



Deccan Education Society's

**Fergusson College (Autonomous)
Pune**

**Learning Outcomes-Based Curriculum
for 3/4 years B. Sc. / B. Sc. (Honours) Programme**

as per guidelines of

NEP-2020

for

F. Y. B. Sc. (Environmental Science)

With effect from Academic Year

2023-2024

Program Outcomes (POs) for B. Sc.	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	Academic competence: (i) Apply the knowledge, facts, and rules of basic and applied sciences (Physics, Chemistry, Mathematics and Statistics) for understanding elements of Electronic Science. (ii) Identify basic elements and systems of the real analog world and modern digital world.
PSO2	Personal and Professional Competence: (i) Demonstrates the ability to build and test basic blocks of modern digital systems and computers. (ii) Operate basic and advanced tools, equipment and Instruments. (iii) Discuss performance parameters for selection of sensors, actuators, linear and digital ICs.
PSO3	Research Competence: (i) Design and build Electronics systems in various domains like Computers, consumer products, medical, transportation, agriculture and defence. (ii) Formulate and provide creative, innovative and effective solutions to real world problems using hardware - software co-design tools for microcontroller / embedded systems and IoTs. (iii) Develop and utilizes modern tools (like PSPICE, MATLAB, Simulink) for mathematical modelling and simulation for future ready systems.
PSO4	Entrepreneurial and Social competence: Employ the process of thinking independently, taking initiative, working in a team effectively, preparing project reports and developing capability to lead the team through real life projects.

Deccan Education Society's
Fergusson College (Autonomous), Pune
F.Y.B.Sc. Environmental Science (Pattern 2023)
Under NEP-CBCS Pattern (2023) Effective from June 2023

Semester	Paper Code	Paper Title	Credits
I	EVS-100 (Major)	Practical based on Introduction to Environment	2
	EVS-101 (Major)	Introduction to the Environment	4
	EVS-120 (GE/OE)	Physics and Chemistry of Environment	2
	EVS-121 (GE/OE)	Sustainable Development and SDGs	2
	EVS-130 (VSC)	Solid Waste Management Techniques	2
	EVS-140 (SEC)	Fundamentals of Ecotourism	2
	IKS-101 (IKS)	Indian Knowledge Systems	2
II	EVS-150 (Major)	Practical based on Environmental Pollution	2
	EVS-151 (Major)	Environmental Pollution and Human Health	4
	EVS-161 (Minor)	Know your Environment	2
	EVS-170 (GE/OE)	Biological Environment	2
	EVS-171 (GE/OE)	Folk Culture and Traditional Communities of India	2
	EVS-180 (VSC)	Hydroponics: A Green Way of Urban Farming	2
	EVS-190 (SEC)	Design and Development of Eco-friendly Products	2

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F.Y. B.Sc. Semester I

Title of the Course and Course Code	EVS-100 (Major): Practical based on Introduction to Environment	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Recall laboratory safety rules for handling environmental samples while performing practical. List different methods used for sample collection and preservation.	
CO2	Estimate moisture content and water holding capacity of soil sample.	
CO3	Illustrate chemicals used for estimation of organic carbon.	
CO4	Identify and illustrate physical properties of rock and mineral samples.	

Contents	
1.	Laboratory safety rules and introduction to laboratory equipment.
2.	Collection and preservation of water samples (Field Practical).
3.	Collection and preservation of soil samples (Field Practical).
4.	Determination of pH & Electrical Conductivity from soil sample.
5.	Estimation of the Moisture Content soil.
6.	Estimation of the Water Holding Capacity of soil.
7.	Determination of Organic Content from soil.
8.	Estimation of lapse rate.
9.	Identification of different Rock specimens from their physical properties.
10.	Identification of different Mineral specimens from their physical properties.
11.	Visit to geology museum.
12.	Use of social media for e-networking and dissemination of ideas on environmental issues.

F. Y. B. Sc. Semester I

Title of the Course and Course Code	EVS-101 (Major): Introduction to the Environment	Credits-4
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Students will appreciate the Knowledge about the environment and the role of human beings in shaping the environment	
CO2	Understand various components of the environment and interfaces	
CO3	Illustrate the hydrological cycle with its components. Critically appreciate the environmental concerns of today	
CO4	Explain different layers in atmospheric structure. Identify the change in lapse rate due to different processes of climate change and other anthropogenic impacts.	

