publications. 12. Reinharz Shulamit & Lynn Davidman.(1992). Feminist Methods in Social Research.Oxford University Press 13. Robert Helen.(1986). *Doing Feminist Research.* London: Routledge. 14. Stanley L. and Sue Wise.(1993). *Breaking Out Again: Feminist Ontologyand Epistemology*. London: Routledge. Tannen Deborah. (1994). *Gender and Discourse*. New York: OUP.	
Learning Outcome	Students at the end of the course will understand the research process and will develop skills in: 1. Conducting a review of literature and undertake a pilot study. 2. Develop a research proposal.	

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Course Code: ESTE - 535
Title of the Course: Technology Enabled Solutions for Sustainable Development
Number of Credits: 4

Prerequisite for the course:	Students who have undergone M. A. Part I.	
Objectives:		
Content:	**Module I** Introduction – Technology, Sustainability, Sustainable Development, Technology enabled Sustainable Development. Examples of Technology for Sustainable Development. Components of Sustainability – Social, Economic and Environmental, Sustainable Development Goals, Measuring Sustainability.	15 hrs.
	Module II Sustainable Development Discussions and innovative solutions under the following themes – Sanitation and Hygiene for Overall Health, Water Management, Waste Management, Energy Management and Greenery, Technology for Sustainable Development under following themes – Sanitationand Hygiene for Overall Health, Water Management, Waste Management, Energy Management and Greenery.	15 hrs.
	Module III Challenges for use of Technology for Sustainable Development in Villages, Digital Divides – Awareness, Availability, Accessibility and Affordability. Role of Stakeholders for addressing these issues to support Technology Enabled Solutions for Sustainable Development.	15 hrs.
	Module IV Choose any Village and Apply the concepts learnt in theory above and preparereport showing impact of Technology Enabled Solutions for Sustainable Development in the Village Selected.	15 hrs.
Pedagogy:	Lectures/ assignments/presentations/field visits/learning by engaging with the villagers and thestakeholders	
References/ Reading:	1. https://www.undp.org/sustainable-development-goals, accessed on 6th November2022 2. https://www.researchgate.net/publication/342624965_SUSTAINABLE_DEVELOPM ENT_AND_ENVIRONMENTAL_ETHICS, accessed on 6th November 2022 3. Rogers,P.P.,Jalal,K.F.andBoyd,J.A.,AnIntroductiontoSustainableDevelopment,Pre ntice-Hallof India Pvt. Ltd., New Delhi, 2008. 4. Dorf, Richard C., Technology, humans, and society: toward a sustainable world,Academic Press, 2001. 5. Published papers and reports.	

Learning Out come	Students will be able to: 1. Appreciate the goals of sustainable development. 2. Understand use of technology for sustainable development. 3. Measure the impact of using technology for sustainable development in the villages 4. Understand Challenges faced while implementing Technology enabled solutions for sustainable development.

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Course Code: ESTE - 536
Title of the Course: Research Methodology in International Relations.**Number of Credits:** 4

Prerequisites for the course:	Students who have undergone M.A. / M.Sc. Part I.	
Objective:	1. The course seeks to offer insights on various theories as well as methods and techniques of research in International Relations. 2. Students will be given some modest training in the application of the methodological approaches by way of sessional work on themes of current issuesrelated to the discipline.	
Content:	**Module I** Meaning and Objectives of Research, Formulation of Aims and Objectives; Research Types: Quantitative and Qualitative, Deduction, Induction, Empirical and Normative; Various Other Methods: Participant Observation, Case Study Mode, Survey.	15 hrs.
	Module II Challenges to Theme Selection, Wide Gamut of Areas: Politics, Society, Economy, History, Science and Technology; General Usage of Concepts and Terms of Research Methodology; Comparative Approach to Research and Analysis.	15 hrs.
	Module III Definition of Analysis, Levels of Analysis, Content Analysis, Analytical Rigor and Richness, Elements and Style of Research Proposal Writing in International Relations: Salience of Objectives, Significance, Relevance and Impact of Themes, Tentative Chapterisation.	15 hrs.
	Module IV Collection of Data, Challenges to Data Interpretation, Drawing Inferences; Types of Reports, Salience and Features of Reports, Steps in Report Writing**.** Footnotes, Endnotes, Bibliography, Formatting the Research Paper and Reports; Ethics and Riskin Research--Plagiarism, Role of Integrity in Research.	15 hrs.
Pedagogy:	Lectures/Tutorials/Assignments/Self-Study/Discussions/Audio-Visuals	

