Courses on Climate Science and/or Environmental Sustainability

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31.	Personal and Family Health and Wellness	SDG 3, SDG 4, SDG 6, SDG 11, SDG 12	Good Health and Well-being, Quality Education, Clean Water and Sanitation, Sustainable Cities and Communities, Responsible Consumption and Production	70

Energy and its Resources

Course Objective:

This course will offer

- Understanding of energy units, unit conversion, unit magnitudes
- Description and quantification of various energy resources – renewable and non-renewable
- Understanding energy needs of self, institution, country and world, energy consumption by sector
- Debate on advantages and disadvantages of energy sources
- Energy resources of India and World, Sankey diagrams
- Wind, biomass and solar energy resources
- Per capita energy consumption and impact on social and economic parameters
- Future scenarios of energy requirements

Course Content:

A. Theoretical Learning

Each lecture is assumed to be of one hour. In content column, if possible breakdown the content of 1 hour in sub-topics

Lecture No.	Contents
1.	**Energy and its units:** discussion on role of energy in our lives, various sources of energy that we use, units of energy, small and large units of energy, magnitude of energy units, units for energy consumption of individual, institution and country
2.	**Renewable and Non-renewable energy:** difference, characteristics of resources, advantages and disadvantages, discussion in class on which type of resources to be used by individual, by a country, reason out why?
3.	**Understanding individual energy requirements:** take a case of any student, discuss what energy resources he/she uses, differentiate between energy and power, estimating electrical energy needs, estimating fuel energy needs (petrol/diesel), estimating cooking energy needs, convert all energy sources in single energy units, estimate total energy needs of a person, discussion on possible growth on energy demand, should it grow or not?
4.	**Energy requirements of a country:** evolution of energy consumption, population of country, number of demands for energy, per demand energy, estimating energy consumption of country, discussion on possible growth on energy demand, should it grow or not?
5.	**World energy scenario- consumption:** energy consumption of world, by resources, by sector, per capita electricity and total energy consumption,

Lecture No.	Contents
	comparison among countries and between continents, relationship between Human Development Index (HDI) and energy consumption, discussion in the class on disparity in energy consumption.
6.	**World's energy resources – non-renewable:** fossil fuels like coal, oil gas as energy resources, difference between reserves and resource, current production and consumption rates of fossil fuels, peak oil, first and second oil shock, discussion on limited nature of the fossil fuels, whether peak oil would ever come?
7.	**World energy flows:** world energy consumption, total primary energy supply (TPES), total final consumption (TFC), Sankey diagram for depicting energy flow, draw Sankey diagram for world energy flow and few selected countries,
8.	**India's energy scenario – non-renewable:** India's energy consumption from all resources, consumption of oil, coal, gas, import of fossil resources, foreign exchange requirements, discussion on energy security of country and imports dependency
9.	**Renewable energy sources:** what are renewable energy sources? Why they are renewable?, summary of all RE resources, global scenario of these resources
10.	**Wind and Biomass resources in India**: discussion on origin of these resources, potential of these resources in India, how these resources are converted into useful energy,
11.	**Solar energy resources:** Sun as source of energy, solar energy reaching the Earth's surface, solar spectrum, photons of different energy, solar irradiation and solar radiation/insolation, extra-terrestrial solar radiation, global, direct and diffuse solar radiation
12.	**Quantifying solar energy resources**: units of solar energy, air mass, AM1.5 and standard test conditions; hourly, daily, monthly and yearly solar radiation, solar radiation maps of India and world, variation of solar radiation at a given location within a day, over a season and reason behind it, significance of summer and winter solstice.
13.	**Finding solar radiation data**: measuring solar radiation data, meteorological stations, sources of solar radiation data for various cities of India
14.	**Optimal collection of solar radiation:** apparent motion of sun and earth, apparent position of sun for an observer, optimal angle of solar collectors for maximum solar radiation collection, optimum angle for summer and winter
15.	**Hydrogen energy:** source and storage medium, generation of hydrogen, storage of hydrogen, conversion of hydrogen into useful energy, future of hydrogen
16.	**Future energy scenarios:** summary of the class, students to summarize their experiences in the form of poster on any one topic, discussion on what are possible scenarios?

B. Practical Learning

In contents please provide as detailed titled of the experiments as possible, also break down experiments in sub experiments to give clear indication on what are the concepts/observations students are expected to learn in each experiments.

Experiment No.	Contents
Note	Conduct any of the five experiments listed below
1	Measure instantaneous solar irradiation (W/m2) inside a classroom, under cloudy condition (if possible), and under clear sunny sky and compare. Measure 8 to 10 readings of instantaneous solar irradiation over couple of hours and based on readings estimate the solar insolation (kWh/m2) falling over duration of experiment day of experiment.
2	On the day of experiment, take a solar panel out under the sunlight and measure its short circuit current under various orientation of solar panel with respect to the Sun. Note down reading, compare the variation in measured current values and compare and comment on variation in the values.
3	Measure energy consumption of a light and a fan (or any other appliance) in your lab using power meter / energy meter over the duration of experiment. Also do the theoretical estimation of possible energy consumption by the appliances over the same time. Compare both and comments.
4	Figure out from which point electricity is entering your campus, how it is being measured (visit the site), check if you can take any reading, discuss the electrical supervisor on daily, monthly electricity consumption of the campus, discuss the variation of electricity consumption with season and reason behind it. Make summary of your observations.
5	Visit canteen of your campus, make a list of all appliances used in campus, note down the hours of usage and estimate daily and monthly electricity consumption of canteen. Also estimate how much energy is consumed in canteen through other fuels like LPG or coal or any other sources.
6	Debate on which energy sources to be promoted, students are to be divided in 4 or 5 groups, each group representing different source, each group presents their idea why that particular source should be promoted, the task of the whole class is to come to a conclusion on use of a particular source.

C. Social Learning

This activity would be most crucial and needs careful design. This includes activities outside the classroom and outside the laboratory. Students must do something to apply their knowledge. This can also be exercise to apply the knowledge learned in classroom and laboratory and gather more information/data from society on a topic.

Social experiment No.	Contents
Note	Conduct any of the three experiments / exercises
1	Estimate the monthly energy consumption of your own family, include energy consumption from electricity, petrol, diesel, LPG, public transportation, etc. Make a brief report on it.
2	Make a brief report on energy consumed for food production and consumption, collect the data on energy consumed on per meal basis
3	Estimate the energy consumption of an industry / start-up /institution in your area, include energy consumption from electricity, petrol, diesel, LPG, public transportation, etc. Make a brief report on it.
4	Write a brief 2-page report on total annual energy consumption of any country, other than India. Include energy consumed from all resources, and draw its Sankey diagram.
5	Write a brief 2-page report on annual renewably energy consumption of any country, other than India. Include energy consumed from all resources, and draw its Sankey diagram.
6	Measure instantaneous solar radiation at your location, collect reading every hour from 10am to 4pm. Use a pyranometer or solar cell. Prepare a report on it. Assuming similar radiation falling on entire city. How much total solar energy would be falling on your city/village over those three days?

Climate Change: Understanding & Observation

Course Description:

Climate Change poses an increasing threat to the stability of Earth's systems. If we want to protect our planet from dangerous and unprecedented change, first we must understand the science behind climate change. This course will help in looking back across understanding the dynamics of climate change, its causes, and consequences, and learning the difference between 'natural' from 'human' induced climate change; looking to the present to see how the impacts of climate change are already being felt; finally looking to the future to see what it might hold for our planet.

Course Objective:

This course will offer

- Understanding of climate change, the difference between climate and weather
- Understanding the causes, consequences of climate change
- Evidence of the climate change - frequency and intensity of the erratic climatic events
- Comprehending the future of fossil fuels in a carbon-constrained world
- Understanding the past climate agreements
- Understanding the pledges of COP26
- Future scenarios of climate action
- Up-scaling renewable energy

Course Content

A. Theoretical Learning

Each lecture is assumed to be for one hour. In the content column, if possible breakdown the content of 1 hour in sub-topics

Lecture No.	Contents
1	**Understanding the climate and weather:** discussion on what is climate, weather, the difference between the two, and defining climate change, understanding the relevance of 1.5 degrees and 2-degree Celsius warming.
2	**Science of climate change:** In-depth understanding of the causes climate change, human contribution to climate change, anthropogenic drivers of climate change
3	**Understanding the depletion of natural elements:** What would be the impacts of these changes in climate for human well-being and the natural world? Understanding the consequences of climate change on the depletion of the two natural resources - **water and soil changes,** amount of changes, reasons behind, what are future trends

Lecture No.	Contents
4	**Understanding the depletion of natural elements: change:** An understanding and analysis of the consequences of the climate change of two parameters - **temperature and precipitation change,** amount of changes, reasons behind, what are future trends
5	**Understanding the depletion of natural elements:** An understanding and analysis of the consequences of the climate change of two parameters - **droughts & heatwaves and hurricanes,** amount of changes, reasons behind, what are future trends
6	**Understanding the depletion of natural elements:** An understanding and analysis of the consequences of the climate change of two parameters - **sea levels and glacier melting,** amount of changes, reasons behind, what are future trends
7	**The future of fossil fuels in a carbon-constrained world:** Understanding the fossil fuels and how they will be earmarked in the future of the energy generation and consumption, how we can move towards the decarbonized world
8	**Climate Change Agreements:** Understanding the evolution of the climate agreements, UNFCCC, kyoto protocol, the defining agreements of Paris and COP
9	**The pledges of COP26:** What is COP26?, participating organizations, Understanding the synopsis of the current climate agreement of COP26 and how the countries have committed to marking their progress with the initial commitment
10	**Future scenarios of climate action:** In-depth study of two scenarios - one with the world wherein the consumption of fossil fuels remain the same, then what will happen to our ecosystems and the second scenario, wherein we move towards a decarbonized world, what will be the impact on our ecosystems
11	**Mitigation and Adaptation Strategies (Part -1):** Understanding the what are roles of individuals, countries, and the global community in adapting to climate change and policies for upscaling renewable energy
12	**Mitigation and Adaptation Strategies (Part-2):** Understanding the what are roles of individuals, countries, and the global community in adapting to climate change and policies for upscaling renewable energy
13	**Case Study -1: Climate change mitigation and adaptation**
14	**Case Study -2: Climate change mitigation and adaptation**

B. Practical Learning

Each experiment can be for 4 to 6 hours. In contents please provide as detailed a title of the experiments as possible, also break down experiments in sub experiments to give a clear indication on what are the concepts/observations students are expected to learn in each experiment.

Experiment No.	Contents
Note	Conduct any of the five experiments listed below
1	Find out the records (measurements from meteorology stations) of average temperature changes of the past 20-30 years in your region. Observe the patterns of temperature change and make critical comments on patterns and reasons behind.
2	Find out the records (measurements from meteorology stations) of average precipitation of the past 20-30 years in your region. Observe the patterns of temperature change and make critical comments on patterns and reasons behind.
3	Prepare a report on the possible role of your institutions in the mitigation of climate change. Do this based on discussion with people in society. Frame a set of 5 to 6 questions, interview people and based on the interview prepare a report.
4	Estimate the carbon footprint of your institute based on energy consumption of the institute. Also make an estimate of carbon emission of your institute (even if it is very approximate) that includes travelling by students and staff, carbon footprint due to residents, etc.

C. Social Learning

This activity would be most crucial and needs careful design. This includes activities outside the classroom and outside the laboratory. Students must do something to apply their knowledge. This can also be exercised to apply the knowledge learned in the classroom and laboratory and gather more information/data from society on a topic.

Social experiment No.	Contents
Note	Conduct any of the three experiments/exercises
1	Prepare a report on the possible role of individuals in the mitigation of climate change. Prepare this report based on discussion with people in society. Frame a set of 5 to 6 questions, interview people and based on the interview prepare a report.
2	Visit a nearby river / pond /forest, discuss with people living around it and figure out the changes people have observed since the last 20-30 years. Prepare a report.
3	Prepare a report on what is your and your family's possible role in contribution to climate change and its mitigation. As far as possible quantify the contributions.
4	Prepare a report on newspaper coverage of climate change and related happenings of your region and country since last one year. Make your remarks on newspaper coverage.