Unit	Contents	Lectures
Unit I	Introduction to Environment: ● Fundamentals of Environment, Functions of Environment, Concept of Biosphere, Scope and Importance of Environment. ● Environmental Science, Multidisciplinary and dynamic nature ● Solar system formation and planetary differentiation ● History of Earth ● Theories of Geological evolution ● Geological time scale ● Age of reduction and Atmospheric equilibrium ● Holocene and the emergence of humans ● Role of humans in shaping landscapes	15
Unit II	Earth & its Structural Components: Formation of the Earth: ● Internal Structure of Earth ● Formation and composition of core, mantle, crust	15

	Theories of geological evolution: ● Wager's Continental Drift Theory ● Plate Tectonic Theory ● Sea floor spreading. Types of Rocks – ● Igneous, Sedimentary Metamorphic. ● Rock cycle, Rock-forming minerals – quartz, feldspar, micas, clay minerals, calcite, dolomite etc. Weathering and Soil: ● Soil, Soil Profile ● Soil Formation ● Soil classification ● Physical & chemical properties of soil ● Macro & micro plant nutrients ● Importance and Significance of Soil ● Soil erosion Types, causes and effects	
	Atmospheric phenomenon ● Evolution of earth's atmosphere ● Composition of atmosphere and its vulnerability to climate change Stratospheric Ozone ● Atmospheric temperature measurement and Instruments ● Methods (maximum, minimum, mean temperature, temperature range) ● Factors regulating atmospheric temperature/ temperature controls ● Lapse rate and types ● Temperature inversion & atmospheric stability Atmospheric Pressure and wind: ● Atmospheric pressure on Earth ● Introduction ● Measurement ● Factors affecting the atmospheric pressure ● Atmospheric pressure winds ● Factors affecting winds	15

	• Types of wind	
	Natural resources - • Definition and types, renewable and non-renewable resources, resource use and depletion. Evolution of Hydrosphere • Classification of water resources: • Oceans, rivers, lakes and wetlands • Hydrological cycle –Introduction & significance Evaporation: • Factors affecting the rate of evaporation • Potential evapotranspiration(PE) Condensation: • Factors affecting the rate of condensation • Forms of condensation: • Dew, frost, fog & cloud Precipitation • Factors affecting precipitation • Forms of precipitation: • Rain, drizzle, snow, hail, sleet etc. Surface and subsurface water: • Introduction to surface and groundwater, • Water table • vertical distribution of water • Formation and properties and types of aquifers • Techniques for groundwater recharge • Wetlands and their importance.	15
References 1. D. S. Lal 2003. Climatology Sharda Pustak Bhawan, 2003; ISBN, 8186204121, 9788186204122 Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India.		

2. Brebbia, C.A. 2013. Water Resources Management VII. WIT Press.
3. CEA. 2011. Water Resources and Power Maps of India. Central Board of Irrigation & Power.
4. Grumbine, R.E. & Pandit, M.K. 2013. Threats from India's Himalaya dams. Science 339:
5. Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. Water Resource Systems Planning and
6. Analysis. Englewood Cliffs, NJ, Prentice Hall.
7. Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.
- Schward & Zhang, 2003. Fundamentals of Groundwater. John Wiley and Sons.
8. Souvorov, A.V. 1999. Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications.
9. Vickers, A. 2001. Handbook of Water Use and Conservation. Water Plow Press.
10. Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India.

F.Y. B.Sc. Semester I

Title of the Course and Course Code	EVS-120 (GE/OE): Physics and Chemistry of Environment	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Recall concepts, basic principles of environmental processes.	
CO2	Differentiate concepts of physics and chemistry associated with environmental components and processes in different spheres. Explain environmental pollutants, their processing in the environment and impact on living and nonliving things.	
CO3	Apply practical skills for analysis of water quality and outline different water pollutants affecting water quality and aquatic ecosystems.	
CO4	Differentiate between solutes and solvents, Soaps and Detergents	

Unit	Contents	Lectures
Unit I	● Transfer of heat, conduction, convection, radiative transfer, radiation laws, solar and terrestrial radiations, Stefan Boltzman law, Wien's law and Planck's law, irradiance, absorption, transmission, reflection, emission and scattering of radiations, Rayleigh and Mie scattering, diffraction. Role of aerosols in climate. ● Atmospheric dynamics, steady and non-steady motion,	10

	geostrophic winds, cyclones, hurricanes and thunderstorms. General circulation, global energy balance, global atmospheric change, simple global temperature models	
Unit II	Fundamentals of Environmental Chemistry • Solution concentration (Normality, Molarity, Molality, ppm, Equivalent weight etc.), Types of chemical reactions, acids, bases and salts, solubility products, solutes and solvents, Redox reactions, concepts of pH and pE Chemistry of Water • Hydrogen Bonding and Properties of Water • Changes in Properties of Water on Addition of Solute • Water Reactive Substances and Solubility of Rules • Analysis of Water Chemistry • Chelating Agents, Environmental Applications Fundamentals of Water Pollution • Organic matter • aquatic microbial/biochemical processes • Heavy metals • Emerging water pollutants • Soaps and detergents • Antibiotic load Fundamentals of Soil Pollution • Persistent Organic Pollutants (POPs) • Plastics and polymers • Chemical Pesticides • Poly aromatic Hydrocarbons (PAHs) • Polychlorinated biphenyls (PCBs) Chemistry of Surrounding Environment • Aerosols, Particles, Ions and Radicals as pollutants in Environment • Photochemical Reactions Involved in Environment ,	20