References/ Readings	1. AudieKlotzandDeepaPrakash. (2008).*QualitativeMethodsinInternational Relations:APluralistGuide*.New York:PalgraveMacmillan. 2. ChristopherLamont. (2015) .*ResearchMethodsinInternationalRelations*.NewYork: Sage. 3. Datlef F. Sprinz and Yael Wolinsky-Nahmia. (2007). Eds. *Models, Numbers & Cases:Methods for Studying International Relations*. Ann Arbor: University of MichiganPress. 4. David E. McNabb. (2002). *Research Methods in Political Science*. New Delhi: PrenticeHallofIndia Pvt.Ltd. 5. Dina Zinnes. (1976). *Contemporary Research in International Relations: APerspectiveandaCriticalAppraisal*. New York:The FreePress. 6. Flyod J. Fowler, Jr. (1984). *Survey Research Methods*.	
	Beverley Hills: Sage Publications. 7. JeffreyS.Lantis,LynnM.KuzmaandJohnBoeher. (2000). Eds.*TheNewInter nationalStudiesClassroom:ActiveTeaching, Active Learning*. Boulderand London:Lynne Rienner Publishers. 8. Paul Pennings. (2006). *Doing Research in Political Science*.Thousand Oaks,California:Sage. 9. SantoshGupta. (1995). *ResearchMethodologyandStatisticalTechniques*. NewDelhi: Deepand Deep Publications. 10. William J.Goode and PaulK.Hatt.(1982) .*MethodsinSocialResearch*.Tokyo: McGrawHill-KogaKausha.	
Learning Outcome	A student will acquire knowledge of research techniques widely used in the discipline.	

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Course Code: ESTE - 537
Title of the Course: Environmental Economics
Number of Credits: 4

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objective:	To understand the implications of production and consumption outcomes on the environment and how market and non-market tools can be used in policy-making to move towards sustainable development.	
Content:	**Module I** Perspectives On The Environment - Economics and the Environment; A Framework for Environmental Analysis; Environmental Microeconomics and Macroeconomics. Resources, Environment, And Economic Development - A Brief History of Economic Growth and the Environment;A Summary of Recent Growth; The Future of Economic Growth and the Environment; Sustainable Development. The Theory Of Environmental Externalities - The Theory of Externalities; Welfare Analysis of Externalities; Property Rights and the Environment. Common Property Resources And Public Goods - Common Property,	15 hrs.

	Open Access, and Property Rights; The Environment as a Public Good; The Global Commons **Module II** Resource Allocation Over Time - Allocation of Nonrenewable Resources; Hotelling's Rule and Time Discounting. Valuing The Environment - Total Economic Value; Overview of Valuation Techniques: Revealed Preference Methods, Stated Preference Methods; Cost-Benefit Analysis and its role in Policy Decisions. Ecological Economics: Basic Concepts - An Ecological Perspective; Natural Capital; Issues of Macroeconomic Scale; Long-Term Sustainability; Energy and Entropy. **Module III** Ecosystem Management And Biodiversity - The Economics of Biodiversity; Reconciling Economic and Ecological Principles. Pollution: Impacts And Policy Responses - The Economics of Pollution Control; Policies for Pollution Control; The Scale of Pollution Impacts; Assessing Pollution Control Policies; Pollution Control Policies in Practice. National Income And Environmental Accounting - Greening the National Income	15 hrs. 15 hrs.
	Accounts; Environmentally Adjusted Net Domestic Product; Adjusted Net Saving; The Genuine Progress Indicator; The Better Life Index; Environmental Asset Accounts; The Future of Alternative Indicators. **Module IV** Global Climate Change - Causes and Consequences of Climate Change; Responses to Climate Change; Economic Analysis of Climate Change; Adaptation and Mitigation; Climate Change Mitigation: Economic Policy Options; Climate Change: The Technical Challenge; Climate Change Policy in Practice; Economic Policy Proposals. Institutions And Policies For Sustainable Development - The Concept of Sustainable Development; The Economics of Sustainable Development; Reforming Global Institutions; New Goals and New Production Methods.	15 hrs.
Pedagogy:	ICT enabled lectures/PC lab exercises/Assignments and presentations/Group activity/MOOC (or similar) component.	
References/Readings	1. Jonathan M. Harris and Brian Roach (2018) *Environmental and Natural Resource Economics: A Contemporary Approach, Fourth Edition, Taylor and Francis, New York* 2. Partha D. (2021), *The Economics of Biodiversity: The Dasgupta Review*. Abridged Version. (London: HM Treasury) https://assets.publishing.service.gov.uk/government/uploads/sy	

	stem/uploads/attachment_data/file/957292/Dasgupta_Review_-_Abridged_Version.pdf 3. Lynne Lewis, Thomas H. Tietenberg (2020) Environmental Economics and Policy, Routledge, London 4. Charles D. Kolstad (2012) *Intermediate Environmental Economics*, Oxford University Press, New Delhi 5. *Stephen Smith (2011) Environmental Economics: A Very Short Introduction*, Oxford University Press, Oxford.	
Learning Outcomes	Students will be able to undertake basic environmental valuation,cost-benefit analysis, and analyse environmental policy.	