Energy Storage for Renewables

Course Objective:

This course will offer

- An overview of the storage system suitable for offering reliable energy solutions.
- Energy storage types based on energy form
- Sustainable storage solutions for renewable energy systems will be identified based on reliability and affordability.
- Life cycle cost, energy and environmental analysis of conventional storage systems
- Study of the characteristics of conventional energy storage systems

Course Content

A. Theoretical Learning

Lecture No.	Contents
1.	**Demand-supply mismatch and role of energy storage:** Discussion on types and variation in different load demands such as residential load, office, agricultural load; Variation in renewable energy resources, Understanding the mismatch between load profile and generation profile; introduction to the mismatch time scale
2.	**Overview of different energy storage options:** Introduction to the Ragone plot; Introduction of demand-supply mismatch time scale on Ragone plot; C-rating
3.	**Mechanical Energy Storage-Compressed Air:** Basic thermodynamics; working principle; general consideration; power extraction system-diabatic, adiabatic and isothermal method
4.	**Mechanical Energy Storage-Flywheel:** Introduction to the moment of inertia, angular momentum and kinetic energy of rotating object; working principle; components; characteristics; applications
5.	**Mechanical Energy Storage-Pumped Hydro:** Introduction; working principle; components and complete system; open-loop and closed-loop pumped hydro storage; turbines types and applications
6.	**Thermal Energy Storage:** Introduction to the fluid flow and heat transfer; latent and sensible heat storage; phase change materials (PCM) for thermal energy storage; different geometries for PCM based thermal storage
7.	**Overview of Electrochemical Energy Storage:** Electrochemical cells and batteries; primary cell; secondary cell, Faradic and Non-faradic process, charging and discharging of electrochemical cells and polarity, efficiencies
8.	**Open circuit voltage for electrochemical storage:** Standard pressure and temperature, standard electrode potential, concentration cell

Lecture No.	Contents
9.	**Current-voltage behaviour of electrochemical storage:** Types of electrode-electrolyte interfaces, double layer capacitance, mechanism of electron transfer at the interface, oxidation and reduction and polarity, anode and cathode, cell polarisation behaviour-activation polarisation, ohmic polarisation, concentration polarisation
10.	**Supercapacitor as energy storage:** Introduction, working principle, basic design, types, charging-discharging characteristics and efficiencies, applications
11.	**Batteries storage:** Introduction to Primary battery, reserve batteries and secondary batteries, Lead-acid batteries-working principle, components and characteristics, Li-ion batteries- working principle, components and characteristics
12.	**Hydrogen storage:** Introduction to water electrolysis, alkaline electrolyser, PEM electrolyser, current-voltage characteristics, materials for electrolyser, engineering configurations
13.	**Hybrid energy storage:** Introduction to hybrid energy storage, C-rating of a storage system, Life of energy storage, studying the demand-supply mismatch and selection of storage system
14.	**Flow batteries:** Working principle, Types of flow battery, components and configurations, current-voltage characteristics, efficiencies, lifetime
15.	**Life cycle analysis:** Depth of discharge and state of charge, cycle life of a battery as a function of depth of discharge, full effective cycle, shelf life, life cycle cost analysis, environmental impact and recycling,

B. Practical Learning

The duration of each experiment is for 3 hours.

Experiment No.	Contents
1	Study the characteristics of a lead-acid battery, note down the parameters on charging and discharging cycles
2	Study the characteristics of a flywheel Reference link: https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt= 3
3	Study the behaviour of different electrodes for electrochemical energy storage Study the thermal behaviour of different phase change material

Solar Energy Technologies and System Design

Course Objective:

This course will offer

- An introduction to various solar PV and solar thermal technologies
- Basic parameters of solar PV panels and systems
- Standard test conditions under which the parameters are measured
- Design of solar PV system for electrical energy requirements, sizing of PV modules, battery, electronics, etc.
- Design of solar thermal system for given thermal energy requirements

Course Content

A. Theoretical Learning

Each lecture is assumed to be of one hour. In content column, if possible breakdown the content of 1 hour in sub-topics

Lecture No.	Contents
1	**Materials for solar energy conversion:** discussion on what are different material categorization, use of semiconductors for converting sunlight into electricity and use of metals for converting sunlight into heat, basic properties of semiconductors and metal required for conversion, e.g. bandgap, absorption coefficient, solar spectrum and energy of photons
2	**Material parameters:** important material parameters of semiconductors, band gap, absorption coefficient, absorption length, mobility, carrier drift, diffusion coefficient, carrier diffusion, Light absorption and recombination in semiconductors,
3	**I-V characterizes of P-N junction diode :** forward and reverse biasing of P-N junction, forward biased current, reverse bias current, total current of P-N junction, I-V equation and curve
4	**Illuminated P-N Junction as solar cells:** discussion on why P-N junction diode requires power, but solar cell generates power, different quadrant of operations for P-N junction, dark and illuminated behaviour of P-N junction, demonstration through shift in I-V curve, discussion on photovoltaic effect.
5	**I-V characteristic of solar cells:** I-V characteristics of a P-N junction diode under dark (write expression), light illuminated current component, I-V characteristics of a P-N junction diode under illumination, fourth quadrant operation, explain solar cell parameters Voc, Isc, FF, Efficiency using I-V curve, write down expressions
6	**Standard Test Condition and PV module parameters:** discussion on why there is need of STC, Converting solar cells to modules for obtaining required

Lecture No.	Contents
	current, voltage and power, STC for solar energy technologies, PV modules parameters, effect of temperature and radiation on output parameters, reasons for variation in actual output of solar PV modules in real life conditions
7	**Solar PV technologies (part-I):** discussion on what students have seen in market or real life installations, various material and corresponding PV technologies, thin-film and crystalline Si technologies, commercially available technologies, best efficiencies of solar modules in labs and commercial market
8	**Solar PV technologies (part-II):** discussion on what students have seen in market or real life installations, various material and corresponding PV technologies, thin-film and crystalline Si technologies, commercially available technologies, best efficiencies of solar modules in labs and commercial market
9	**Typical parameters of c-Si solar cells:** Parameters of commercially produced solar cells and modules, typical values of voltage, current, FF and Efficiency, typical power ratings
10	**Solar thermal technologies:** various solar thermal technologies like solar hot water heater, solar cooker, discussion on need of concentration of light for higher temperatures, methods of sun light concentrations, solar concentration for power generation
11	**Design of solar hot water system:** discussion on what should be the solar thermal system components, use of thermosyphon effect, drawing of solar hot water system, estimate the energy required for heating water, estimation of collector area required for delivering required energy, considering typical losses in conversion, efficiency equation of solar thermal system
12	**Design of solar PV system (Part-I):** discussion on what should be the solar PV system components, block diagram of simple (no storage, no electronics) and complicated systems (grid tied with diesel and wind generators), estimating user's electrical energy requirements, sizing solar PV, battery and power conditioning units required in solar system, configuration of battery and panels, fixing input and output parameters of all system components
13	**Design of solar PV system (Part-II):** discussion on what should be the solar PV system components, block diagram of simple (no storage, no electronics) and complicated systems (grid tied with diesel and wind generators), estimating user's electrical energy requirements, sizing solar PV, battery and power conditioning units required in solar system, configuration of battery and panels, fixing input and output parameters of all system components
14	Costing of solar PV system : costing of solar components, per unit costing of panels, batteries, structure, wires, electronics, total system costing
15	Misconception of solar energy generation and Costing of solar system:

Lecture No.	Contents
	discussion on what possible misconception people have in mind, generation in rainy season, need of maintenance, high costing of solar PV system, clarifying with data why these are misconception as per current status of technologies, typical costing of solar PV system components on per Watt basis as per current norms, estimating overall system costing, costing of solar thermal systems

B. Practical Learning

Each experiments can be of 2.5 to 3 hours. In contents please provide as detailed titled of the experiments as possible, also break down experiments in sub experiments to give clear indication on what are the concepts/observations students are expected to learn in each experiments.

Experiment No.	Contents
Note	Conduct any of the five experiments listed below
1	Take a solar panel and look at it carefully, at looking at it comment and write down various aspects of panel, what materials you see are used, how many solar cells are connected, how they are connected, what is the material used in making solar cells (mono or multi-crystalline or any other), what would be per cell parameters, look at name plate rating, does the name plate rating matches with expected outcome based on solar cell configurations
2	Take a solar panel (any wattage, 10, 20, 50, 100, 250, 300 Watt, etc.) and measure its parameters in real conditions, Voc, Isc, FF, Efficiency, repeat the experiments several times. What are your observation on variation in these parameters when you repeat the experiment at 30 min, interval (take at least 5 readings).
3	Measure the effect of sun tracking on output generation by a solar PV module, measure when module is fixed and when it is following the Sun (adjust the orientation of the panel manually), measure power output at every 30 min interval (take at least 5 readings), estimate the energy generated in two conductions and figure out the difference in energy generated when fixed and when tracking the sun.
4	Measure the energy consumed by few loads in the laboratory like lights, fans on the day of your experiments, use power meter and mustimeter, perform the experiments for at least two hour duration
5	Estimate the energy consumed by all appliances used in a lab on monthly basis, design a solar PV system and size various system components for the same, cross-check if your designed system would generate the required energy

E. Social Learning

This activity would be most crucial and needs careful design. This includes activities outside the classroom and outside the laboratory. Students must do something to apply their knowledge. This can also be exercise to apply the knowledge learned in classroom and laboratory and gather more information/data from society on a topic.

Social experiment No.	**Contents**
Note	Conduct any of the three experiments / exercises
1	Visit any installation of solar PV system or solar thermal system in your institution or any nearby area. Take note of interconnection of various components of system, make a comment on how system is designed
2	Measure energy consumed by some loads in your home, use power meter and energy meter to carry out measurements, check if the measured energy consumption is as per your expectations.
3	Make an energy consumption estimation of all the electrical loads in your house, is your estimation matched with the electricity bill that you are paying?
4	Based on your monthly electricity requirement of your home, design a solar PV system to fulfil your monthly electricity needs, write a design report on the same.
5	Visit a nearby school, college or any other institution, estimate their load or use their electricity bill for energy requirement, and design a solar system for institution.

Solar Energy System Installations and Maintenance

Course Objective:

This course will offer

- Understanding the site survey, feasibility study, site access, clearance and identifying component mounting location.
- Estimating the Solar PV plant capacity based on site active area and electricity bill consumption.
- Making Project SLD and Performance report using simulation software.
- Project scheduling, making BOM, material procurement and logistics at site.
- Understanding of installation tools, safety equipment, and risks involved.
- Project execution strategy and understanding best installation practices.
- Understanding civil work and types of module mounting structures.
- Understanding Earthing and Lightening protection system.
- Hands-On installation, testing & commissioning of a 1 kWp Off-Grid and 1 kWp On-Grid Solar PV plant.
- Understanding net metering, gross metering procedures and other important authority policies and approvals.
- Identify common factors that result in deviations from expected system performance.
- Understanding typical maintenance requirements for PV systems.
- Identify the safety requirements for operating and maintaining different types of PV systems.