	● Smog and Acid Rain ● Plume Behavior ● Asian Brown Cloud and Great Smog of London ● Climate Change and Atmosphere	
References 1. Beard, J. M. 2013. Environmental Chemistry in Society (2nd edition). CRC Press. 2. Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley. 3. Connell, D. W. 2005. Basic Concepts of Environmental Chemistry (2nd edition). CRC Press. 4. Forinash, K. 2010. Foundation of Environmental Physics. Island Press. 5. Girard, J. 2013. Principles of Environmental Chemistry (3rd edition). Jones & Bartlett. 6. Harnung, S. E. & Johnson, M. S. 2012. Chemistry and the Environment. Cambridge University Press. 7. Hites, R. A. 2012. Elements of Environmental Chemistry (2nd edition). Wiley & Sons. 8. Manhan, S. E. 2000. Fundamentals of Environmental Chemistry. CRC Press. 9. Pani, B. 2007. Textbook of Environmental Chemistry. IK International Publishing House. 10. Sodhi G. S. 2009. Fundamental concepts of Environmental Chemistry. Narosa publishinghouse.		

F. Y. B. Sc. Semester I

Title of the Course and Course Code	EVS-121 (GE/OE): Sustainable Development and SDGs	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Identify, list environmental, social, and economic aspects for sustainable development	
CO2	Discuss scope, importance of sustainable development and opportunities for sustainability studies	
CO3	Examine pathways and requirements for sustainable development	
CO4	Analyze cross-cutting issues and role of international organizations towards sustainable development	

Unit	Contents	Lectures
Unit I	Sustainable Development, Sustainability • Development of the Concept • Dimensions • Critique • Education for Sustainable Development • Paris Agreement and Sustainable Development • Strategies for Sustainable Development • Public Engagement in Sustainable Development • UN Sustainable Development Knowledge Platform • Sustainable Forest Management • Cultural Elements in Sustainable Development Frameworks Pathways and Requirements • Environmental Characteristics of Sustainable Cities • Land Use Changes, Agriculture and Food • Materials and Waste • Biodiversity and Ecosystem Services • Management of Human Consumption and Impacts • Improving on Economic and Social Aspects • Gender and Leadership in Sustainable Development • Barriers and Cross Cutting Issues	15
Unit II	Sustainable Development Goals • Contents of the 17 Goals • No poverty, Zero Hunger, Good Health and Well-Being, Peace • Quality Education, Gender Equality, Reduced Inequalities, Justice and Strong Institutions • Clean Water and Sanitation, Affordable Clean Energy, Climate Action, Life Below Water, Life on Land • Decent Work and Economic Growth, Industry, Innovation and Infrastructure • Sustainable Cities and Communities, Responsible Consumption and Production, Partnership for Sustainable Development Reporting and Measurements • Challenges for Sustainable Development International Organizations and Sustainable Development • Monitoring Mechanism • Reporting and Progress • Sustainable Development Goal Targets and Indicators • Communication and Advocacy • Corporate Sustainability • Sustainability Metrics and Indices	15

	● Ecological and Carbon Footprint for Sustainability Measurement ● Sustainability Measurement and Reporting Tool ● Sustainability Case Studies Examples	
References ● Clark, William; Harley, Alicia (2020). "Sustainability Science: Toward a Synthesis". Annual Review of Environment and Resources. 45 (1): 331–86. ● United Nations General Assembly (1987) Report of the World Commission on Environment and Development: Our Common Future ● Purvis, Ben; Mao, Yong; Robinson, Darren (2019). "Three pillars of sustainability: in search of conceptual origins". Sustainability Science. 14 (3): 681–695. ● Berg, Christian (2020). Sustainable action: overcoming the barriers. Abingdon, Oxon. ISBN 978-0-429-57873-1. OCLC 1124780147. ● Purvis, Ben; Mao, Yong; Robinson, Darren (2019). "Three pillars of sustainability: in search of conceptual origins". Sustainability Science. 14 (3): 681–695. ● Sachs, Jeffrey D. (2015). The Age of Sustainable Development. New York: Columbia University Press. ISBN 9780231173155. ● Sossa, Jhon (May 2019). "Barriers to sustainability for small and medium enterprises in the framework of sustainable development—Literature review". Business Strategy and the Environment. 28 (4): 512–524. ● Environment and Sustainable Development by M.H. Fulekar, Bhawana Pathak, R K Kale, Springer Nature (2013) ● Sustainable Development in the Digital Era by Dr. Aparna Mishra, Dr. Vikas Dahiya, Dr.Kamini Tandon, JSR Publishing House LLP; (2019). ● The Age of Sustainable Development by Jeffrey D. Sachs and Ban Ki-moon, Columbia University Press (2015) ● Target 3 Billion: Innovative Solutions Towards Sustainable Development by APJ Abdul Kalam, Srijan Pal Singh, Penguin India (2011)		