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Course Code: ESTE - 538
Title of the Course: Environmental History of India**Number of Credits:** 04

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objectives:	1. To cover in a systematic, comprehensive and critical way the nature, issues,problems and movements related to environmental history in India. 2. To encourage an interdisciplinary approach to environmental history. 3. To inculcate the spirit of environmental ethics.	
Content:	**Module I** Definition of Environmental History – Historiography - Sources. Habitats in Human History: Modes of Production and Modes of Resource Use – Gathering Stage to Industrial Stage. Hunter-Gatherer Societies to Agricultural Societies – the Eclectic Belief Systems - Cultural Ecology – Sacred Groves. **Module II** Environmental change and conflict in modern India, Colonial Interests on Forests, Forest Acts (1865, 1878 and 1927) and Policies – Systematic Conservation vs. Exploitation Debate – Shifting Cultivation - Settled Cultivators and the State – Decline of Artisanal Industry – Deforestation – Protests Against the British Forest Acts and Policies. **Module III** Independent India, Policies towards Forestry – Forest Policy Resolutions and Acts (1952, 1980 and 1988) – Policies towards Environment - Role of NGOs. Environmental Movements: Chipko Movement - Appiko Movement – Narmada Bachao Andolan - Save Silent Valley Movement - Scientific Conservation of Environment -	15 hrs. 15 hrs. 15 hrs.

	Environmental Ethics - Major International Environmental Conventions and Protocols. **Module IV** Economic Development and its Impact on the Environment Agriculture - Industry - Urbanisation and problem of Environmental Degradation – Sustainable Development - Conflict Between Socio-Economic Developments and Sustainable Development - Environmental Pollution and Methods of Control - Wild Life Conservation: Animals v/s Humans.	15 hrs.
Pedagogy:	Lectures/tutorials/assignments/ seminars/field work based write up.	
References /Readings:	1. Allchin, B. and R. Allchin. *The Birth of Indian Civilization: India and Pakistan before 500 B.C.* Harmondsworth: Penguin, 1968. 2. Alvares, C. ed., *Fish Curry and Rice, A Sourcebook on Goa, its Ecology and Life-Style.* 4th Edition. Goa: The Goa Foundation, 2002. 3. Arnold, D. and R. Guha. eds., *Nature, Culture, Imperialism, Essays on the Environmental History of South Asia.* Delhi: Oxford University Press,1996. 4. Bellamy, P. *Dictionary of Environment*. 3rd Edition. New Delhi: Academic (India) Publishers, 2007. 5. Chakrabarti, R. ed., *Situating Environmental History.* New Delhi: Manohar, 2007. 6. Dasgupta, P. *The Control of Resources*, Delhi: Oxford University Press,1982. 7. Desai, A.R. ed., *Agrarian Struggles in India.* Delhi: Oxford UniversityPress, 1979. 8. Dhavalika, M.K. *The First Farmers of the Deccan.* Pune: Deccan College, 1988. 9. Fernandes W. and G. Menon, *Tribal Women and Forest Economy: Deforestation, Exploitation and Status Change.* New Delhi: Indian SocialInstitute, 1987. 10. Gadgil, M. and R. Guha. *The Use and Abuse of Nature (incorporatingThis Fissured Land An Ecological History of India and Ecology and Equity).* New Delhi: Oxford University Press, 2008. 11. Gill, Singh M., and J. Kewlani. eds*., Environmental Conscience Socio- Legal and Judicial Paradigm.* New Delhi: Concept Publishing Co., 2009. 12. Guha, R. ed., *Subaltern Studies, Vol. I*, Delhi: Oxford University Press.1982. 13. Guha R. Forestry in British and Post-British India: A Historical Analysis. *Economic and Political Weekly*. Vol.18, (1983). No.44, pp.1882-1896. 14. Guha, R. Forestry in British and Post-British India: A Historical Analysis. *Economic and Political Weekly*. Vol.18, (1983). No.45/46,pp.1940-1947. 15. Guha R. and Gadgil M. 1989. *State Forestry and Social Conflict in*	

	British India. Past and Present. No.123, PP.141-177. 16. Guha, R. *The Unquiet Woods: Ecological Change and Peasant Resistance in the Himalaya*. Berkeley: University of California Press,1989. 17. Guha, R. Sumit. *Environment & Ethnicity in India 1200-1991.* Cambridge: Cambridge University Press,1999. 18. Joseph B. *Environmental Studies. 2nd Edition*. New Delhi: Tata McGraw-Hill Pubg. Co., 2009. 19. Murthy, Linga and others, eds., *Environmental Concerns of EconomicDevelopment.* New Delhi: Serials Publications, 2008. 20. Raju, A.J. and Solomon. *A Textbook of Ecotourism Ecorestoration andSustainable Development.* Kolkata: New Central Book Agency, 2007. 21. Singh, K.S. ed., *Tribal Movements in India, Vo. II.* New Delhi: Manohar,1983.	
Learning Outcome	1. Understand the environmental history of India through the ages from ancient to the modern. 2. Appreciate cultural ecology and its significance. 3. Comprehend environmental ethics. 4. Understand sustainable development, rational use of natural resources,renewable sources of energy, and methods of controlling pollution	

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Course Code: ESTE - 539
Title of the Course: Environmental Politics
Number of Credits: 04

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objectives:	1. The address the role of politics in shaping the discourse on environment at various levels. 2. It shall address how actors and institutions of politics impinge on decision makingand outcomes in addressing environmental problems of the day. 3. To expose the students to issues of power, contestation and cooperation that often emerge at local, national as well as international environmental domain.	
Content:	**Module I** Introduction - Concept of Power, Conflict and Interests in relation toEnvironment, Green Political Theory, Green Political Parties. **Module II** State and environmental politics - State as repository of Power andAuthority, Regulation, State as an agency of development.	15 hrs. 15 hrs.