Course Content

A. Theoretical Learning

Each lecture is assumed to be of one hour. In content column, if possible breakdown the content of 1 hour in sub-topics

Lecture No.	Contents
1	**Site survey and assessment:** Introduction to Solar Radiation, how to measure the solar radiation at site, Optimum orientation of Solar PV modules, Impact of environmental parameters on module performance, Visit and evaluate the site for installation, Points to check when selecting the installation location
2	**PV Capacity Estimation:** Understanding the electricity consumption of the customer, case study of any user electricity bills and understanding various parameters essential for estimating the solar capacity, comparing the electricity consumption vs the area available at the site

Lecture No.	Contents
	and propose the best capacity that can, In this case as both the inputs are not available, the BATTERY as storage medium
3	**System SLD and Performance Ratio using Simulation Software:** Read and Interpret the Single Line Diagram, Layout Diagrams Solar Panels Sizing, String combination, Inverter selection, Inverter rating, AJB rating, ACDB rating, How to make the SLD, System designing in Simulation software for calculating the plant performance ratio.
4	**Understanding PV Components and their Datasheets:** Identify the different components of a Solar PV system and its basic operation; Identify and understand the working of different types of Solar PV systems, Understand and acquire know-how of different Types, sizes and specifications of , Modules, Solar Inverters, Charge Controllers, Cables, Conduits, Junction Boxes, Solar Batteries and allied accessories, Read and Interpret the manufacturing data specification sheets
5	**Importance of Civil work and type of Solar Structures:** Understand and acquire know-how of different Types, sizes and specifications of foundations/footings, Select the right footing/foundation as per site location including suitability of roof condition or suitability of soil, What is a module mounting structure (MMS), why a mounting structure, What are the typical components of a MMS, design criteria
6	**Understanding BoS:** The key balance of system components, selection criteria, installation process, Do's and Don'ts while installation. The balance of system equipment must be selected and installed correctly. If appropriate design procedures are not followed through, the system could have performance and reliability problems, premature faults and even failure.
7	**Plant and array Layout:** How to make a plant layout, Maintenance walkways, safety lifeline, access to solar panels, Shadow impact mitigation, Stringing – as per inverter specifications, temperature, Inter-row gap w.r.t. latitude of site, Landscape or portrait orientation
8	**AC and DC Cables and its sizing:** What is a conductor, Aluminum and Copper conductor difference, Power cable, Properties of cable insulation, Points to check before wiring, Types of wires, Different sizes of wires, Selection parameters of wires, Select the correct cable type, color, and gauge, Sizing of wires as per the plant design, Case study on cable sizing for different distances between Inverter and LT panel.
9	**Understanding Distribution Boards and LT Panels** Identifying the grid LT panels at the site, What is a DCDB/AJB, what are the protections used in a AJB, types of AJB, Connection between Solar panel and AJB, Voltage and current rating of AJB, IP ratings of AJB and ACDB, ACDB types and

Lecture No.	Contents
	protections, ACDB ratings and connection with LT panels
10	**Installation tools and Safety at Site** Introduction to measuring Instruments and types of tools, Marking Tools and hardware required for solar installation such as fasteners, nut bolts, lugs, etc, Plant Safety, inventory management and Assembly, Safe practices against harsh weather, Potential electrical hazards, Potential chemical hazards, Common steps to begin with a safe work practices, How a First aid kit for solar is different
11	**Project Execution Strategy**: The installer's responsibilities in SPV installation, System Design plan, Procurement plan, Site preparation plan, Material delivery plan, Installation plan, Civil work, Structure erection, Module mounting, Cable laying, Battery connection, Inverter mounting, meter connection and testing commissioning, Testing and commissioning plan, Operation and maintenance plan
12	**Net and Gross Metering concepts:** Comparison of Net metering and Gross metering, understanding the state policies for net metering, benefits and drawbacks of the net metering, procedure, charges and energy tariff. Eligibility criteria for net metering, various government approvals as per state energy regulation commission. Case study of an electricity bill before meter metering and after solar net meter.
13	**Grid Synchronization** Protection at the AC side, AC side connection topology, Grid Integration, Integration challenges, Anti Islanding process, What is a micro grid system, Synchronization with DG
14	**Typical operation and maintenance(O&M) of a PV Plant** What is O&M, approaches or types of O&M, parts of O&M, challenges to O&M, factors that affect the cost of O&M, Health and safety during O&M, Performance indicators in O&M, Warranty Management & its objectives, What should be the general steps in O&M activity?, How you will come to know that O&M is needed & how you will initiate? How you will find the fault & trouble shoot it?
15	**PV Plant protections** Lightning, Surge, faults, earthing and protection, Lightning and Earthing EN standards, IEEE standards, What does a lightening arrestor do, Type of lightening arrestor, Surge arrestors, Earthing procedure and types of earthing, determining the number of earthing in a Solar PV plant.

B. Practical Learning

Each experiments can be of 1.5 to 3 hours. In contents please provide as detailed titled of the experiments as possible, also break down experiments in sub experiments to give clear indication on what are the concepts/observations students are expected to learn in each experiments.

Experiment No.	Contents
Note	Hands On Installation in group of 4-5 students
1	Site assessment, Finalizing the shadow free area facing to the south direction, Foundation Marking using line, dori and measuring tape, Casting Civil Blocks (or using ready-made) with the mentioned grade and steel enforcement and Anchoring the fasteners for MMS
2	Module Mounting Structure installation for a 1 kWp Solar Plant, Safety at heights and work health
3	Solar Panel Installation for a 1 kWp Solar Plant, Testing of solar array, Earthing and wiring test
4	Making string connection as per the plant layout and cable laying to the DCDB/Inverter through conduits, Dismantling cable and crimping termination
5	Battery connection for Off grid system, Inverter and ACDB erection on the wall, terminating the AC Cables from Inverter to ACDB and ACDB to LT Panel, Testing of batteries and charge controller

C. Social Learning

This activity would be most crucial and needs careful design. This includes activities outside the classroom and outside the laboratory. Students must do something to apply their knowledge. This can also be exercise to apply the knowledge learned in classroom and laboratory and gather more information/data from society on a topic

Social experiment No.	**Contents**
Note	These experiments are to be done as team work, entire batch can make one or two teams Teams may choose the installation of any other renewable energy technology based system like hot water system, biogas plant, wind turbine, etc.
1	Make a project plan to install solar system in a school / college / NGO, estimate the cost and raise funds. Plan may include installation of solar power system, street light, water pump or any other requirement
2	Conduct the site survey and estimate the solar PV capacity using his electricity bills, Finalize the design and SLD, make the BOM list
3	Material procurement and transportation, Installation of the solar, commissioning of solar power plant

Development Economics and Policy

Course Description:

This course introduces students to the basics of development economics, with discussions of the concepts of development and growth, poverty, inequality, as well as various issues related to development. The course discusses various growth models and evaluate these models using growth experiences in different nations. It explores connections between growth and inequality and discusses the role of globalization and trade in today's dynamic world with increased international dependence.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Demonstrate the understanding of the difference between growth and development and the important models and theories in economic development and their policy implications
2. Understand the measurement of inequality, Poverty and Population issues
3. Acquire a basic understanding of globalization and sustainable development taking into account both global and local perspectives.
4. Demonstrate an ability to identify, formulate and solve problems related to socio-economic development at national and international level using economic data appropriately
5. Demonstrate an ability to link economic growth and development theories with development policies.

Unit 1:

Introduction to Economic Growth and Development - The concepts of economic growth and development- meaning and distinctions; Basic indicators of development and their measures- real income, health and education; Gross National Income, Gross Domestic Product, Purchasing power parity, Human Development Index, Characteristics of the developing world.

Unit II:

Theories of Economic Growth and Development - Rostow's Stages of growth, The Harrod-Domar growth model, The Lewis theory of economic development, The Dualistic development thesis; the Solow Neoclassical growth model; Starting economic development-The Big Push.

Unit III:

Poverty, Inequality and Development - Measuring Inequality-Size distribution of income-Lorenz curves, Gini Coefficients; Factor share distribution of income; Measuring Absolute Poverty; Kuznets's Inverted-U Hypothesis

Unit IV:

Demography and Development - Population Growth and Quality of life; Demographic Transition; the Malthusian Population theory; Urbanization and Migration; Human Capital-Role of education and health in economic development.

Unit V:

Environment and Sustainable Development - Environment and development, Sustainable development, A brief history of environmental change; Global warming and climate change- scope, mitigation and adaptation; Common-pool resources; environmental externalities and policy options

Unit VII:

Development Policies - The key challenges of economic growth and structural change, the role of institutional development in supporting long-term growth- importance of inclusivity, poverty reduction, human development, and equality; issues of social and economic insecurity and the policy challenges involved in implementing sustainable development strategies; development policies for inclusive growth and sustainable development; designing coherent and integrated macroeconomic, social, and environmental policies; strengthening governance for sustainability.

Sustainable Business Management: ESG

Course Description:

This course provides a deep and applied understanding of Sustainable Business Management principles and their increasing significance in shaping responsible and resilient business strategies. As investors, regulators, consumers, and employees increasingly demand sustainable and ethical conduct, ESG knowledge has become critical for modern business leadership. Students will explore the origins, frameworks, and impact of Sustainability, engage with global reporting standards such as GRI, SASB, TCFD, and SEBI's BRSR, and learn how sustainability integrates into corporate strategy, risk management, operations, and human resources. Through interactive case studies, simulations, materiality assessments, and sustainability reporting exercises, learners will develop the skills to identify and lead Sustainability initiatives across sectors. By the end of the course, students will be equipped to navigate the complex intersection of profitability and sustainability, align business objectives with the UN Sustainable Development Goals, and prepare for careers in consulting, sustainable finance, corporate governance, and impact strategy.

Course Objectives:

The course aims to:

1. Understand the key concepts and frameworks in sustainable and responsible business management.
2. Analyze business decisions using sustainability perspectives.
3. Apply the PRME (Principles for Responsible Management Education) to real-world business challenges.
4. Design responsible business strategies aligned with SDGs and stakeholder needs.
5. Evaluate and interpret sustainability disclosures/reports.

Expected Learning Outcomes:

Upon completion of the course, students are expected to:

- **CLO1:** Demonstrate understanding of sustainability principles, including TBL and SDGs.
- **CLO2:** Evaluate sustainability integration in corporate strategies.
- **CLO3:** Apply ethical reasoning and stakeholder perspectives to management decisions.
- **CLO4:** Develop responsible business models and sustainability action plans.
- **CLO5:** Communicate sustainability performance using global and Indian reporting standards (GRI, BRSR, TCFD)

Sustainable Organizations (HRM)

Course Description:

A sustainability-oriented vision of human resource management (HRM) has become the dominant approach for HRM practitioners and is critical to achieving sustainable business strategies in a globalized world. In sustainable HRM, the success of an organization extends beyond the single financial performance bottom line, considering simultaneously social, human, and ecological outcomes. At present, developing the knowledge and capabilities to design and embed sustainable business practices is considered an essential skill for human resource managers. For students to be capable of doing this, they will need knowledge and understanding of the sustainability-oriented aspects of HRM functions and practices. With this course, we intend to provide knowledge and understanding of HRM in the context of sustainability and to develop the understanding and skills among students that are necessary to identify sustainable HRM practices that meet stakeholders' needs and contribute value to businesses and societies.

Course Objectives:

At the end of the course, the students are expected to:

1. Develop an understanding of the role of Human Resource Management in achieving sustainability.
2. Acquire knowledge of different theoretical models of sustainable HRM.
3. Discuss intricacies of green HRM and its various components
4. Develop skills to identify and analyze the ethical approaches of organizations toward implementing sustainable HRM practices.

Expected Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Analyze and differentiate the frameworks and theories for sustainable HRM to facilitate organizations in achieving sustainability.
2. Demonstrate conceptual clarity of components of Green HRM and their impact on organizational effectiveness.
3. Identify and analyze ethical approaches of organizations to implement sustainable HRM practices.

Syllabus:

The proposed course is divided into nine modules.

Module I:

Evolution of Sustainable HRM - Concept of sustainability and corporate social responsibility; Strategic HRM; Evolution of Sustainable HRM; Difference between Strategic HRM and Sustainable HRM

Module II:

Introduction to Sustainable HRM - Definitions of Sustainable HRM; Depleting Human Resources at the workplace; Need for Sustainable HRM; Challenges in creating sustainable organizations

Module III:

Theoretical Perspectives of Sustainable HRM -Stakeholder Theory; Institutional Theory; Respect Openness Continuity (ROC) Model; Natural Resource-based view (NRBV); Paradox Theory; Duality theory; Dilemma Theory; Developing a Paradox Framework for Sustainable HRM

Module IV:

Developing Context for Sustainable HRM -Sustainable Work system; Creating a Sustainable Work Culture; Ethical Climate of firms (Ego, Benevolence, and Principled)

Module V:

Implementing Sustainable HRM -Framework of Sustainable Mindset**;** Strategic positioning in relation to sustainable HRM**;** Sustainable HRM strategies**;** HR skills needed for successful implementation

Module VI:

Concept of Green HRM -An overview of Green HRM; Green Employability; Green Training; Green job involvement; Challenges in creating a Green organization; Role of Artificial Intelligence in adopting Green HRM practices

Module VII:

Sustainable Leadership - Characteristics of sustainable leaders; Cambridge sustainability leadership model

Module VIII:

Measuring Sustainable HRM -Measures focusing on the social dimension (including employees); Measures focusing on the environmental dimension; Measures focusing on the business dimension

Module IX:

Sustainable HRM in different contexts - Sustainable HRM in US; Sustainable HRM in Asia; Sustainable HRM in Europe

Personal and Family Health and Wellness

Course Justification:

Life in the contemporary world not only offers opportunities, comforts, and affluence but also risks, illness, and poverty. Given the diverse life experiences of our population across demographic, social, and economic dimensions, educational institutions must teach students about two of the most important pragmatic objectives of every individual and family: developing and maintaining robust health, and maximizing wealth in one's lifetime.