F. Y. B. Sc. Semester I

Title of the Course and Course Code	EVS-130 (VSC): Solid Waste Management Techniques	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		

CO1	Understand the characteristics of wastes and the systems, and processes of waste management.
CO2	Identify the case specific issues related to pollution potentials of solid wastes
CO3	Address solid waste management practices through a cradle-to-grave approach
CO4	Apply understanding to generate resources from wastes. Develop the practical skills for production of value added from solid waste products like Compost and Vermi compost

Unit	Contents	Lectures
Unit I	Introduction: Definitions, sources, composition; and generation of: • Municipal solid wastes (MSW) • Biomedical wastes • E-waste • Hazardous wastes • National and global scale. Introduction to Environmental regulations: • Municipal Solid Wastes (Management and Handling) Rules 2000 Hazardous Wastes Management and Handling Rules 1989 • Bio-Medical Waste (Management and Handling) Rules 1998; Eco Friendly or green products. Physico-chemical characterization: • Density, field capacity, particle size, field capacity, pH, organic C, NPK, heat value etc.).	15

Unit II	Techniques of resource recovery: • Composting • Microbial decay Concept of energy recovery from waste: • Refuse derived fuel (RDF) Different WTE processes: • Combustion • Incineration • Pyrolysis • Gasification • Landfill gas (LFG) recovery; • Anaerobic digestion; . Environmental impacts: • Major pollutants • Human health effects • Ecosystem damage • Air quality • Water quality • Soil quality.	15
SKILLS 1. Scientific knowledge of identification of waste. 2. Scientific knowledge of characterization of waste. 3. Segregation of waste on the basis of physical characteristics. 4. Knowledge of resource recovery from waste. 5. Identification of environmental impacts of pollutants.		
References 1. Bio-Energy Resources: P. Chaturvedi, Concept Publishing Company. 2. Destruction of Hazards Chemicals in the Laboratory: G. Lunn and E. B. Sansone. 3. Environmental Chemistry: M. Satake, Do, S. Sethi, S. A. Eqlbal. 4. Asnani, P. U. 2006. Solid waste management. India Infrastructure Report 570. 5. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons. 6. Blackman, W.C. 2001. Basic Hazardous Waste Management. CRC Press. 7. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons. 8. US EPA. 1999. Guide for Industrial Waste Management. Washington D.C. 9. White, P.R., Franke, M. & Hindle P. 1995. Integrated Solid Waste Management: ALifecycle Inventory. Blackie Academic & Professionals. 10. Zhu, D., Asnani, P. U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. Improving Municipal Solid Waste Management in India. The World Bank, Washington D.C.		

F. Y. B. Sc. Semester I

Title of the Course and Course Code	EVS-140 (SEC): Fundamentals of Ecotourism	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Appreciate concepts of ecotourism and its management	
CO2	Understand values of wildlife and minimizing impact on natural ecosystem due to tourism	
CO3	Learn basic concepts of ecotourism, facility management and hospitality needs.	
CO4	Appreciate sustainability in ecotourism	

Unit	Contents	Lectures
Unit I	● Introduction Ecotourism: concepts and definitions; Evolution and characteristics of ecotourism; ● Ecotourism guidelines: National and State level ecotourism guidelines; Laws, Tourism bill of rights; code for environmentally responsible tourism; World Ecotourism Summit ● Tourism Impacts, Economic, social, political and environmental impacts, Sustainable Ecotourism - prospects and Challenges	15
Unit II	● Geography of India India's biodiversity, Parks and Sanctuaries, Environmental concerns ● Community based Ecotourism, Significance of ecotourism planning Carrying capacity and development Benefits of sustainable tourism; Peoples' initiatives on Ecotourism, Community Education and Public Awareness (CEPA)	15

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| | <ul style="list-style-type: none"> ● Case study- ecotourism development in a hill station | |
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References