	Module III Non-state actors and environmental politics - Non-Governmental organizations as pressure groups/advocates/partners in environmental change, Conflict with state andcorporations. **Module IV** Multilateral institutions and environmental regimes - International and regional organizations relating to environment, Multilateral institutions as sites of international negotiations,goal setting and accountability.	15 hrs. 15 hrs.
Pedagogy:	Lectures, tutorials, assignments based on self-study, case-studies	
References /Readings	1. John B., (1999). *Rethinking Green Politics Nature*, Virtueand Progress, Sage Publishers. 2. Schumacher E.F. (1993). *Small Is Beautiful: A Study of Economics as ifPeople Mattered*, RHUK Publishers 3. Guha R. (2016). *Environmentalism: A Global History*, PenguinRandom House. India. 4. Gareth P. (1995). *Global Environmental Politics: Second Edition* (Dilemmas in World Politics), West view Press 5. Neil C. (2012). *The Politics of the Environment: Ideas, Activism andPolicy*, Cambridge University Press. 6. Duit A. et al., (2014). *State and Environment – The Comparative Studyof Environmental Governance*, MIT Press. 7. Newell P. (2006). *Climate for Change: Non-State Actors and the Global Politics of the Greenhouse*, Cambridge University Press. 8. Schiele S. (2014). *International environmental regimes and their*	
	treaties, Cambridge University Press. 9. Gupta S.S. 2016. *Caring for Nature: The River of life (The Story of the Narmada Bachao Andolan*), The Energy and Resources Institute. 10. Khanna D.R., Kumar P. and Singh V. 2013. *Ecology of the TehriDam*, Biotech Books. 11. Kutting G. and Herman K. (2018). *Global Environmental Politics: Concepts, Theories and Case Studies*, Taylor and Francis.	
Learning Outcome	1. The student should be able to understand the relationship between environment and politics. 2. He/she would be able to understand key environmental issues at local and national level. 3. The course would enable students to understand about governance and policies related to environment.	

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Course Code: ESTE - 540

Title of the Course: Gender, Environment and Ecology
Number of Credits: 04

Prerequisites for the course:	Students who have undergone M. A. Part I.	
Objectives:	1. To understand the relationship between society, gender, the environment and women's role in various environmental conflicts and movements. 2. This course will introduce students to some of the key environmental issues from an eco feminist perspective.	
Content:	**Module I** What is Feminist Political Ecology. Eco feminism. Theories and debates on gender and environment.	15 hrs.
	Module II Mapping Environment Movements across the country: Development, Environment, Livelihoods and Conflict: Chipko, Narmada Bachao Andolan, Silent Valley – A People's Movement that Saved a Forest, Nagaland and Amur Falcons- Bano Haralu, Stork lady of Aasam-Purnima Barman, Female forest Guards of Gir, Goa Bachao Abhiyan, SEZ Movement, Agitations against mining, tourism , etc.	15 hrs.
	Module III Environment and Women's Agency: Relationship of Women with Environment. Women, Land and Agriculture. Women's Knowledge of Traditional Health Care and Practices. Impact of natural calamities on gender.	15 hrs.
	Module IV Women and nature conservation in India - workshops on Solid Waste Management: Segregation, Vermicompost, Recycling/ Outreach Programmes: Street play, Awareness sessions in schools and villages / campus walk for basics of natural history: flora and Fauna and rain water harvesting. Case studies of movements /Example: Traditional knowledge systems for biodiversity	15 hrs.

