

## 1<sup>st</sup> Semester

### EN 501 : CONVENTIONAL ENERGY SYSTEMS

Energy Sources, Various methods of conversion to Electrical Energy.

**Hydro Electric Stations** : Selection of site, Essential features and elements, Principal Auxiliaries, Plant Layout , Classification of Hydro power plants, Hydraulic Turbines, Water wheel Generators.

**Thermal Power Stations:** Selection of site for Coal fired power plants, Essential features and elements, Principal Auxiliaries, Plant Layout, Steam Turbines, Turbo Alternators. Gas Electric power plants, Diesel Electric power plants.

**Nuclear Power Stations:** Fission and fusion technology fundamentals. Basic construction and comparison of various types of nuclear reactors, Plant Layout, Risks and Safety measures.

Comparison of various conventional energy systems, their prospects and limitations.

#### **Economic aspects of Power Plant Operation :**

Load curves, load factor, diversity factors and their significance, Economic scheduling of power stations. Interest and depreciation, Costs of electrical energy, Methods of determining depreciation Tariff, characteristics and types of tariff.

Economic efficiency, time value of money, types of interests, inflation, interest formulae relating present and future worth of single amount. Pay back period and Net-present value methods to assess financial efficiency of power plants.

**Demand Side Load Management:** Concepts, Barriers, Planning and Implementation methods etc.

Reference Books :

1. Electrical Power by J.B.Gupta
2. Power System by V K Mehta
3. Power Plant Engineering by R.K.Rajput
4. Financial evaluation of renewable technology by T.C.Kaupal

### EN 502: RENEWABLE ENERGY SOURCES

Introduction to Renewable Energy Sources

**Solar Energy** : Principles and scope, solar radiation, Energy collection and devices. Principle of Wind Energy Conversion. Tidal and geothermal Energy.

**Bio-Energy** : Biomass and its uses, Classification of biomass, Biomass as a source of energy, Characteristics of biomass, Biomass conversion processes, Buiqueting of biomass, Gasification and combustion of biomass, Gasifiers.

Biomethanation, Basics of anaerobic processes, it's advantages, Biogas as a rural energy source, Environmental significance, Biogas production mechanism, Biogas plant and it's components, Types of biogas plants, Design and construction features.

Hydel Energy : Types of Hydro Power Plants, Hydro Power Estimates – Hydrological analysis, Flow & power duration curves, Effect of storage, load analysis & Pondage requirement, estimates of Primary and Secondary Power.

Water Ways – Fourbay, trashtacks, intake gates, air inlets, power canal, surges in power canal and penstocks. Types & working of surge tanks.

Hydraulic Turbines – Types of turbines, their parts and working, Governing and controls of turbines.

### **EN 503: ENERGY CONSERVATION AND ENERGY MANAGEMENT**

General energy problem: Energy use patterns and scope for conservation.

Energy audit: Energy monitoring, Energy accounting and analysis, Energy Audit, Energy Accounting & Analysis, Heating, Ventilation & Air Conditioning audit, Building system energy audit.

Energy management, Energy management Information system.

Electrical Energy Conservation in building, heating and lighting. domestic gadgets, Energy efficient motors. Tariffs and power factor improvement in power system, Load curve analysis and load management.

Energy audit, Energy accounting & analysis.

Thermodynamics of Energy Conservation. Basic principle. Irreversibility and second law efficiency analysis of systems. Primary energy sources, optimum use of prime-movers, energy efficient house keeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Thermal energy audit in heating, ventilation and air conditioning. Maintenance and Energy audit – friction, lubrication and tribo-logical innovations. Predictive and preventive maintenance.

Reference Books:

1 Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M.

2 Energy management by Paul'Callaghan

### **EN-504 BUILDING AND ENERGY**

Need of energy in buildings. Assessment of need of energy in building. Aspects influencing the energy need in building. Role of building design and building services to evaluate the energy performance in buildings.

Study of Climate and its influence in building design for energy requirement.

Environmental science of buildings. Study of Thermal environment and visual environment.

Heat gain and heat loss phenomenon of buildings. Role of building enclosures, openings and materials in thermal environment.

Basic principles of light and daylight. Energy efficient light design of buildings. Daylight design of buildings. Design for visual environment.

Energy survey and Energy Audit of buildings. Calculation of energy inputs in buildings. Energy Audit reports of buildings. Energy rating of buildings.

### **ELECTIVE-I-**

#### **EN-511-516**

#### **EN-511 COMPUTATION FLUID DYNAMICS**

Introduction : Definition and overview of CFD, need advantages, problem areas and models of CFD. Convergence, consistency, von-neumann stability analysis, projection error, evolution error, solution accuracy, computational efficiency.