- Holden A. Environment and Tourism, Routledge, London, 2008.
- Sharma S.P., Tourism and Environment, Kanishka, New Delhi, 2006
- Weaver D. Eco-Tourism, John Wiley and sons Australia Ltd, 2008.
- Wood M., Eco Tourism – Principles, Practices and Policies for Sustainability, UNEP and TIES
- Beddard F.E., A text book of Zoogeography, BiblioLife
- Bulbeck, C. (2005). *Facing the wild : ecotourism, conservation, and animal encounters*. London: Earthscan.
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- North Benninton: The Ecotourism Society.
- Page, S.J. and R.K. Dowling. (2002). *Ecotourism*. New York: Prentice Hall.
- Patel Prima, (2020). A Study on Eco-Tourism and its Sustainability in India: Research gate. DOI:[10.13140/RG.2.2.18651.80160](https://doi.org/10.13140/RG.2.2.18651.80160)
- Wood, M.E. (2002). *Ecotourism: Principle, practices and Policies for Sustainability*: UNEP.
- Wearing, S. and J. Neil. (1999). *Ecotourism: impacts, potentials, and possibilities*. Oxford: Butterworth- Heinemann.
- Weaver, D. (2001). *Ecotourism*. Milton: John Wiley & Sons.

SKILLS

- Field visit to Eco restoration sites.
- Identification of tracks and sites, bird identification, bird calls
- Ecotourism opportunities along with community participation.
- Identification of Carrying capacity of protected area.
- Identification of Ecological sensitive areas

- Understanding importance of protected area network in nearby areas
- Appreciation of values associated with the conservation concept
- Understanding the importance of community participation in conservation
- Identification of impacts of tourism
- Understanding the importance of Efforts in making the natural sites free of any of the threats

F. Y. B. Sc. Semester I

Title of the Course and Course Code	IKS-101 (IKS): Indian Knowledge Systems	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Recall the basic concepts of Indian Knowledge System (IKS)	
CO2	Articulate the foundation of IKS and explain historical and cultural context of Indian knowledge systems	
CO3	Use the knowledge of IKS to understand discipline specific case studies.	
CO4	Develop critical thinking and problem-solving skills in the context of Indian knowledge systems.	

Unit	Contents	Lectures
Unit I	Overview of IKS • Survey of IKS Domains: A broad overview of disciplines included in the IKS, and historical developments. • Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen / eighteen vidyasthanas, tantrayukti • Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja, janata, loktantra, prajatantra, ganatantra, swariva, surajya, rashtra, desh. • Philosophical foundations of IKS: Introduction to Samkhya, vaisheshika and Nyaya • Methods in IKS: Introduction to the concept of building and	15

	testing hypothesis using the methods of tantrayukti. Introduction to pramanas and their validity, upapatti; Standards of argumentation in the vada traditions (introduction to concepts of vaada, samvaada, vivaada, jalpa, vitanda). Concept of poorvapaksha, uttarapaksha.	
Unit II	Case Studies (Few of these may be selected as appropriate) • Mathematics of Madhava, Nilakantha Somayaji • Astronomical models of Aryabhata • Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings • Foundational aspects of Ayurveda • Foundational aspects of Ashtanga yoga • Foundational aspects of Sangeeta and Natva Shastra • Discipline Specific Case Study	10
Unit III	• India and the World: • Influence of IKS on the world, knowledge exchanges with other classical civilizations. and inter-civilizational exchanges	5
References: 1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India). 2. Indian Knowledge Systems: Vol I and I, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd). 3. The Beautiful Tree: Indigenous India Education in the Eighteenth Century. Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd. Combatore, 1995. 4. Indian Science and Technology ni the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science. 5. The Wonder That Was India, Arthur Llewellyn Basham, 1954, Sidgwick& Jackson. 6. The India they saw series (foreigner visitors on India ni history from 5CE to 17th century), Ed. Meenakshi Jain and Sandhya Jain, Prabhat Prakashan		

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-150 (Major): Practical based on Environmental Pollution	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Recall laboratory safety rules for handling waste water samples while performing practical. List water quality monitoring techniques.	
CO2	Understands the basic concepts of air quality monitoring	
CO3	Illustrate chemicals used for estimation of Alkalinity.	
CO4	Measure and illustrate the noise levels	

Contents	
- Demonstration of air sampling with RDS/handy sampler - Measurement of particulate matter in air by grab sampling and gravimetric method. - Determination of pH & Electrical Conductivity from water. - Determination of Alkalinity from water. - Determination of Turbidity in water by Secchi disc (Field practical). - Determination of TDS, TSS & TS from water by gravimetric method - Determination of Total Hardness (Ca & Mg) from water. - Determination of Chlorides from water. - Understanding and comparing noise levels of localities - Field visit: Visit to a local polluted site (Urban/Rural/Industrial/Agricultural) - Collection and characterization of planktons / plant bio-indicators from Eutrophic Lake(Field Practical). - Use of social media for e-networking and dissemination of ideas on environmental issues	