This course focuses on personal and family health and wellness, particularly with an emphasis on good, constructive, and proven practices of body postures, breathing, movement, and exercises, for promoting health and preventing illness. Given

a) the known variations in an individual's decision-making capabilities across lifecycle stages, and

b) the continuation of the family as our society's basic building block, the maintenance of robust health and wellness of all in our families presents a clear and present challenge that can only be met effectively if individuals and families are sufficiently informed and motivated. This course broadens our perspectives and uses comprehensive mental models to recognize that all our students and their families are part of our educational ecosystem. This change in our perspectives and understanding of our immediate stakeholders (value-receivers) motivates us to share our knowledge on health and wellness purposefully, constructively, and in an integrated manner. This course demonstrates how education helps to manage health and wellness across society, especially considering families as the unit of interest and study.

This course offers imaginative and inclusive programmes to help build our socio-economic fabric.

Being classified as a "value-added course" following our UGC's guidelines, IFHE plans to follow up on this course with a natural corollary involving personal and family wealth management in the next semester.

Course Vision: To be studied, understood and used as a globally unique and pioneering course aimed at a yet-to-be-leveraged learner group, namely, the family as a systemic unit, including the individual student, who would serve as the anchor for the family in the full context and scope of the lessons offered in the course. The course will also be meaningful to orphan-students without an immediate family.

Course Guiding Principle and Value System: For aeons, the family – joint, extended, or nuclear – has been and continues to be the unit of Indian society. Individuals, via their filial relationships, or sometimes even through their socially developed relationships, serve as the building blocks of their genetic and/or social families, which represent the basic element of our nation's socio-cultural fabric. The core value system of this course is to sustain this status and role of families in Indian society far into the future. This course explicitly **promotes** family-based social structures while recognizing and upholding the core guiding principle for **all** humans, "Peace with Dignity".

Overall Course Frame: The contents of the course are structured as elements in a matrix having Human Lifecycle Stages of an individual human represented in the columns, the applicable **modal** (or, most common) as well as exceptional or occasional health-related issues spread across the rows and presented with reference to (a) the key family actors, including the individual human of concern, (b) their necessities, and (c) objectives with respect to the column entities. With this as the reference, the class will identify and discuss hard and soft resource requirements, and activities to be performed by each capable member of a family for the sake of the others' health and welfare. The respective labels or instances or examples are represented within the cells. This overall matrix framework presents an accessible, intuitive and easy-to understand map of the entire knowledge content of the course in a well-structured, simple form.

Course Learning Focus: The course and all the lessons are focused on building students' familiarity and overall understanding of (a) human lifecycle stages, (b) biorhythms in the human body that are beyond deliberate control, (c) concept of robust health and wellness, (d) modal or common issues/concerns of family actors with reference to each other's lifecycle stages, (e) exceptional or occasional issues/concerns

Course Description:

The course has been designed to impart education and knowledge about the significance of correct body postures, breathing, movement, and exercises for fostering healthy natural life. This course uses the lens of an individual's lifecycle or life course commencing from conception till old age. Accordingly, students will be familiarized with skills, in self-realization and setting goals in life. It will also help the students to be focused towards their goal and make them physically, mentally and spiritually strong to face different challenges in life. Pursuing this course will develop leadership qualities in the students along with their personality development. Yoga is the science of achieving absolute union with the divine.

Course Objectives:

To impart knowledge about the benefits of yoga in one's life

To impart the skills required to practice yoga on a regular basis

To introduce students to yoga, and help them achieve a reasonable level of proficiency in performing yoga

Expected Learning Outcomes:

After completing this course, the students will be able to:

- Appreciate the importance of health and wellness
- Practice postures on a regular basis and thus achieve better physical and mental health
- Exhibit high energy levels and attention

Syllabus:

Module I:

Human Life Cycle Stages - Introduction; Prenatal development; Infancy; Babyhood; Early Childhood; Late Childhood; Adolescence; Adulthood; Middle Age; Old Age; Theories of Life Span Development; Maintaining a healthy life balance across the life span.

Module II:

The Home and the External Environment - The family at home and members' interdependencies; synchronization and coordination of work for harmony; Hygiene, Cleanliness, and Sanitation; Waste Management; The zero-waste family; socio-economic and environmental factors influencing health; the zero-waste community; water management; community wellness.

Module III:

Health and Wellness - Introduction to Health and Wellness; Heredity and Environment; Genetic Dispositions and Evolution of the concept of wellness; Circadian rhythms and their implications for wellness; Benefits of health and wellness; Physical Conditions and Dimensions of wellness; Wellness economy.

Module IV:

Managing Health and Wellness - Health – Physical and Mental; Modal concerns across human life course stages; Anticipatory and preventive practices - Diet and Nutrition for wellness, physical activities and rest + sleep, injury prevention practices, immunization, periodic health check-ups; Health risk behaviours – smoking, addiction (alcohol, drugs and technology), time-abuse, Accepting and demonstrating personal responsibility for health and safety.

Module V:

Course Review - Review via Open interactions; Fine Tuning of Practices

Understanding India

Course Description:

The younger generations in India are often not clear about the nation that is India and what it stands for; and about their role as Indian citizens. They also have very little awareness about the past, as compared to the previous generations. With the gradual dismantling of the joint family system and with both parents often being busy with their own careers, the traditional transfer of knowledge, understanding and values from parents and grandparents is no longer happening as it used to before. In a way, the youngsters of today are rudderless and confused, as they are barraged with muddled information and views from diverse and at times prejudiced sources available aplenty in public domain. The aim of this course is to enable the Indian youth to understand contemporary India together with its historical background and context, so that they emerge as confident citizens of India.

Learning Objectives:

- Develop a clear understanding of India's history and contemporary context and appreciate the foundations and aspirations of modern India.
- Gain the ability to critically evaluate information and views from diverse sources.
- Emerge as a confident and informed citizen of India.
- Understand and appreciate India’s rich heritage from the perspective of education system, land and its people, art and architecture, Spiritual, Linguistic & Scientific Heritage and foundations of modern India
- Know the impact of changes in family structures and societal dynamics on the transmission of knowledge and values to the younger generation.

Expected Learning Outcomes:

The syllabus provides a detailed description of what may be covered in this course. However, it should be borne in mind that this is only an introductory course. Though a large number of topics and sub-topics are mentioned, they are only meant to be touched upon in a simple, summarized and interesting form so that the students get the big picture. Also, the sub-topics listed are indicative. One could touch upon more or less number of sub-topics, and include those mentioned below or some other relevant ones.

Upon successful completion of this course, the student will be able to:

- Appreciate the progression of historical and cultural development of India, and the concept of India as a nation together with all its diversity.
- Understand the Indian nation as it stands today, what it stands for both internally and externally, and nurture one’s personal development as a clear and confident citizen of India.

Syllabus:

Unit I:

India -The Land and its People - Who are we Indians? Where did we come from? – An anthropological, migrations and genetics-based perspective on modern Indians. India's geographical and national identity – evolution from Meluha, to Bharathavarsha, Sindhu/Hindu and Hindustan to the India of today. The legacy of early civilizations and cultures and how we are influenced by them – Mehrangarh & Indus Saraswathi Civilization, Vedic & Post-Vedic Civilization, the Tamil Sangam Civilizations, etc. Kingdoms and empires that ruled over large realms – Maurya, Gupta, Chola, Shatavahana, Chalukya, Vijayanagara, Mughal, Maratha and British empires – their role in integrating the nation as one economic, political and cultural entity

Unit II:

Spiritual, Linguistic & Scientific Heritage - The kaleidoscope of India's spiritual heritage and its impact on modern India – encompassing religions, philosophies, mythology & folklore, reform movements and festivals. Modern Indian languages, their origins and evolution from earlier languages. The four major language families in India. Scientific Advancements in early India – astronomy, mathematics, medicine & metallurgy in particular

Unit III:

Developments in Art & Architecture - Architecture & Sculpture – Urban planning in the Indus Valley & Keezhadi; Ashokan stupas & edicts; rock-cut & cave temples; Chalukya, Pallava, Chola, Hoysala & other architectures; Mughal, Indo-Saracenic & European architectures; modern & contemporary architecture. Stone & metal sculptures**.** An overview of painting, music & dance forms – Ajanta, Mughal, Rajasthani, Madhubani, Tanjore, Ravi Varma and other styles of painting; classical & folk music and dance forms from different parts of India

Unit IV:

Indian Knowledge Systems – Past & Present -Traditional knowledge systems – Gurukuls, Pathashalas, Madrasas, etc. Beginning of Modern Education – The British Government's approach & dismantling of the traditional knowledge systems. Development of basic, higher & technical education in post-independent India, NEP 2020.

Unit V:

The Foundations of Modern India -The independence movement & its vision for India. The Indian Constitution – Fundamental rights & duties of Indian citizens. The Indian States & their Origins – including States Reorganization. Transformation of the Indian Economy – from licence raj to liberalization & beyond; from agriculture-driven to a services-driven economy. Panchayati Raj – Decentralizing governance and giving more power to the people. India's Foreign Policy – Evolution from non-alignment and Panchsheel to a strong & confident player among the polity of nations. Modern India's Aspirations across Demographics and Society.

Public Policy

Course Description:

The Introduction to Public Policy is a single credit course, which is designed to introduce the basic paradigms of Public Policy to management students in India. The course exposes business school students to perspectives on how self-interested economic agents, both inside and outside government, drive public policy making, how they utilize specific ideas to influence the policy process and how institutions play a role in policy formulation and execution. While there are text books and references provided, for students preparing for the course, it is crucial that they widen their knowledge of current issues in public policy and current affairs and relate the concepts to what they observe.

Course Objectives:

The Introduction to Public Policy course is 1 credit course. The objectives of this course are:

- To discuss how self-interested economic agents, both inside and outside the government drive public policy and how they influence policy process
- Todiscusshowinstitutionsplayaroleinpolicyformulationandexecution.
- To introduce the basic paradigms of PublicPolicy to management students in India.
- Widen the knowledgeof current issuesin public policy and current affairsand relatethe conceptstowhat they observe.

Expected Learning Outcomes:

At the end of the course,the student will be able to:

- Understand thefeaturesof differentactors,processes and stages involved in publicpolicy formulation and execution in India.
- Understand thefunctioning of different institutions involved in public policy making

Site Planning, Landscape Design and Climate Change

Course Overview:

This course introduces students to the fundamental concepts of site planning and landscape design, and their importance in creating responsive and meaningful built environments. Students learn how to observe, analyze, and work with natural site features to inform design decisions. The course also creates awareness about climate change and how site planning and landscape design can contribute to resilience and environmental responsibility.

Course Objective:

This course aims to help students:

- Understand the **purpose and process of site analysis** and how it informs architectural design decisions.
- Gain basic knowledge of **landscape architecture** and its contribution to shaping human experiences and ecological balance.
- Identify and apply key **elements and principles of landscape design** to enhance outdoor spaces.
- Learn how to **organize built and open spaces** using essential site planning concepts such as orientation, zoning, access, drainage, and circulation.
- Recognize the **impact of climate change** on built environments and explore simple, responsive design strategies at the site level.

Course Content:

Unit I:

Introduction to Site Planning - Introduction to Site Planning -What is Site planning; Introduction to site survey and appraisal, site analysis; Preparing a site inventory checklist; Identifying and documenting key components of site analysis; Understanding the purpose of site planning in architectural design; Introduction to building orientation and layout based on site features; Basics of integrating built form with natural site conditions.

Unit II:

Introduction to Landscape Design - Introduction to landscape - Definition and meaning of landscape architecture; Understanding how landscape connects people with nature; Role of landscape architecture in shaping built and natural environments. Elements of Landscape Design; An understanding of ancient traditional garden design in various regions like Persian, Spanish, Italian, French, Moghul, English, Japanese Garden styles.

Unit III:

Elements of Landscape Design - Key Elements of Landscape Design - landforms, water, plants, built elements, application of materials, street furniture in a designed landscape; Landscape components that shape the design of outdoor spaces; Understanding the functional and aesthetic roles of each element; Basics of selecting appropriate landscape materials and features for different site contexts.

Unit IV:

Principles of Site Planning and Landscape Design - Principles and methods of Site Planning - Zoning and Spatial Organization, Orientation, Access and Circulation, Grading and Drainage, Integration with Natural Features; Principles of Landscape Design; Sustainable Landscape design approaches- green roofs & walls, rain water harvesting etc.

Unit V:

Climate Change and Site Planning - Definition of Climate change; Simple Causes of climate change; Role of the construction industry in GHG emissions, materials etc. ; Effects of Climate Change on the Built Environment; Designing for Climate Challenges —like floods, heat, and drought (Case studies) ; Basic Climate-Responsive Site Planning - site and landscape designs that are adaptive, resilient, and reduce environmental impact.