Classification of Partial Differential Equations : Elliptic, parabolic and hyperbolic equations, equations in differential and integral form stream function, vorticity, continuity, momentum equation, Navier-stokes equations.

Numerical Methods: Explicit, implicit, finite difference method and finite element and finite volume method, discretisation of solution domain, L & W, Mac. & upwind scheme, flux vector splitting, flux difference splitting scheme.

Initial and boundary conditions: Types of boundary conditions, Neumann boundary conditions, Dirichlet boundary conditions (flow, No slip, on free surface, at exit and entry of ducts)

Grid Generation: Geometry description, algebraic grid generation, Tran's finite interpolation, p.d.e. based grid generation.

#### **EN-512 ADVANCED CONTROL SYSTEM**

Design and Compensation : Design consideration, lead compensation, lag compensation, lag lead compensation. Design of compensator using Bode plots.

Discrete-time Systems: Sampling process, difference equations, z-transform, pulse transfer function, inverse z-transform; z-domain & s-domain relationship. Stability analysis.

State Space Analysis: State variables, state models, Transfer Matrix, Diagonalisation, State equations, Canonical variable representation, pole placement design using state variable feedback.

Adaptive Control: Introduction, controllability, observability, Time optimal control system, Adaptive control.

Digital Control: Introduction, Microprocessor PC based control applications, PID controllers.

## **EN-513 URBAN ENERGY PLANNING AND MANAGEMENT**

Challenges faced by the urban environment today with projections in to the future. Component of urban environment and the modifications in Natural environment. Urban Heat Islands. Energy consumption and requirement in urban areas.

Conventional energy resources: socio – economic aspects, distribution, planning and management. Integration of conventional and renewable energy sources in urban infrastructure.

Urban environment and energy: International and National policies. Sustainability and Eco friendly aspect.

Example of cities or establishments that display sustainable urban environmental and energy planning and management

## **EN-514. ADVANCED DIGITAL COMMUNICATION**

Digital PAM, binary PAM formats, line coding, bandlimited digital PAM systems, Nyquist pulse shaping, equalization, synchronization techniques, bit and frame synchronization. Coded pulse modulation, voice digitization rate (VDR) of PCM, DPCM, DM, ADM, CVSD, log PCM, their performance comparison. VDR reduction by speech coding, VOCODERS., noise performance of PCM and DM, Digital multiplexers, AT & T and CCITT hierarchies, quasi synchronous multiplexers.

Digital CW modulation, BPSK, DPSK, DEPSK, QPSK, M'ary PSK, QASK, BFSK, CPFSK, MSK, Doubinary encoding, QPR coherent and non-coherent systems, matched, correlation and optimum filters, error probabilities in PSK, DPSK, FSK, QPSK, 16 QAM, MSK, QPR, bit and symbol error rate.

## **EN-515 STRENGTH AND SELECTION OF ENERGY EFFICIENT MATERIALS**

Electronic Structure, Atomic Bonding, Atomic Packing, Crystalline Structure, Imperfections. Strengthening Mechanisms of Metal and Alloys. Polymers types structures and property. Composite material, MMC, FRP, Mechanics of composites. Insulators Conductors and semiconductors.

Basic Principles involved in substitution of materials, control of properties of materials and the basis of control.

Mechanical Behavior of Material under tension, compression, bending, creep, fatigue and fracture.

Design and selection of material for strength, durability and economics for power generation, power transmission etc. Materials requirement for nuclear energy, substitution of nuclear fuels (such as Thorium in place of Uranium) and related problems. Various types of energy converters such as fuel cells, Electromechanical converter and materials for conversion of solar light into electricity.

## **EN-516 POWER ELECTRONICS**

Introduction to power electronics devices. Power diodes, SCRs, Triacs, GTOs, Power Transistors, P-Mosfets, CMOS and other devices.

Converters : A.C. to D.C. Rectifiers and Inverter operations. Reactive power requirements, Waveforms and filters.

Choppers & Inverters : Turn off Methods of SCRs, Chopper circuits, D.C. Link inverters. Single-phase and three-phase and three-phase inverter circuits. Waveforms, harmonic control, filters.

A.C. to A.C. Regulators: Voltage control, frequency control. Use of triacs, static switches.

Trigger and Controller Circuits: Trigger devices UJT, Optocompilers. Typical firing angle control circuits.

Power Electronics Applications: AC and DC Motor controllers, Oven and furnace control, Switch mode power supply. HVDC transmission, Static VAR controllers, Generators Excitation control etc