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-151 (Major): Environmental Pollution and Human Health	Credits-4
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Knowledge on the basic types and the science of environmental pollution	
CO2	Appreciation of the effect of pollution on human health	
CO3	Analytical ability to link cause and effect of pollution	
CO4	Critical issues of handling pollution vis a vis human being	

Unit	Contents	Lectures
Unit I	Introduction: Definition of pollution; pollutants; classification of pollutants Soil Pollution: Causes of soil pollution and degradation; effect of soil pollution on environment, vegetation and other life forms; control strategies. Marine pollution Marine resources and their importance; sources of marine pollution; oil spill and its effects; coral reefs and their demise; coastal area management; existing challenges and management techniques (planning, construction, environmental monitoring of coastal zones).	15
Unit II	Air Pollution: Introduction, air pollutants, types and sources, history of air pollution episodes, air pollution and effects on human health, health effects of Particulate matter, heavy metals (Pb in particular), sulphur dioxide (SO ₂), nitrogen dioxide (NO ₂), volatile organics, surface ozone	15
Unit III	Water pollution- introduction, sources of water pollutants, organic matter, organic micro pollutants, microbial pollution, Agriculture and Water pollution, Problems of pesticides and chemical fertilizers, Geogenic Contamination – problems of As and F ⁻ in ground water and human health, Case of As and F ⁻ , Groundwater Contamination by Hazardous Wastes leaching. Industrial and Mining Operations and water pollution, Sewage and wastewater, Implications on health – appreciation of Minamata disease, <i>itai itai</i> disease, blue baby syndrome.	15
Unit IV	Noise pollution:	15

	Introduction, noise categories, Noise effects - hearing loss, Cardiovascular effects, Psychological impacts, Stress, Annoyance, control of noise pollution and regulation Radioactive and thermal pollution: Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); thermal pollution and its effects.	
References 1. Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt.. 2. Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt.. 3. Air Pollution; Rao M.N. & Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989. 4. Environmental Pollution Control & Environmental Engineering; Rao C. S.; Tata McGraw Hill; New Delhi; 1994. 5. Pollution Management; Agarwal S.K. 6. Environmental Science; Daniel Chiras. 7. Waste Water Engineering, Treatment, Disposal & Reuse; Metcalf & Eddy. 8. Textbook of Noise Pollution & Its Control – S.C. Bhatia 9. Air Pollution; Rao M.N. & Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989 10. Chemical & Biological Methods for Water Pollution Studies; Trivedi R. K. & Goel P. K.;Environmental Publications; Karad; 1986. 11. Advanced Air and Noise Pollution Control - L. K. Wang & N. C. Pereira 12. Environmental Chemistry - B.K. Sharma		

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-161 (Minor): Know your Environment	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Students will appreciate the Knowledge about the environment	
CO2	Understand various components of the environment and interfaces	
CO3	Critically appreciate the environmental concerns of today	
CO4	Understand the role of human beings in shaping the environment	

Unit	Contents	Lectures
Unit I	• Multidisciplinary nature of Environmental Science • Environment – Definition and the components – the physical components, socio- economic and cultural component • Natural resources – definition and types, renewable and non-renewable resources, resource use and depletion	15

Unit II	● The atmosphere – structure and composition, physicochemical role of the atmosphere, radiative balance and earth's temperature regime ● Rocks and minerals, the rock cycle, biogeochemical cycles, soil- structure and types, land resources, and landforms ● Water resources, water bodies and water use, issues with water and conservation	15
References 1. D.S.Lal 2003. Climatology Sharda Pustak Bhawan, 2003; ISBN, 8186204121, 9788186204122 Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India. 2. Brebbia, C.A. 2013. Water Resources Management VII. WIT Press. 3. CEA. 2011. Water Resources and Power Maps of India. Central Board of Irrigation & Power. 4. Grumbine, R.E. & Pandit, M.K. 2013. Threats from India's Himalaya dams. Science 339: 5. Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. Water Resource Systems Planning and 6. Analysis. Englewood Cliffs, NJ, Prentice Hall. 7. Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications. Schward& Zhang, 2003. Fundamentals of Groundwater. John Willey and Sons. 8. Souvorov, A.V. 1999. Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications. 9. Vickers, A. 2001. Handbook of Water Use and Conservation. Water Plow Press.		