Course Outcome:

- CO1: To understand the process of site survey, analysis, and site planning based on natural features.
- CO2: To Describe the role of landscape architecture in connecting people, nature, and culture.
- CO3: To Identify and apply basic elements and principles in landscape design for functional spaces.
- CO4: Apply principles of site and landscape design.
- CO5: Recognize the relationship between climate change and built form, and suggest basic design strategies for climate-responsive planning.

Climatology, Building Sciences & Performance

Course Overview:

This course develops a knowledge base for architectural design to provide thermal, visual comfort, and indoor environmental quality for well well-being of occupants. It includes an introduction to various concepts in environmental physics that help in aiding the comprehension of how a building interacts with its environment. Various metrics and standards of thermal, lighting, and other performance aspects of building are covered, along with parameters influencing these aspects of the built environment.

Course Objective:

- Understand the principles of climatology and environmental physics as they relate to building design and occupant comfort.
- Analyze and apply key performance metrics and standards to evaluate thermal, visual, and environmental quality in buildings.
- Understand and assess various passive design strategies that enhance energy efficiency and indoor environmental performance, considering their suitability for specific climatic conditions.

Course Content

Unit I:

Introduction to climatological studies - terms of climate and weather, macro and micro climate; Big Picture - Relation between Sun and Earth, Sun Path Diagram (azimuth and altitude angles), Solar Constant, Prevailing Wind Conditions, Climate Classifications (Koppens climate classification, Climate zones as per Indian codes and Regional variations); Impact of Earth Sun relation and Prevailing winds on climate of a place;

Unit II:

Introduction to thermal comfort - Factors of thermal comfort, Elements of climate influencing thermal comfort, body heat exchange, thermal balance, psychrometric chart, Thermal Comfort Models - Predictive Mean Vote (PMV), Percentage People Dissatisfied (PPD), Standard Effective Temperature (SET), Adaptive Thermal Comfort, Tropical Summer Index (TSI), Universal Thermal Climate Index (UTCI), Subjective Temperature Index (STI), Wet Bulb Globe Temperature (WBGT) and Heat Stress Index (HSI). Effect of increased Wind Speed on thermal comfort (IS code / NBC and ASHRAE models).

Lab - measurement of various parameters of thermal comfort models in a building. Plotting these parameters in thermal comfort models to assess thermal comfort. Tools like CBE Thermal Comfort Tool, Psychrometric Chart, etc to be used for mapping.

Unit III:

Introduction to heat transfer in a building - Thermal conductivity, emissivity, radiation, Reflectivity and Convection, thermodynamic equilibrium of a zone; Thermal properties of materials like density, thermal conductivity, and specific heat; Thermal properties of transparent/translucent materials - Solar Heat Gain Coefficient (SHGC), Shading Coefficient, U value; Thermal properties of material system assemblies like thermal transmittance, thermal resistance, latent heat, thermal bridging, diffusivity, Time-Lag; Heat loss/gain through common building elements and its impact on occupants thermal comfort.

Lab - Understanding and demonstration of heat transfer concepts in buildings as a function of time through software like Energy 2D. Calculation of Window Shade sizes as per solar geometry.

Unit IV:

Introduction to Light in building sciences - Radiation spectrum, Solar radiation / Insolation, spectral sensitivity of eye, cone of vision, visual comfort and glare; Metrics related to lighting measurement - Luminous Flux, Luminous Intensity, Illuminance, Luminance and others; Introduction to Daylighting in a Building and metrics related to it (Illuminance at a point of time, Daylight Factor, Daylight Autonomy, mean DA, cDA and sDA), quality and spread of light in building.

Lab - Measurement of Lighting levels in various spaces and assessing if the lighting levels meet set standards

Unit V:

Climate Responsive Design Strategies (with emphasis on passive strategies) - Analysis of climatic parameters towards potential design strategies with tools like Mahoney's Table, BioClimatic Charts, Strategies to alter climatic conditions mapped on Psychrometric Charts, Strategies specified by Climate Consultant, etc. Study of Various Passive Design Strategies (like wind tower, green roof, cool roof, trombe wall, etc) with case studies.

Lab - Software like Climate Consultant to import weather data and suggest strategies based on the specific weather data.

Course Outcome:

- CO1 - Students will be able to interpret climatic data and apply principles of environmental physics to analyze building–climate interactions.
- CO2 - They will be able to evaluate thermal and visual comfort using performance metrics and standards.
- CO3 - They will propose appropriate climate-responsive design strategies to improve energy efficiency and indoor environmental quality in buildings.

Green Building Architecture and Environmental Performance Analysis

Course Overview:

This course introduces students to the concepts and practices of Green Building Architecture along with various national and international rating systems. It covers mandatory codes, sustainability goals, and comparative frameworks for green certifications such as GRIHA, IGBC, and LEED. Students will gain insights into the certification process, professional affiliations, and documentation methods. The course also emphasizes computational analysis of building performance, enabling students to assess and enhance thermal comfort, energy use, and daylighting in line with green building standards.

Course Objective:

This course introduces students to the Green building concepts, various rating systems available in India and across the globe. This course also exposes the students to the process of green building certification and professional associations with rating agencies. This course also develops skills to analyze quantitative environmental performance of built forms through computational simulations which becomes the basis for green building certifications.

Course Content:

Unit I:

Introduction to Green Building Architecture - Concepts of Green Architecture and parallel concepts, UN Sustainable Development Goals, Mandatory Codes in India regarding Green Concepts (EIA, PCB norms, BEE-ECBC, NBC, Byelaws,), Indian Perspective towards rating systems, Various rating systems across the globe (LEED, CASBEE, BREEAM, Green Star, Passivhaus, etc.), Green rating systems prevalent in India (Griha, IGBC, LEED, etc.,).

Unit II:

Green Rating Systems - Scale of Projects and changing concerns, Rating systems for various types of development and scope of work, comparison of assessment criteria. Details of any two rating systems (building scale) (choice of the faculty) may be discussed in a comparative approach along with mandatory codes. Examples of the documentation for accreditation and design feedback in Projects.

Unit III:

Process of professional association & project certification - Professional associations with rating agencies in India (Griha, IGBC, LEED) – Accredited Professional, memberships, evaluators, etc., Methods of project registration and certification, Framework/Templates of project certifications.

Unit IV:

Environmental Performance Analysis - with knowledge gained from courses like climatology, climate change, building science performance measurements, this section covers methods to assess thermal comfort, energy performance, daylight assessment in built forms, through computational simulations used in industry. These results need to be analyzed with performance goals set by codes and industry standards. This extends into development of base case and improved case by altering materials and passive design strategies.

Note: Assignment may include study and documentation of a project in the format required for certification. Students may be encouraged to go for Green Accredited Professional Certification through the course.

Course Outcome

- **CO1** - Understand and compare various green building rating systems, sustainability frameworks, and mandatory codes applicable in India and globally.
- **CO2** - Demonstrate knowledge of the green building certification process, including documentation and professional engagement with rating agencies.
- **CO3** - Analyze environmental performance of buildings using simulation tools to evaluate and optimize thermal comfort, energy efficiency, and daylight performance.

Climate Vulnerability Assessment, Disaster Mitigation & Management

Course Overview:

This course provides a comprehensive understanding of climate-induced and other natural or anthropogenic disasters. It focuses on risk and vulnerability assessment, institutional frameworks, disaster response strategies, and resilient design principles. Through global and local case studies—especially from vulnerable or extreme regions—students will explore how communities have coped with disaster events and climate stressors. The course empowers students to integrate climate risk and disaster resilience into architectural and planning decisions.

Course Objectives:

- To introduce the interdisciplinary dimensions of climate vulnerability, risk assessment, and disaster response.
- To familiarize students with climate change impacts and adaptive responses of vulnerable communities.
- To build capacity in multi-hazard assessment and spatial risk analysis.
- To expose students to skill-based techniques for incorporating disaster and climate resilience in site planning and design.
- To engage students in real-world case studies and field-based learning to internalize context-specific approaches to disaster mitigation.

Course Content:

Unit I:

Introduction to Disasters and Climate Risk - Definitions: Disaster, Hazard, Climate Vulnerability, Risk, Mitigation, Resilience; Typologies of disasters: Natural, Man-made, Biological, Climate-induced; Historical and contemporary disasters in India and globally; Climate change scenarios and the relationship between climate variability and hazards.

Unit II:

Multi-Hazard Risk & Vulnerability Assessment - Risk and vulnerability concepts in architecture and planning; Climate risk mapping techniques (GIS, participatory tools); Indicators of vulnerability: physical, environmental, social, economic; Methods of hazard profiling and spatial risk analysis; Skill-based exercises: reading maps, overlaying hazard data, site-based vulnerability scoring.

Unit III:

Disaster Management Frameworks and Response Strategies - Stages of disaster management: a) Pre-disaster: Risk Reduction & Preparedness, b) During-disaster: Emergency Response & Coordination, c) Post-disaster: Recovery, Rehabilitation & Reconstruction; Climate-resilient recovery and strategies to rebuild in a better way; Case studies: Cyclone-prone coastal towns, heat-affected urban areas, flood-impacted riverine communities.

Unit IV:

Institutional Mechanisms, Policies & Governance - National and International frameworks: NDMA, SDGs, SFDRR, UNFCCC; Indian Acts and Policies: Disaster Management Act (2005), Environment Protection Act, Coastal Regulation Zone Norms, National Climate Mission; Role of local bodies and community-based disaster risk management; Legal and policy implications for architecture and planning: zoning, bylaws, building codes.

Unit V:

Designing for Resilience – Built Environment Strategies - Elements of climate-resilient and disaster-resistant design; Traditional knowledge systems and resilient vernacular architecture; Low-cost, sustainable, and adaptive building strategies; Capacity building for resilient communities; Student projects: site assessments, design responses incorporating risk analysis; Case studies of communities on the margins: deltaic regions, mountainous settlements, urban slums, drought-affected villages.

Course Outcomes:

- CO1 - Interpret climate vulnerability and disaster risk through spatial and social lenses
- CO2 - Conduct a basic multi-hazard vulnerability assessment for a given site
- CO3 - Formulate design strategies that mitigate risk and enhance resilience
- CO4 - Analyze how different communities adapt to climate change and disaster pressures
- CO5 - Integrate disaster mitigation strategies into architectural proposals and urban planning

Advanced Building Performance Assessment Methods

Course Overview:

This course introduces advanced concepts and practical methods for evaluating building performance, primarily focusing on energy efficiency and indoor lighting quality. It will develop advanced skills in simulation software for predicting thermal performance and energy consumption with HVAC; lighting design with artificial lighting systems and glare analysis. These skills will help in designing systems that complement natural lighting and ventilation to achieve desired conditions as per standards.

Course Objective:

- To introduce advanced concepts for evaluating building performance.
- To assess annual building energy consumption and identify interventions to improve energy efficiency.
- To assess daylight and required artificial light in the building towards visual comfort.
- Understand trade-offs in building design towards overall efficiency and balanced design.

Course Content:

Unit I:

Introduction to Building Performance and Assessment - Definitions and scope of building performance, Performance criteria: energy, thermal, visual, acoustic, IAQ, and user satisfaction, Overview of building codes, standards, and rating systems (ECBC, NBC, LEED, GRIHA)

Unit II:

Mandatory and Voluntary building performance compliance in India - Various organizations (like BIS, BEE, etc.,) that set minimum standards in building performance; understanding goals of minimum criteria set by various agencies; scope of some of the mandatory compliance codes like NBC, SP41, ECBC etc,; local building bye-laws. Various voluntary compliance systems available in India, their goals; impact of these voluntary compliances on the built environment; emphasis on more prevalent sustainability rating systems and their comparison.

Unit III:

Advanced Energy and Thermal Performance Assessment - Along with the thermal performance of buildings, concepts of various HVAC systems available need to be introduced. Various models of HVAC use cases in buildings (naturally ventilated, completely conditioned and mixed use scenarios), adaptable thermal comfort in each of the scenarios and methods to incorporate these scenarios in energy modelling are included. Advanced software skills to access energy performance.

Unit IV:

Daylighting and Visual Comfort Analysis - This covers assessing daylight in built forms, methods to assess impact of artificial light in built forms towards visual comfort. Parameters in Radiance software, different types of sky models are also included.

Advanced software skills to access the lighting performance.

Course Outcome

- CO1 - Evaluate building energy and thermal performance using advanced simulation tools and assess compliance with mandatory and voluntary standards.
- CO2 - Analyze the impact of HVAC systems and design strategies on overall energy efficiency in naturally ventilated, conditioned, and hybrid buildings.
- CO3 - Assess daylight availability and artificial lighting performance to optimize visual comfort and reduce glare using advanced lighting simulation methods.