	conservation: Vegetation management, Sacred Groves, Agriculture, cultivation ofmedicinal plants, traditional ethos, water and biodiversity. Women and Environmental activism: Finding and supporting passion for change, Online Activism/Media Journalism, Informed Activist, Pursuing a career in activism, Challenges for women wildlifer/Environment activist Environment NGO's in India: Greenpeace, Ashoka Trust for Research in Ecology and the Environment, Nature Conservation Foundation, Wildlife Conservation Society, WildlifeConservation Trust, Bombay Natural History Society, World Wide Fund for Nature, International Union for conservation of Nature and Natural Resources, Wetlands International, Convention on International Trade in Endangered Species.	15 hrs.
Pedagogy:	Lectures/assignments/workshops/Outreach Programmes/Street play/ campus walk /Documentaries and discussion/ presentations	
References/ Readings	1. Agarwal, B. (2010). *Gender and Green Governance: Political Economy of Women'sPresence within and beyond Community Forestry*. NY: Oxford University Press 2. Alvares Claude (2002). *Fish curry and rice: A sourcebook on Goa, its ecology and life-style*. Goa: The Goa Foundation. 3. Biswal T. (2006). *Human rights, Gender and Environment*. New Delhi: Vivabooks. 4. Buckingham-Hatfield Susan. (2006). *Gender and Environment.* London, New York:Routledge. 5. Krishna S. (2003). *Livelihood and Gender: Equity in Community ResourceManagement.* New Delhi: Sage. 6. Krishna S., De Arprita. (2013). *Women Water Professionals*. New Delhi: Zubaan. 7. McCully Patrick. (1998). *Silences rivers: The ecology and politics of large dams.* Hyderabad: Orient Longmans. 8. Rocheleau D., B. Thomas-Slayter and E. Wangari (eds.). (1996). *Feminist Political Ecology: Global Issues and Local Experiences*. London: Routledge. 9. Shiva V. (1992). *The Violence of the Green Revolution: Third World Agriculture Ecology and Politics.* Mapusa: The Other India Press. 10. Shiva Vandana. (1998). *Staying Alive: Women, Ecology and Survival in India*. NewDelhi: Kali for Women.	
Learning Outcome	1. Students will understand the impact of political economy on the local realities affecting the environment. 2. Students will understand the vital role of women in conservation of nature, sustainable use of natural resource, mitigating environmental conflicts and addressing environmental issues through activism. 3. Hands-on training in solid waste and water management practices.	

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Course Code: ESTE - 541
Title of the Course: Eco-criticism
Number of Credits: 04

Prerequisi tes for thecourse:	Students who have undergone M. A. Part I.	
Objectives:	1. To highlight the symbiotic relationship of humans and ecology in literature andother writings. 2. To focus on the various perspectives discussed by the traditional and modernwriters and thinkers in the context of environmental and cultural issues. 3. To evaluate the representation of anthropogenic connections with nature andculture in various texts. 4. To encourage the students to adopt an interdisciplinary approach while dealingwith the various dimensions of issues pertaining to ecology and culture.	
Content:	**Module I** Introduction - History of Ecocriticism, Understanding the concept ofEcocriticism, Defining the Ecocritical theory. **Module II** Background: Traditional Approaches - English Romanticism, William Blake, William Wordsworth, S.T. Coleridge, P.B. Shelly. American Transcendentalism, Ralph Waldo Emerson, Henry David Thoreau, Walt Whitman - Pathetic Fallacy, John Clare, Thomas Hardy. **Module III** Modern Theories and Movements - Understanding the major theories and concepts: Green Cultural studies, Blue Cultural studies, Anthroprocene age and Consumer culture, Global Governance and New Conflicts, Capitalism in the Age of Globalization. **Module IV** Indian Perspective - Cultural and Spiritual quest in India's Past from Antiquity, Gandhi's Critique of Modernity, Indian women and nature Chipko Movement, Contemporary Indian Writers: Vandana Shiva, Amitav Ghosh, Ruskin Bond.	15 hrs. 15 hrs. 15 hrs. 15 hrs.
Pedagogy:	Lectures/tutorials/assignments/seminars.	
Referenc es/ Readings:	1. Buell, Laurence. (1995). *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture*. Cambridge: Harvard UP, 2. Dryzek, John. *The Politics of the Earth: Environmental Discourses*. Oxford: Oxford UP, 2005.Garrard, Greg. *Ecocriticism*. London: Routledge, 2011. 3. Garrard, Greg, ed. (2012). *Teaching Ecocriticism and Green Cultural*	

	Studies. New York: Palgrave Macmillan, 4. Glotfelty, Cheryll, and Harold Fromm, eds. (1996). *The Ecocritical Reader: Landmarks in Literary Ecology*. Athens: The U of Georgia P, 5. Ghosh, Amitav. (2016). *The Great Derangement: Climate Change and the Unthinkable*. University of Chicago Press. 6. Hamilton, Geoff, and Brian Jones, eds. (2013). *Encyclopedia of the Environment in American Literature.* Jefferson: McFarland, 7. Handley, George B. (2007). New World Poetics: *Nature and the Adamic Imagination of Whitman, Neruda, and Walcott*. Athens: U of Georgia P, 8. Schweninger, Lee. (2008). *Listening to the Land: Native American LiteraryResponses to the Landscape.* Athens: U of Georgia P, 9. Shiva, Vandana and Mies. Maria. (2014) *Ecofeminism*. Zed Books. 10. Vakoch A. Douglas and Sam Mickey. (2018) *Literature and Ecofeminism: Intersectional and International Voices*. Routledge, Taylor & Francis Group.	
Learning Outcome	1. The students will be acquainted with the various dimensions of environmental discourses as well as the theoretical works. 2. Outline the interconnectivity of humans and ecology as expressedin various writings. 3. Evaluate and interpret a text in the light of Ecocritical theory.	