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-170 (GE/OE): Biological Environment	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Understand the biosphere and biotic community	
CO2	Appreciate physiology of plants and animals, and relation with environment	
CO3	Appreciate the Climatic factors, stress and physiology	
CO4	Critically examine the impact of human action on the biological environment	

Unit	Contents	Lectures
Unit I	● Biosphere: Living species of the Earth, Interactions of living species and their changes with the present environmental modifications ● Understanding Bio complexity: Biological complexity of life. Different habitats and their way of interactions with the environment, India's common flora and fauna. Strategies adopted by plants, animals, fungi, bacteria and archaea to cope with their habitat. ● Animal behavior and Physiology: Adaptation to external environments, adaptive responses that enable species to survive and reproduce. Environmental change and physiologies of animals.	15
Unit II	● Plant Physiology and Ecophysiology: Key concepts on how plants capture energy and transform it to ecosystems. ● The productivity of plants and plants in the field, their influence on water, carbon, nutrient and energy cycles is central to the functioning of landscapes. ● Long-distance transport in the phloem; uptake, movement and control of water fluxes in the soil-plant-atmosphere continuum; landscape carbon and water budgets.	15
References 1. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi. 2. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192. Singh, J. S., Singh, S. P. & Gupta, S. 2006. 3. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. 4. Conservation Biology for All. Oxford University Press. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.		

5. Singh, G. 2012. Plant Systematics: Theory and Practice (3rd edition). Oxford & IBH Pvt. Ltd., New Delhi. Wheeler, Q.D. & Meier R. 2000.
6. Species Concepts and Phylogenetic Theory: A Debate. Columbia University Press, New York. Wilkins, J. S. 2009.
7. Species: A History of the Idea (Vol. 1). University of California Press.

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-171 (GE/OE): Folk Culture and Traditional Communities of India	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Appreciation of mega diversity of cultures.	
CO2	Value of India's heterogeneity in diverse cultures and their uniqueness.	
CO3	Importance of India's pluralistic, democratic and constitutional ethos.	
CO4	Understanding folk traditions in agriculture, animal husbandry, fisheries, tribal foragers and their indigenous traditional knowledge systems (TKS).	

Unit	Contents	Lectures
Unit I	● Diversity of traditional folk cultures. ● Lives and lifestyles of complex traditional communities. ● Linkage of biogeographic zones to indigenous cultures. ● The "adivasi" their importance in futuristic India. ● Tribal art, handicraft, music, dance, folklore, mythology, dress codes, local food, etc.	15
Unit II	● Communication, education and public awareness (CEPA) for long term preservation for traditional knowledge systems. ● Ethical issues in conservation of indigenous culture.	15
References ● Basham, A.L., The Wonder That was India, Surjeet Publications, 2008 ● Basham, A.L., The Illustrated Cultural History of India, OUP , 2007		

- Patra, A., The Spiritual Life and Culture of India, Oxford University Press, England. 2012
- Henderson, C. E. Culture and Customs of India. Greenwood Publishing Group. 2002
- Husnain, N., Tribal India, Palaka Prakashan, 2001
- Husnain, N., Indian Society and Culture: Continuity and Change, 2010
- Ministry of Tribal affairs, Government of India (<https://tribal.nic.in/>)

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS-180 (VSC): Hydroponics: A Green Way of Urban Farming	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Acquire knowledge of fundamentals of hydroponics	
CO2	Understand the role and responsibilities of various institutions.	
CO3	Aware about policies and legislation on safety in industries and workplace environments.	
CO4	Gain knowledge of the principles of watershed hydroponics techniques.	

Unit	Contents	Lectures
Unit I Concept of Hydroponics	● A brief history of Hydroponics ● Hydroponics mediums: Coconut Coir Perlite. LECA. Perfect Starts. Rockwool. ● Hydroponic Technology: Sand And Gravel Culture. The Dutch Bucket Method. The Rockwool Slab Drip System. The Nutrient Film Technique (NFT). The Raft System. Ein Gedi System. Aeroponics. The Autopot. Vertical Gardening. ● Plant Nutrition: The Organic Composition Of Plants. Macronutrients. Micro Nutrients. Selecting A Hydroponic Nutrient. Making Your Own Nutrients. Maintaining Nutrient Concentration And pH. Nutrient Solution Microbiology. Supercharge Your Garden With CO₂. CO₂ And You. Do-It-Yourself CO₂. ● Light Requirements: High Intensity Discharge (HID) Lighting. Intensity. Duration (Photoperiod): Color (Photosynthetic spectrum). Choosing A Grow Light.	15
Unit II	Applications of Hydroponics	15