Introduction to Entrepreneurship and Startup Ecosystem

Course Description

This course provides students with a foundational understanding of entrepreneurship and the startup ecosystem. It introduces the concept, importance, and process of entrepreneurship, along with the mindset and characteristics required to become a successful entrepreneur. The course explores the evolution and types of entrepreneurs, idea generation techniques, business models, and startup planning.

Students will gain insights into the components of the startup ecosystem. The course also addresses common myths, challenges, and pitfalls faced by entrepreneurs and highlights the impact of entrepreneurship on economic and social development. Through case studies and practical examples, learners will develop a basic entrepreneurial outlook and critical thinking skills necessary for venture creation and innovation.

Course Objectives

- At the end of the course, students are expected to:
- To introduce the concept and significance of entrepreneurship
- To identify key traits and skills of successful entrepreneurs
- To provide an overview of the startup ecosystem
- To understand the process of business idea generation and opportunity assessment
- To explain the fundamentals of business models and startup planning
- To foster innovative thinking and entrepreneurial mindset

Course Learning Outcomes

Upon successful completion of the course, the student will be able to:

- CLO 1 - Demonstrate an understanding of entrepreneurship, its types, and its importance in the economy.
- CLO 2 - Recognize entrepreneurial traits, mindset, and motivations through real-world examples.
- Explore the components, stakeholders, and enablers of the startup ecosystem.
- CLO 3 - Apply ideation tools and techniques to develop and assess business opportunities.
- CLO 4 - Design a business model using frameworks like the Business Model Canvas and draft an initial startup plan.
- CLO 5 - Prepare and deliver a clear, persuasive startup pitch.
- CLO 6 - Use creativity and analytical skills to address real-world startup challenges or problems and make decisions in entrepreneurial settings.

Sustainable Finance

Course Description:

Sustainability is the need of the hour. The corporate world needs appropriate techniques for investing keeping in view the environmental, societal, and governance factors. The Course will go through the relevant concepts of green finance, sustainable finance, and the challenges involved in its transition. Investing in these mechanisms for sustainability will be discussed. The main idea is to understand how investing and financing decisions impact the sustainability of the projects. Several case studies will provide practical insights into sustainable finance investment across equity and bonds and other aspects of Sustainable Finance.

Course Objectives:

At the end of the course, students are expected to:

- Understand the concepts of Sustainable Finance.
- Apply the principles of SDG in Finance and Reporting.
- Analyze the challenges in Sustainable investing and Sustainable Financing, especially in the area of Climate Finance.
- Evaluate the existing models in Sustainable Finance.

Expected Learning Outcomes:

Upon successful completion of the course, the student will be able to:

- Apply the concepts of sustainability in investing and financing decisions.
- Report Sustainable non-financial data.
- Interpret sustainability reports
- Raise financing innovatively for his business
- Contribute to the creation of the innovative Sustainable Business Models.

Syllabus:

Module I:

Introduction to Sustainable Finance and Challenges/Opportunities involved - Understanding Sustainable Finance, why is sustainable finance important? Understanding the challenges and opportunities involved in Sustainable Finance

Module II:

Environmental, Social, Governance Finance and CSR - Understanding Concepts and Definitions of Environmental factors related to Sustainable Finance, Understanding Concepts and Definitions of Social factors related to Sustainable Finance. Understanding Concepts and Definitions of Governance factors related to Sustainable Finance. What is the role of CSR in Sustainable Finance?

Module III:

SDGs and Sustainable Finance Framework - Linking of SDGs with Sustainable Finance. Understanding different stages of Sustainable Finance, Understanding Theories of competitive position, intangibles, and strategy, comparing business models and Circular Business model, what are material sustainability issues? What is value creation using sustainable finance?

Module IV:

ESG Investing (Equity and Bonds) - Understanding ESG investing in Equity and Bonds, How the investing decisions are taken in Corporates – processes, governance etc, why does sustainability matter to equities and Bonds? Integrating sustainability into equity investing and bond investing, what is Impact Investing, what are Green Bonds and Social Bonds, Indian Framework of Green Bonds (India's Sovereign Green Bond framework)

Module V:

Sustainable Finance in Banks and Insurance - Why does sustainability matter to lending and insurance? What is Risk-based approach towards sustainable lending and Insurance. What is Value-based banking and Value-based Insurance.

Module VI:

Climate Change and Climate Finance - What is Climate change and Climate Finance? What is its impact on Sustainable Finance? What are carbon credits, plastic credits and green credits? How do they operate, how to reduce Carbon Footprint?

Module VII:

Sustainability reporting - Financial reporting: merits and limitations. Nonfinancial metrics, data and value drivers. What is the need of integrated reporting? IFRS Sustainability Disclosure Standards. Carbon Disclosure Project (CDP): A widely used framework for sustainability reporting. Task Force on Climate-related Financial Disclosures (TCFD): A widely used framework for sustainability reporting. Factors for Sustainability data providers. What is the Future Outlook?

Environmental Studies and Disaster Management

Course Description:

Research indicates that there have been alterations in food and energy systems, thanks to the human displacement. Whether it is floods in Pakistan or scorching heat waves in India or severe drought conditions in Africa, all these hint towards climate change and the consequent threats to the communities. On the brighter side, the world has been witnessing a surge in renewable energy capacity. It is optimistic that all the countries across the world have signed the UN biodiversity agreement to conserve 30% of the world's land and water by 2030.

In light of these pressing issues, the course environmental studies and disaster management is designed to reiterate the components of environment and highlight the social issues affecting sustainability. The course also probes into the legislative framework for environmental protection and the crucial role of environmental ethics. The course familiarizes the learners with various stages of disaster management and enumerates the roles and responsibilities of the community towards disaster management.

Course Objectives:

At the end of the course, the students will be able to:

- Explain the scope of environmental studies
- Appraise the importance of conservation of ecosystem diversity and natural resources
- Elucidate environmental legislations and the relationship between environment and society
- Critique on disaster management planning and policies
- Examine the stages of disaster management

Learning Outcomes:

- Demonstrate awareness about importance of optimum utilization of natural resources and responsibility towards environment.
- Formulate strategies for sustainable development
- Develop framework for crisis situation identification
- Interpret plans for bringing in the participation of communities towards disaster management

Syllabus:

Module I:

Introduction to Environmental Studies - Environment - Meaning and Types; Components and Segments of Environment; Meaning and Scope of Environmental Studies; Importance of Environmental Studies; Multidisciplinary Nature of Environmental Studies; Need for Awareness of Environmental Problems; Relationship between Man and Environment.

Module II:

Ecosystem, Biodiversity and Natural Resources - Classification of Ecosystem; Structure of Ecosystem; Functioning of Ecosystem; Ecological Pyramids and Ecological Succession; Various Types of Natural Resources; Role of Natural Resources in Human Life; Misuse and Exploitation of Natural Resources; Conservation of Natural Resources; Biodiversity-Meaning and Types; Levels of Biodiversity; Patterns of Biodiversity; Endangered and Endemic Species; Values of Biodiversity; Threats to Biodiversity; Conservation of Biodiversity.

Module III:

Environmental Pollution - Environmental Pollution and its Types; Air Pollution; Water Pollution; Noise Pollution; Soil Pollution; Climate Change; Global Warming; Ozone Layer Depletion; Acid Rain.

Module IV:

Environmental Legislation - Environment Management System; Need for Environmental Legislation; Framework of Indian Environmental Legislation; The Environmental (Protection) Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; Water (Prevention and Control of Pollution) Act, 1974; The Wildlife (Protection) Act, 1972; The Forest (Conservation) Act, 1980; Environmental Impact Assessment (EIA); Issues Involved in the Enforcement of Environmental Legislation.

Module V:

Society and Environment - Measures of Sustainable Development; Problems of Sustainable Development; Environmental Ethics; Watershed Management; Wasteland Reclamation; Consumerism and Waste Products; Population Growth; Causes of Population Growth; Effects of Population Growth; Variations in Population Growth; Environment and Human Health; Human Rights and Environment; Environment and Technology; Role of Information Technology in Environment and Human Health Protection.

Module VI:

Disaster Management-An Overview - Introduction to Disaster Management; Types and Causes of Disasters and Hazards; Consequences of Disasters; Vulnerability Analysis; Risks and Pandemic.

Module VII:

Disaster Management and Planning - Disaster Management and Planning; Policy of Disaster Management; Types of Plans; Identifying Crisis Situation: A Framework.

Module VIII:

Responsibilities and Challenges in Disaster Management - Ascertaining Roles and Responsibilities; Roles and Responsibilities of Communities; Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs); Impact of Development Projects; Changes in Land Use.

Module IX:

Disaster Mitigation - Concept of Disaster Mitigation; Structural Mitigation; Non-structural Mitigation; Emerging Trends in Disaster Mitigation; Strengthening Capacity for Reducing Risk

Module X:

Disaster Preparedness - Disaster Preparedness; Three As of Disaster Preparedness; Principles of Disaster Preparedness; Steps of Disaster Preparedness, Organizational Structure for Disaster Preparedness; Contingency Planning; Importance of Building a Team; Community Relations for Environmental and Emergency Managers.

Module XI:

Disaster Response - Aims of Response; Components of Disaster Response; Control Process and Measurement; Role of States, Centre and Other Stakeholders.

Module XII:

Disaster Recovery - Disaster Recovery; Components of Disaster Recovery; Disaster Management Act; Disaster Management Policies; Plans and Programmes; Disaster Risk Management in India; Hazard and Vulnerability Profile of India; Components of Disaster Relief in India.

Circular Economy, Lean and Sustainability Thinking

Course Outcomes:

1. Apply the concept of circular economy to environmental problems
2. Use the principles of circularity for application to sustainable development
3. Apply complexity aspects of circular economy for creating circular business models
4. Understand the basic concept of Sustainable Development, the environmental, social and economic dimensions.
5. In-depth learning and analysis of factors that support to achieve sustainability and resilience in an individual level and in a community.
6. Develop an encompassing understanding of sustainability issues.
7. How sustainability considerations can actually be embedded within an individual's and community's day to day activities and decision making processes.

Syllabus:

Module I:

Introduction to Circular Economy (8 Sessions)

Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs. Circular Economy, Characteristics of Circular Economy, Material recovery, Waste Reduction, reducing negative externalities, Explaining Butterfly diagram, Concept of Loops.

Module II:

Circular design, innovation and Assessment (7 Sessions)

Zero waste: Waste Management in context of Circular Economy, Circular design, Research and innovation, LCA, Circular Business Models

Module III:

Legal and policy framework (5 Sessions)

Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG

Module IV:

Introduction to Sustainable Development: Glimpse into History and Current Practices (5 Sessions)

Broad introduction to SD-its importance need, impact and implications; definition coined; evaluation of SD perspectives (MDGs and SDGs) over the years; recent debates; 1987 Brundtland commission and outcome; later UN summits (Rio summit, etc.) and outcome.

Module V:

Ecosystem & Sustainability (7 Sessions)

Introduction to sustainability & its factors, requirements for sustainability: food security and agriculture, renewable resources - water and energy, non-renewable resources, factors and trade-offs, sustainability conflicts, a conceptual framework for linking sustainability and sustainable development, Climate Change and its impacts

Module VI:

Dimensions to Sustainable Development (13 Sessions)

Society, environment, culture and economy; current challenges - natural, political, socio-economic imbalance; sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation - political, economic, and environmental. Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.

Human Society in the Natural Environment: Sustainability Issues

Objectives:

- To make students understand how the natural and built environments shape and are shaped by multiple socio-cultural and political factors.
- To make students understand the causes of the prevailing environmental problems and ways of addressing them.
- To help students contemplate various environmental issues across and beyond existing disciplinary boundaries and aid them in becoming aware of the diverse forms of knowledge and experience that arise from human interactions with the environment around them.
- To make students reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Learning Outcomes:

The course will assist the students in nurturing knowledge, respect, and compassion for their natural surrounding environment.

Students will be able to live responsibly and appreciate the environmental and cultural histories associated with the respective places.

Students will be able to understand the importance of proper utilization of natural resources in order to develop sustainably as an individual as well as a society as a whole.

Students will be aware of their role as citizens, consumers and environmental actors in a complex, interconnected world.

Syllabus:

Module - I:

Introduction to environmental studies - Definition, components, scope and multi-disciplinary nature of environment studies

To acknowledge the importance and need for awareness of environmental problems/issues

Module - II:

Natural Resources - Different types of renewal and non-renewal resources.

Contribution of these resources in human life and their misuse and exploitation.