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Course Code: ESTE - 542
Title of the Course: Environmental Security: Dimensions and Perspectives**Number of Credits:** 04

Prerequisites for theCourse:	Students who have undergone M. A. Part I.
Objectives:	1. To disseminate rudimentary knowledge in the realm of environmental security, aligned with concurrent analytical comprehension of the natural and human induced environmental mutations, plausibly impacting human security and well-being. 2. Information coalesced around conflicts impelled by environmental resources- scarcity and instituted peace-building processes, would find vivid elaboration, so that the students-genre can emerge as stakeholder-contributors to wide-ranging policy analysis in environmental security and peace, beyond their preferred domain of core-competent scientific expertise. 3. Emphasis on national, regional and global environmental contexts, would serve to bring typologies of environmental stresses, such as demographics and migration, the dialectic choices between conventional and renewable energy sources, and socio-economic underpinnings of poverty-led insecurity, to public domain discussion, in requisite appraisal and appreciation of Environmental Security, on broad canvass.

Content:	**Module I** Introduction - Conceptual-Construct and Topical Phenomenon, Definitions,Narratives in Discourse, Schools of Thought, Theoretical Paradigms (Securitisation Debate). **Module II** Environmental Security qua 'Conventional' and 'Non-Conventional' Security - Typologies of Armed Conflicts & Analysis; Inter-State Conflicts in the Global South (Case Studies from Africa, West Asia, South Asia); Population Pressures and Migration Patterns in Conflict; Role of Non-StateActors; Socio-Economic Issues (Poverty, Occupation and Livelihoods, Infectious Diseases, Industrialisation and Urbanisation Trends) **Module III** Environmental Security and Sustainability Imperatives for Ecological Harmony and Development: Food Security; Water Scarcity; Energy Security and Independence; Coastal, Marine, and Blue Economy Resources; Climate Change; Natural Resources Administration; Disaster Management; Land and Forests Vulnerability. **Module IV** Environmental Security as Global Commons and Global Good – Perspective	15 hrs. 15 hrs. 15 hrs.
	on Challenges; Template for Cooperation; Environmental Peace-buildingMovements, Environmental Justice.	15 hrs.
Pedagogy:	Classroom lectures, Written and oral assignments, Audio-Visual presentations.	
References/ Readings	1. Hough, P. (2021). *Environmental Security: An Introduction*, Routledge (2nd Ed.), 2. Lanicci J., et. al. (2020). Environmental Security – Concepts, Challenges and Case Studies, AMS, 3. Lee, J. (2019). *Environmental Conflict and Cooperation: Premise, Purpose, Persuasion and Promise*, Routledge (1st Ed.), 4. Das, O. (2013). *Environmental Protection, Security and Armed Conflict: A Sustainable Development Perspective*, Edward Elgar Publishing Ltd., 5. Scheffran, J., et al., (eds.), (2012). *Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability*, Springer, 6. Richard, M. (2010). *Global Environmental Change and Human Security*, (London: MIT Press), 7. Pirages, D., et al., (2011). *'Ecological and Non-traditional Security Challengesin South Asia'*, NBR Special Report,	

Learning Outcome	1. The course is designed to accomplish the ostensible objective of acquainting students with the latest discourse on environmental security and peace-building, in a manner that helps internalise the conceptual phenomenon, as cross-cutting generations, policy-axes, and vectors of human endeavour. 2. Students would glean, as to how environmental harness and the excesses of it materially impinge, on the natural security calculus of individual nation-states, inducing the imperative for responsible and sustainable recourses, by sovereign and institutional actors, alike. 3. Environmental preservation and protection remains pivotal, to beneficently shaping critical sustainable development concerns, of water, food and energy security, that intimately segue with existential aspects of upholding livelihoods and fostering societal- uplift, vide ecological sentience.	

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Course Code: ESTE - 543
Title of the Course: Global Environmental Governance**Number of Credits:** 04

Prerequisites for the course:	Students who have undergone M. A. Part I.
Objectives:	1. To provide interdisciplinary knowledge and competences that assist in dealing with environmental governance in an international context. 2. This inter-disciplinary course provides in-depth insights to the actors, processes and problems of global environmental politics and aims to summarize debates about 'global' environmental problem. 3. It will also aim to understand the various international organisations and their role in global governance.