	● Hydroponics as a Commercial activity ● Establishing a Market For Your Garden. ● Investigate Your Local Market. ● Product Quality Considerations for project ● Approaching Prospective Customers. ● Hydroponics - applications and customisation under Indian conditions	
SKILLS: 1. Hydroponics allows teachers to teach a range of topics from science and agriculture to teamwork and critical thinking. 2. Regularly checking the measurements of pH and EC is easier to accomplish when students share the responsibility. 3. Allows students to share their in-depth knowledge of the field and help students progress toward a career in their area of expertise. 4. Students will learn to identify appropriate media for the growth of plants 5. Students understand the use of equipment and maintenance and repair of the same 6. Students will make acquainted themselves with the Skills like problem-solving, interpersonal, farm management and organizational skills are all important for successful farming 7. Students will develop a good awareness of current developments in pesticide use, irrigation and strategies to improve cultivation, harvest, storage and transportation can help farmers be efficient at work. 8. To fulfill market demands and success in their career, a student manages their time effectively and consistently. 9. Students use organizational abilities to maintain accurate records of various activities 10. Students will learn adaptability that helps them adjust to various factors like demand, weather and inflation		
References 1) Green house Technology - Arupratan Ghosh 2) Handbook of Saline and alkali soils -USDA 3) Vegetable Production in India- D.V.S.Chauhan 4) Vegetable growing in India – P.S. Arya and Santprakash 5) vegetable growing – Choudhary 6) Horticulture at glance- Amarsingh 7) Plant Propagation – Hertman et al 8) Preservation of fruits and Vegetables -Girdharilal and Tondon 9) Principles of fruit growing – Yawalkar and Kunte 10) Foods and Nutrition – Sumati Mudambi 11) Plant Physiology- Pandey and Sinha 12) Plant physiology –Jain 13) Hand book of Agriculture – ICAR Publications 14) How to Hydroponics-by Keith Roberto		

F. Y. B. Sc. Semester II

Title of the Course and Course Code	EVS -190 (SEC): Design and Development of Eco- friendly Products	Credits-2
Course Outcomes (COs) On completion of the course, the students will be able to		
CO1	Understand the concept of Eco-design	
CO2	Design and develop eco products using natural raw material	
CO3	Articulate the importance of various supporting schemes and organizations for startups	
CO4	Connect the social and environmental needs with employment generation	

Unit	Contents	Lectures
Unit I	Eco design ● Concept and Principles ● Factors and Guidelines for implementation ● Tools used in Eco designing Ecomark scheme ● Eco-labelling for eco-friendly products ● Eco-mark scheme ● BIS implementation guidelines	15
Unit II	Eco-friendly products: ● Harmful effects of existing products in the market ● Effect on environment: water, soil, plants etc., ● Adverse effects Human health ● Benefits of eco products ● Marketing aspects: Market research for product ● Examples : Herbal colors, soaps and dish washing liquid made from natural ingredients etc. ● Waste to wealth : product formulation using waste material ● Paper and fabrics products ● Fuel pallets Eco Friendly product formulation	15

	i) Soap making: ● Raw material: Availability, cost, ingredients, importance ● Additional accessories ● Safety measures ● Production process: hot and cold process ● Benefits and limitations ii) Homemade dishwashing liquid: Raw availability, cost, preparation, benefits and limitations iii) Fuel pallets: Raw material, cost, accessories, benefits and limitations Government schemes to support startup: ● Pradhan Mantri Mudra Yojana, Ministry of Micro, Small and Medium Enterprises, Govt. of India ● Government funding for startup ● Startup India Network ● Connect with Incubators: Find incubators in your region that can support your startup's growth. ● Connect with Government: Reach out to the relevant Ministries or Departments Organizations: ● Governmental and nongovernmental organizations ● Examples : KVIC support, Zee Marathi home minister etc.	
SKILLS: 1. To develop a skill to design and formulate eco-friendly products. 2. To understand and identify the threats associated with synthetic and chemical products. 3. To conduct a market survey for the availability of eco-friendly products. 4. To apply traditional knowledge and skill in development of eco products. 5. To develop marketing skill in this field 6. To understand the demand and social needs of the community. 7. To acquire the knowledge for applying various government schemes for startups. 8. To aware the community about environmental and health problems with synthetic and chemical products and benefits of eco products. 9. To apply the principle of circular economy in this process of eco product formulation. 10. To develop resource management skill and application of principles of green chemistry.		
References ● https://europa.eu/youreurope/business/product-requirements/compliance/ecodesign/index_en.htm#:~:text=There%20are%20certain%20products%20that,impact%20throughout%20the%20product's%20lifecycle. ● https://www.designer.com/directory/cat/Sustainable-Design/Books ● https://bis.gov.in/index.php/product-certification/operation-of-eco-mark-scheme/?lang=en ● https://www.elsevier.com/books/the-circular-economy/sillanpaa/978-0-12-815267-6 ● https://www.bhg.com/homekeeping/house-cleaning/cleaning-products-tools/homemade-cleaners/ ● https://lovelygreens.com/eco-friendly-cold-process-soap-recipe-instructions/		

- <https://www.greenmatters.com/p/make-your-own-soap>
- <https://naturecode.org/biodegradable-soap/>
- <https://msme.gov.in/schemes/pm-employment-generation-program-and-other-credit-support-schemes>
- <https://www.homeminister.com/bizdetails/4959871945405174258>