Module - III:

Ecosystem - Definition, structure, function, and energy flow in ecosystem: food chains, food webs & ecological succession

Different types of ecosystems and their interdependence on each other

Module - IV:

Biodiversity & Conservation - Introduction and levels of biological diversity; biodiversity patterns and global biodiversity hotspots with a focus to India as a mega biodiversity nation. Endangered and endemic species; threats to biodiversity and ways to conserve the same.

Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module - V:

Environmental pollution - Environmental pollution: types (air, water, noise, soil, marine, thermal, radiation), and their causes, effects, and controls. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste.Other environmental concerns (climate change, Global warming, ozone Layer depletion, acid rain) and its impact on human life. Cases on environmental pollution.

Module - VI:

Environmental policies and practices - Environment Laws & Regulations: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention & Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves of India.

Module - VII:

Human communities and the environment - Human population growth: impacts on environment, human health and welfare. Disaster management: Floods, earthquake, cyclones, and landslides. Resettlement and rehabilitation of affected persons. Environmental movements such as Chipko, Silent Valley; and Bishnois of Rajasthan. Environmental Ethics: Role of Indian and other Religions and cultures in environmental Conservation.

Environment and Development

Course Description:

The course "Environment and Development" focuses on the interplay between economic development and the environment. The goal of this course is to help scholars understand the challenges and opportunities in the area of sustainable development. Economic activity has environmental effects at all scales from local pollution and resource depletion such as deforestation, loss of biodiversity to regional impacts from overfishing or excessive use of water resources, and on to global concerns such as climate change and global warming. It covers topics such as SDGs, environmental policies and practices, international agreements for environmental protection and issues related to management of common property resources-global and local commons.

Syllabus:

Unit I:

Economic Development and Environment - Development and Environment: linkages; Environment Kuznets Curve Hypothesis; Poverty and Environmental Degradation; The social and economic consequences of land degradation, water pollution and air pollution; Multi-Country evidence on Environment–Poverty relations, Poverty and Climate Change; Trade and Environment Nexus, Trade Openness and Environmental quality, Pollution haven hypothesis, Pollution halo hypothesis.

Unit II:

Environmental Challenges in a Global Context -Climate Change and Global Warming; Impacts and consequences of climate change on various sectors of the economy-Agriculture, Health etc; Climate Change and the Poor, Climate Action: Mitigation and Adaptation Strategies; Reducing the Vulnerability of the Poor through Adaptation, Loss of Biodiversity and world's poor; Convention on Biological Diversity

Unit III:

Sustainable Development Goals - UN Agenda 2030; Sustainable Development Index- Cross Country Analysis; Issues and Challenges in achieving SDGs by 2030 by Developed Countries, developing and less developed countries; NITI Ayog and SDG initiatives in India, Challenges, Localizing SDGs: India's challenges, best practices etc.

Unit IV:

Environmental Policy and Practices - Introduction to Environmental Policy Instruments; Traditional Standards (Command and Control); Taxes/Subsidies;Tradable Emission Permits; Environmental policies and practices in India.

Unit V:

International agreements/Multilateral Frameworks - Montreal protocol, The United Nations Framework Convention on Climate Change (UNFCCC), COPs, Kyoto protocol and climate negotiations, The Paris Agreement, Convention on Biological Diversity (CBD), G 20 Summit@ News Delhi & News Delhi Leaders' Declaration.

Unit VI:

Common Property Resource Management - Common property resources, Global and Local Commons, Tragedy of Commons, Institutions for Collective Action, Common property resource management in India, Traditional community-based models of governance; Discussion of Indian Case studies from India such as management of tanks, forest land, ponds, rivers, fisheries etc.

Environmental Studies and Disaster Management

Course Description:

Research indicates that there have been alterations in food and energy systems, thanks to the human displacement. Whether it is floods in Pakistan or scorching heat waves in India or severe drought conditions in Africa, all these hint towards climate change and the consequent threats to the communities. On the brighter side, the world has been witnessing a surge in renewable energy capacity. It is optimistic that all the countries across the world have signed the UN biodiversity agreement to conserve 30% of the world's land and water by 2030.

In light of these pressing issues, the course environmental studies and disaster management is designed to reiterate the components of environment and highlight the social issues affecting sustainability. The course also probes into the legislative framework for environmental protection and the crucial role of environmental ethics. The course familiarizes the learners with various stages of disaster management and enumerates the roles and responsibilities of the community towards disaster management.

Course Objectives:

At the end of the course, the students will be able to:

- Explain the scope of environmental studies
- Appraise the importance of conservation of ecosystem diversity and natural resources
- Elucidate environmental legislations and the relationship between environment and society
- Critique on disaster management planning and policies
- Examine the stages of disaster management

Learning Outcomes:

- Demonstrate awareness about importance of optimum utilization of natural resources and responsibility towards environment.
- Formulate strategies for sustainable development
- Develop framework for crisis situation identification
- Interpret plans for bringing in the participation of communities towards disaster management

Syllabus:

Module I:

Introduction to Environmental Studies - Environment - Meaning and Types; Components and Segments of Environment; Meaning and Scope of Environmental Studies; Importance of 180. Environmental Studies; Multidisciplinary Nature of Environmental Studies; Need for Awareness of Environmental Problems; Relationship between Man and Environment.

Module II:

Ecosystem, Biodiversity and Natural Resources - Classification of Ecosystem; Structure of Ecosystem; Functioning of Ecosystem; Ecological Pyramids and Ecological Succession;

Various Types of Natural Resources; Role of Natural Resources in Human Life; Misuse and Exploitation of Natural Resources; Conservation of Natural Resources; Biodiversity-Meaning and Types; Levels of Biodiversity; Patterns of Biodiversity; Endangered and Endemic Species; Values of Biodiversity; Threats to Biodiversity; Conservation of Biodiversity.

Module III:

Environmental Pollution - Environmental Pollution and its Types; Air Pollution; Water Pollution; Noise Pollution; Soil Pollution; Climate Change; Global Warming; Ozone Layer Depletion; Acid Rain.

Module IV:

Environmental Legislation - Environment Management System; Need for Environmental Legislation; Framework of Indian Environmental Legislation; The Environmental (Protection) Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; Water (Prevention and Control of Pollution) Act, 1974; The Wildlife (Protection) Act, 1972; The Forest (Conservation) Act, 1980; Environmental Impact Assessment (EIA); Issues Involved in the Enforcement of Environmental Legislation.

Module V:

Society and Environment- Measures of Sustainable Development; Problems of Sustainable Development; Environmental Ethics; Watershed Management; Wasteland Reclamation; Consumerism and Waste Products; Population Growth; Causes of Population Growth; Effects of Population Growth; Variations in Population Growth; Environment and Human Health; Human Rights and Environment; Environment and Technology; Role of Information Technology in Environment and Human Health Protection.

Module VI:

Disaster Management- An Overview- Introduction to Disaster Management; Types and Causes of Disasters and Hazards; Consequences of Disasters; Vulnerability Analysis; Risks and Pandemic.

Module VII:

Disaster Management and Planning - Disaster Management and Planning; Policy of Disaster Management; Types of Plans; Identifying Crisis Situation: A Framework

Module VII:

Responsibilities and Challenges in Disaster Management - Ascertaining Roles and Responsibilities; Roles and Responsibilities of Communities; Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs); Impact of Development Projects; Changes in Land Use.

Module IX:

Disaster Mitigation - Concept of Disaster Mitigation; Structural Mitigation; Non-structural Mitigation; Emerging Trends in Disaster Mitigation; Strengthening Capacity for Reducing Risk.

Module X:

Disaster Preparedness-Disaster Preparedness; Three As of Disaster Preparedness; Principles of Disaster Preparedness; Steps of Disaster Preparedness, Organizational Structure for Disaster Preparedness; Contingency Planning; Importance of Building a Team; Community Relations for Environmental and Emergency Managers

Module XI:

Disaster Response - Aims of Response; Components of Disaster Response; Control Process and Measurement; Role of States, Centre and Other Stakeholders

Module XII:

Disaster Recovery- Disaster Recovery; Components of Disaster Recovery; Disaster Management Act; Disaster Management Policies; Plans and Programmes; Disaster Risk Management in India; Hazard and Vulnerability Profile of India; Components of Disaster Relief in India.

Workplace Diversity & Inclusion (WDI)

Course Description:

In the workplace, interactions with peers, managers, and customers from diverse backgrounds and experiences are a constant. When effectively managed, these differences can spark creative breakthroughs and enhance team and organizational learning. However, if not handled properly, they can create challenges for employees' values, performance, relationships, and overall team effectiveness. Managing and leveraging diversity is, therefore, of utmost importance for organizations. This course is designed to help students effectively navigate diverse and cross-cultural organizational settings, enhancing their ability to work within and lead global teams. Students will engage with critical topics such as identity, bias, discrimination, and equity, examining how these issues impact organizational power, privilege, and effectiveness. The course also emphasizes the importance of understanding diverse perspectives on a global scale, preparing students to thrive in international and multicultural environments.

Course Description:

In the workplace, interactions with peers, managers, and customers from diverse backgrounds and experiences are a constant. When effectively managed, these differences can spark creative breakthroughs and enhance team and organizational learning. However, if not handled properly, they can create challenges for employees' values, performance, relationships, and overall team effectiveness. Managing and leveraging diversity is, therefore, of utmost importance for organizations. In alignment with United Nations' sustainable development goals, specifically SDG5, SDG8, and SDG16, this course is designed to help students effectively navigate diverse and cross-cultural organizational settings, enhancing their ability to work within and lead global teams. Students will engage with critical topics such as identity, bias, discrimination, and equity, examining how these issues impact organizational power, privilege, and effectiveness. The course also emphasizes the importance of understanding diverse perspectives on a global scale, preparing students to thrive in international and multicultural environments.

Course Objectives:

The course intends:

- To develop critical thinking among students on issues of stereotyping, prejudice, bias, and discrimination existing in the workplace.
- To acquaint students with institutional and individual actions that can be applied to promote diversity and inclusion (D&I) in the workplace.
- To equip students with the right skills to identify and analyze the complex workforce issues associated with human diversity and exclusion/inclusion.
- To enable students to utilize knowledge and skills gained here to assist in creating a more inclusive workplace environment.

Learning Outcomes:

Upon completion of this course, students are expected to:

- Demonstrate critical thinking on issues of stereotyping, prejudices, discrimination, and bias, influencing opportunity and effectiveness in organizations operating in domestic and global contexts.
- Identify and analyze the current D&I approaches of organizations in managing a diverse workforce.
- Analyze the challenges that block diverse and inclusive cultures in organizations and then suggest ways to accelerate progress in the concerned zone.

Syllabus:

Module I:

Introduction to Diversity - Workforce Diversity-Meaning, Features, and Significance; Dimensions of Workforce Diversity; Global Demographic Trends Impacting Workforce Diversity; Advantages and the Challenges related to Workforce Diversity

Module II:

Employment Legislation - Overview of Major Laws and Guidelines- A Review from the International Labor Organization; Employment Discrimination Laws in India

Module III:

Identity & Differences - Personal and Social Identities; Salience and Intersectionality; Privilege and Oppression; Meritocracy, Melting Pot (Assimilation), Colorblind Ideal

Module IV:

Reaction to Differences (Part 1) - Implicit & Explicit Bias; Prejudice-In-Groups and Out Groups; Stereotypes; Systemic and Interpersonal Discrimination; Overt Discrimination; Subtle Discrimination - Microaggressions

Module V:

Reaction to Differences (Part 2) - Forms of Discrimination- Gender, Race & Ethnicity, Age, Religion, Disability, Sexual Orientation

Module VI:

Social Psychological Perspectives of Diversity - Social Identity theory; Status Construction theory; Social Comparison theory; Symbolic Interaction theory; Identity Threat model of Stigma (SIIT)

Module VII:

Culture, Communication, and Relationships - Cultural Value Dimensions: Hofstede's Framework, GLOBE study; Elements in Cross-Culture Communication; Cultural Styles & Relational Mental Models; Theoretical Perspectives on Interpersonal Cross-Cultural Communication

Module VII:

Diversity in Teams - Concept of Team Diversity; Two Perspectives – Systems Theory & Steiner's Group Productivity Model (GPM)

Module IX:

Diversity Management Paradigms - Concept of Diversity Management; Diversity Training; Human Resource Paradigm in Diversity Management; The Multicultural Organization Paradigm in Diversity Management; Models of Global Diversity Management

Module X:

Inclusive Workplace - Concept of Inclusion; Difference between Diversity & Inclusion; The Inclusive Workplace: Level I Inclusion Within the Work Organization, Level II Inclusion Through Corporate-Community Collaborations, Level III Inclusion Through State/National Collaborations

Module XI:

Inclusive Leadership - Diversity Paradox; Organizational Leadership & Inclusion; Inclusive Leadership at the Supervisor Level: LMX

Module XII:

Contemporary D&I Strategies - D&I Analytics; Design Thinking: Problem Solving in the Diverse Workplace

Circular Economy, Lean and Sustainability Thinking

Course Outcomes:

1. Apply the concept of circular economy to environmental problems
2. Use the principles of circularity for application to sustainable development
3. Apply complexity aspects of circular economy for creating circular business models
4. Understand the basic concept of Sustainable Development, the environmental, social and economic dimensions.
5. In-depth learning and analysis of factors that support to achieve sustainability and resilience in an individual level and in a community.
6. Develop an encompassing understanding of sustainability issues.
7. How sustainability considerations can actually be embedded within an individual's and community's day to day activities and decision making processes.