Content:	**Module I** Introduction: Globalization of Environmental Threats and Impact on Security, Trade, Health and Development. Actors, Institutions—International Organizations—the UN System and Global Environment. **Module II** Core Dimensions and Key Actors of Global Environmental Governance: Environment Summits—From Stockholm to Rio to Johannesburg; India's Environmental Diplomacy; Millennium Development Goals, Concept of Sustainability, Factors Governing Sustainable Development, Linkages Among Sustainable Development, Environment, and Poverty, Determinants ofSustainable Development, Case Studies on Sustainable Development, Sustainable Development Goals (SDGs). **Module III** Environmental Accords and Governance: History of Environment's Lawmaking and Institution Building Processes—1987 Brundtland Commission Report, International Environmental Agencies including UNEP, Commission on Sustainable Development, Select Multilateral Environmental Agreements-Agreements on Climate Change, Antarctica Treaty, Polar Regions and the Amazonia. **Module IV** The Indigenous and Environmental Governance in Comparative Perspective: Case Studies from the High North (Polar Region) and the Amazonia: Evolving Indigenous Governance in the Arctic; Rights of Minorities and Indigenous Peoples in the Arctic Region; Indigenous People and the Amazonia—Issues,	15 hrs. 15 hrs. 15 hrs. 15 hrs.
	Challenges and Governance of the Region; Role of Groups and Questions ofLand and Water Rights in the High North and the Amazonia.	
Pedagogy:	Lectures, Interactions, Assignments, Presentations.	
References/ Readings	1. Chasek, Pamela S., David L. Downie, and Janet Welsh Brown. Eds. (2017). *Global Environmental Politics: Dilemmas in World Politics*. New York: Routledge. 2. Dauvergne, Peter. (2005). *Handbook of Global Environmental Politics*. Cheltenham: Edward Elgar. 3. Delmas, Magali A. and Oran R. Young. Eds. (2009). *Governance for the Environment*. Cambridge: Cambridge University Press. 4. Elliot, Jennifer A. (2010). *An Introduction to Sustainable Development.* New York: Routledge. 5. Jakobson, L. and N. Melvin. (2016). *The New Arctic Governance*. Oxford: Oxford University Press. 6. Lalfagianni, Agni, Doris Fuchs, and Andres Hayden. Eds. (2020). *Routledge Handbook of Global Sustainability Governance*. London: Routledge.	

	7. Nicholson, Simon and Paul Wapner. (2014). *Global Environmental Politics: From Person to Planet.* London: Routledge. 8. Rogers, Peter P., Kazi F. Jalal and John A. Boyd. (2008). *An Introduction to Sustainable Development*. Sterling, VA: Earthscan. 9. Speth, James Gustave and Peter M. Haas. Eds. (2006). *GlobalEnvironment Governance*. London: Oisl and Press. 10. Andonova, Liliana B., and Matthew J. Hoffmann. (2012). "From Rio to Rio and Beyond: Innovation in Global Environmental Governance". *The Journal of Environment & Development*. 21(1): 57-61. 11. Andonova, Liliana B., M. Betsill, and H. Bulkeley. (2009). "Transnational Climate Governance". *Global Environmental Politics*. 9(2): 52–73. 12. Chase, Veronika Miranda. (2019). "The Changing Face of EnvironmentalGovernance in the Brazilian Amazon: Indigenous and Traditional PeoplesPromoting Norm Diffusion". *Revista Brasiliera de Politica Internacional.* 62 (2) https://doi.org/10.1590/0034-7329201900208 13. Dubash, Navroz K. (2012). "Toward Enabling and Inclusive Global Environmental Governance". *The Journal of Environment & Development*. 21(1): 48-51. 14. Esty, Daniel C. (2009). "Revitalizing Global Environmental Governancefor Climate Change". *Global Governance*. 15(4): 427-434. 15. Hey, Ellen. (2006). "International Institutions and Global EnvironmentalGovernance". *Proceedings of the Annual Meeting*. 100 (29 March - 1 April): 310-312. 16. Johnson, Samantha. (2021). "Indigeneity, Environment, and Governancein the Amazon: The Impact of Indigenous Movements on Environmental Conservation Policy in Nation-States of the Amazon Rainforest". https://academiccommons.columbia.edu/doi/10.7916/d8- 9vvv-rk15/ 17. Rechkemmer, Andreas. (2003). "Rio and the Origins of Global Environmental Governance". *Security and Peace*. 21(3/4): 173-178. 18. Toohey, David E. (2012). "Indigenous Peoples, Environmental Groups, Networks and the Political Economy of Rainforest Destruction in Brazil". *International Journal of Peace Studies*. 17(1): 73-97. 19. *Global Environmental Governance: A Reform Agenda.* (2006). Winnipeg: International Institute for Sustainable Development (IISD). https://sustainabledevelopment.un.org/content/documents/global%20e nvironmental%20governance.pdf	
Learning Outcome	The students can retrieve and recognize knowledge acquired from the course on global environmental problems and issues, International organizations and regimes.	

Semester - IV

Course Code: ESTE - 544
Title of the Course: Academic Writing in English.**Number of Credits:** 4

Objectives:	1. To refine the writing skills of students. 2. To discourage plagiarism and inculcate research ethics. 3. To introduce tools beneficial while conducting research.	
Content:	**Module I** Academic and Research Writing – Introduction, Importance and Basic Rules,Importance of the English language in Academic Writing. **Module II** MLA Style – Referencing and Citation, Research Ethics – Types of Plagiarism, Detection tools and how to avoid Plagiarism. **Module III** Journal and Author Metrics, Literature Review – Process, Online databases, Tools, Review Paper Writing, Research Proposal and Thesis Writing – Process,Empirical and Non-Empirical Studies. **Module - IV** Abstract, Conference/Research Paper, Book Chapter – Process, Team and Time Management, Challenges in Indian Research Writing, Open Educational Resources.	15 hrs. 15 hrs. 15 hrs. 15 hrs.
Pedagogy:	Lectures/tutorials/assignments/seminars.	
References:	1. Adler, Abby. "Talking the Talk: Tips on Giving a Successful ConferencePresentation." *American Psychological Association,* April 2010,apa.org/science/about/psa/2010/04/presentation 2. Anson, Chris M. and Robert A. Schwegler. *The Longman Handbook for Writers andReaders*.6th edition. 3. Creswell, J. W. (2008). *Educational Research: Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Upper Saddle River:Pearson. 4. Gibaldi, Joseph. (2009). *MLA Handbook for Writers of Research Papers*. Modern LanguageAssociation of America, Print. 5. Henly, Susan. "Finding the right journal to disseminate your research." Nursing Research, Wolters Kluwer Health Inc, November-December 2014, journals.lww.com/nursingresearchonline/Fulltext/2014/11000/Finding_the_Right_Jo urnal_to_Disseminate_Your.1.aspx?WT.mc_id=HPxADx20100319xMP. 6. Hadley, Chris. "How to Get Started With a Research Project".*wikiHow*, 5 January2021, wikihow.com/Get-started with-a-Research-Project. Modern Language Association.*MLA Handbook Eighth Edition.*	

	https://style.mla.org/"Open Educational Resources". *Wikipedia*, Wikimedia Foundation, 15 March 2021, en.wikipedia.org/wiki/Open educational_resources.
	7. Pappas, Christopher. "Top 10 Free Plagiarism Detection Tolls for eLearning Professionals". *eLearning Industry*, 18 November 2013, elearningindustry.com/top-10-free-plagiarism-detection-tools-for-teachers. 8. Roberts J. "Plagiarism, Self-Plagiarism, and Text Recycling." *Headache,*John Wiley& Sons Inc, 26 February 2018, headachejournal.onlinelibrary.wiley.com/doi/full/10.1111/head.13276.
Learning Outcome	The students will be able to write in a professional and academic manner, having learnt to use the appropriate style and cite sources.

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Course Code: ESTE - 545
Title of the Course: Idea of Nature in Eastern and Western traditions**Number of Credits:** 4

Prerequisites for the course:	Students who have undergone M. A. Part I.
Objectives:	1. To comprehend the conceptualization of nature and the interplay between humans,the divine, and the natural world in eastern and western traditions. 2. To examine the significant contributions and approaches employed by thesetraditions in nature conservation.

Content:	**Module I** Introduction - Introduction to the concept of nature: Philosophical, Religious, and Spiritual Interpretations. **Module II** Eastern traditions - Indic and East Asian religious views on nature:Nature as Divine, Sacred natural sites, Animism. **Module III** Western traditions - Ancient Greek and Abrahamic views on nature: Cosmogonic myth, Genesis/ Anthropogenesis, Stewardship theory. **Module IV** Conservation through traditional beliefs and practices - Customary laws,Indigenous practices, Spiritual and religious ecology.	15 hrs. 15 hrs. 15 hrs. 15 hrs.
Pedagogy:	Lectures/assignments/workshops/visits/documentaries and discussion/presentations.	
References/ Readings	1. Glacken, Clarence J. (1992). "Reflections on the History of Western Attitudes to Nature," *GeoJournal,* Vol. 26, No. 2. 2. Nakamura, Hajime. (1992). "The Idea of Nature in the East in Comparison with the West,"*GeoJournal,* Vol. 26, No. 2. 3. Barnhart, Michael G. (1997). "Ideas of Nature in an Asian Context,"*Philosophy East and West,* Vol. 47, No. 3. 4. Evans, J. C. (2005).*With Respect for Nature: Living As Part of the Natural World*, New York: State University of New York Press. 5. Naddaf, Gerard. (2005). *The Greek Concept of Nature*. New York: State University of New York Press. 6. Foss, Jeffrey E. (2009). *Beyond Environmentalism: A Philosophy of Nature*. New Jersey: John Wiley & Sons, Inc. 7. Baindur, Meera. (2015). *Nature in Indian Philosophy and Cultural Traditions.* New Delhi: Springer (Sophia Studies in	
	Cross-cultural Philosophy of Traditions and Cultures, Vol. 12.) 8. Vetlesen, Arne J. (2015). *The Denial of Nature: Environmental Philosophy in the Era of Global Capitalism*, New York: Routledge. 9. Rots, Aike P. (2015). "Sacred Forests, Sacred Nation: The Shinto Environmentalist Paradigm and the Rediscovery of "Chinju no Mori"." *Japanese Journal of Religious Studies*, Vol. 42, No. 2. 10. Lie, Svein A. N. (2016). *Philosophy of Nature: Rethinking Naturalnes,*New York: Routledge. 11. Liu, Jing. (2016). "What is Nature? Ziran in Early Daoist Thinking,"*Asian Philosophy,* Vol. 26, NO. 3.	
Learning outcome	1. The students will be able to appreciate traditional ideas and the interrelationshipbetween humans and nature. 2. The students will develop an ecological conscience by critically appraising the traditional belief systems in order to maximize the potential for conserving nature and its diversity.	