Syllabus:

Module I:

Introduction to Circular Economy (8 Sessions) - Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs. Circular Economy, Characteristics of Circular Economy, Material recovery, Waste Reduction, reducing negative externalities, Explaining Butterfly diagram, Concept of Loops.

Module II:

Circular design, innovation and Assessment (7 Sessions) - Zero waste: Waste Management in context of Circular Economy, Circular design, Research and innovation, LCA, Circular Business Models

Module III:

Legal and policy framework (5 Sessions) - Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG.

Module IV:

Introduction to Sustainable Development - Glimpse into History and Current Practices (5 Sessions) - Broad introduction to SD-its importance need, impact and implications; definition coined; evaluation of SD perspectives (MDGs and SDGs) over the years; recent debates; 1987 Brundtland commission and outcome; later UN summits (Rio summit, etc.) and outcome.

Module V:

Ecosystem & Sustainability (7 Sessions) - Introduction to sustainability & its factors, requirements for sustainability: food security and agriculture, renewable resources - water and energy, non-renewable resources, factors and trade-offs, sustainability conflicts, a conceptual framework for linking sustainability and sustainable development, Climate Change and its impacts

Module VI:

Dimensions to Sustainable Development (13 Sessions) - Society, environment, culture and economy; current challenges - natural, political, socio-economic imbalance; sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation - political, economic, and environmental. Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.

Air Pollution and Control

Course Objectives:

- Develop an understanding of the classification, sources and effects of pollutants
- Describe general air pollution problems, air transport equations
- To understand the fundamentals of meteorology
- Study the principles and equipment description of control technologies
- Introduction of major problems in indoor air pollution and control, regulations

Unit – I:

Introduction: sources, effects on – ecosystems, classification of atmospheric pollutants, air pollution episodes of environmental importance. Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Windrose diagram. General characteristics of stack emissions, plume behaviour, heat island effect.

Unit – II:

Air Quality models - Gaussian convection-diffusion model for point, line and areal sources. Air Pollution Control of particulate matter & gaseous pollutants from point & non-point sources – gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – Adsorption, absorption, scrubbers, condensation and combustion. Dust suppression measures.

Unit – III:

Indoor Air Pollution – sources, effects and control. Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

Unit – IV:

Monitoring of particulate matter and gaseous pollutants – respirable, non-respirable and nano-particulate matter. CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

Autonomous Vehicles

Objectives:

- Understand the rational for and evolution of automotive electronics;
- Understand which automotive systems have been replaced by electronic control systems and the advantage of doing so;
- Understand the fundamental theory of operation of electronic control systems;
- Understand the basics of how automotive ECUs function in conjunction with the vehicle data bus networks and sensors;
- Become familiar with the various types of advanced driver assistance systems.
- Students are able to synthesize performance specifications for autonomous driving.

Unit – I:

Introduction to Automated, Connected, and Intelligent Vehicles, Introduction to the Concept of Automotive Electronics, Automotive Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Advanced Driver Assistance Electronic Systems, Connected and Autonomous Vehicle Technology, Basic Control System Theory applied to Automobiles.

Unit – II:

Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data, Networks and Autonomy, Sensor Technology for Advanced Driver Assistance Systems, Basics of Radar Technology and Systems. Ultrasonic Sonar Systems, Lidar Sensor, Technology and Systems, Camera Technology, Night Vision Technology. Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

Unit – III:

Overview of Wireless Technology, Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Signal Propagation Physics, Basic Transmission Line and Antenna Theory, Wireless System Standards and Standards Organizations, Role of Standards, Standards Organizations, Present Standards for Autonomous Applications.

Unit – IV:

Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks, Review of On-Board Networks – Use & Function, Connected Car Technology Connectivity Fundamentals Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview, Advanced Driver Assistance, System Technology, Basics of Theory of Operation, Applications – Legacy,

Applications – New, Applications – Future, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion, Connected Car Display Technology, Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, Warning Technology – Driver Notification

Unit – V:

Warning Technology – Driver Notification, Impaired Driver Technology, Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology, Vehicle Prognostics Technology, Monitoring of Vehicle Components, Basic Maintenance, End-of-Life Predictions, Advanced Driver Assistance System Sensor Alignment and Calibration, Autonomous Vehicles, Driverless Car Technology, Moral, Legal, Roadblock

Issues, Technical Issues, Security Issues, recent Advanced Driver Assistance System Technology Examples, Advanced Driver Assistance System Technology Examples, Toyota, Nissan, Honda, Hyundai, Volkswagen, BMW, Daimler, Fiat Chrysler Automobiles, Ford, General Motors, Troubleshooting and Maintenance of Advanced Driver Assistance, Systems

Failure Modes – Self Calibration, Sensor Testing and Calibration, Redundant Systems Standard Manufacturing Principles. Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation.

Environmental Sciences

Course Objective:

- To familiarize students with the ecological system and emphasize its significance in architecture
- To explore the challenges faced by urban ecosystems and principles of sustainable design
- To provide insights into sustainable energy and water management practices in buildings.
- To facilitate an understanding of key environmental legislations, acts, and institutions governing sustainable development in India.

Unit - I:

Ecological system - Ecology as a system, Environmental resources, Bio-geographical classification of India, Introduction to Ecosystem Services, challenges for safeguarding ecosystems, Ecology and architecture, Challenges of urban ecosystems- pollution, loss of habitat, urban heat, groundwater, public health etc., Introduction to Ecological footprint

Unit - II:

Ecology and Architecture - Ecology and its significance in architecture, Climate change, Greenhouse effect, Evolution of sustainable development- Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Convention on Biological Diversity, Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits, COP etc. Sustainable Development Goals, Impact of architecture on the environment, Principles of sustainable design

Unit - III:

Energy, Water and Nature-Based Solutions - Environmental Cost, Energy sources and consumption in buildings, Passive design strategies for energy efficiency, Renewable energy technologies in architecture, Water consumption in buildings, Sustainable water use in buildings, Rainwater harvesting and greywater reuse, Introduction to Nature-Based Solutions.

Unit - IV:

Environmental Legislations, Acts, Institutions Annexure III - Environmental provisions in the Constitution of India, fundamental rights and, fundamental duties, Legal definitions of environmental pollution, natural resource, biodiversity, forest, sustainable development, Relevant environmental acts of India

Role of Ministry of Environment, Forest & Climate Change, National Green Tribunal, Indian Green Building Council, GRIHA, TERI, and BEE

Course outcome:

- Demonstrate an understanding of ecological systems and ecosystem services and their relevance to architecture
- Identify and analyze challenges associated with urban ecosystems
- Apply energy-efficient design strategies to enhance the sustainability of buildings
- Implement sustainable water management practices
- Interpret and adhere to key environmental legislations, acts, and institutional frameworks governing sustainable development in India, including their implications for architectural practice.

Environmental Studies

Course Description:

This course focuses on economic causes of environmental problems. In particular, economic principles are applied to environmental questions and their management through various economic institutions, economic incentives and other instruments and policies. Economic implications of environmental policy are also addressed as well as valuation of environmental quality, quantification of environmental damages, tools for evaluation of environmental projects such as cost-benefit analysis and environmental impact assessments. Selected topics on international environmental problems are also discussed.

Course Outcomes:

- Students will have an idea about the components, importance & problems associated with natural environment.
- To make the students understand about different types of natural resources.
- Students will be able to know about biodiversity & conservation.
- Students will be able to know the causes, effects & remedies of different types of pollutions.
- Students will be able to know about the ecosystem

Unit - I:

Introduction to environmental studies - Definition, components, scope and multidisciplinary nature of environment studies-The importance and need for awareness of environmental problems/issues-Ecosystem-Definition, structure, function, and energy flow in ecosystem: food chains, food Webs & ecological succession-Different types of ecosystems and their interdependence on each other.

Unit - II:

Natural Resources - Different types of renewal and nonrenewal resources- Contribution of these resources in human life and their misuse and exploitation

Unit - III:

Biodiversity & conservation - Introduction and levels of biological diversity; biodiversity patterns and global biodiversity hotspots with a focus to India as a mega biodiversity nation-Endangered and endemic species; threats to biodiversity and ways to conserve the same - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit - IV:

Environmental Pollution - Environmental pollution: types (air, water, noise, soil, marine, thermal, radiation), and their causes, effects, and controls - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste- Other environmental concerns (climate change, Global warming, ozone Layer depletion, acid rain) and its impact on human life.

Unit - V:

Environmental Policies and Practices - Environment Laws & Regulations: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention & Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols And Convention on Biological Diversity (CBD)-Nature reserves of India.

Unit - VI:

Human Communities and the Environment - Human population growth: impacts on environment, human health and welfare- Disaster management: Floods, earthquake, cyclones, and landslides. Resettlement and rehabilitation of affected persons-Environmental movements such as Chipko, Silent Valley; and Bishnois of Rajasthan - Environmental Ethics: Role of Indian and other Religions and cultures in environmental Conservation.

Intelligent Transportation Systems

Objective:

- To develop an understanding of system engineering processes
- To describe the concepts of system architecture and their evolution
- Understand the capability of key technologies
- Understand impact of technology on different modes and movement
- Understand how to evaluate technologies, applications and services

Unit – I:

Fundamentals of ITS - Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS.

Unit – II:

Sensor technologies and Data requirements of ITS - Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC).Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection.

Unit – III:

ITS User Needs and Services and Functional areas - Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS).

Unit – IV:

ITS Architecture - Regional and Project ITS architecture; Concept of operations; ITS Models d Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.

Unit – V:

ITS applications - Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Personal and Family Health and Wellness

Course Description:

The course has been designed to impart education and knowledge about the significance of correct body postures, breathing, movement, and exercises for fostering healthy natural life. This course uses the lens of an individual's lifecycle or life course commencing from conception till old age. Accordingly, students will be familiarized with skills, in self-realization and setting goals in life. It will also help the students to be focused towards their goal and make them physically, mentally and spiritually strong to face different challenges in life. Pursuing this course will develop leadership qualities in the students along with their personality development. Yoga is the science of achieving absolute union with the divine.

Course Objectives:

- To impart knowledge about the benefits of yoga in one's life
- To impart the skills required to practice yoga on a regular basis
- To introduce students to yoga, and help them achieve a reasonable level of proficiency in performing yoga

Syllabus:

Module - I:

Human Life Cycle Stages - Introduction; Prenatal development; Infancy; Babyhood; Early Childhood; Late Childhood; Adolescence; Adulthood; Middle Age; Old Age; Theories of Life Span Development; Maintaining a healthy life balance across the life span.

Module - II:

The Home and the External Environment - The family at home and members' interdependencies; synchronization and coordination of work for harmony; Hygiene, Cleanliness, and Sanitation; Waste Management; The zero-waste family; socio-economic and environmental factors influencing health; the zero-waste community; water management; community wellness.

Module - III:

Health and Wellness - Introduction to Health and Wellness; Heredity and Environment; Genetic Dispositions and Evolution of the concept of wellness; Circadian rhythms and their implications for wellness; Benefits of health and wellness; Physical Conditions and Dimensions of wellness; Wellness economy.

Module - IV:

Managing Health and Wellness: Health – Physical and Mental; Modal concerns across human life course stages; Anticipatory and preventive practices - Diet and Nutrition for wellness, physical activities and rest + sleep, injury prevention practices, immunization, periodic health check-ups; Health risk behaviours – smoking, addiction (alcohol, drugs and technology), time-abuse, Accepting and demonstrating personal responsibility for health and safety.

Module - V:

Course Review - Review via Open interactions; Fine Tuning of Practices.