ELECTRICAL POWER GENERATION SYSTEMS

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEC10	Core	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Electrical Circuits (AEEC02), Electromagnetic Fields ().

I. COURSE OVERVIEW:

This course provides ability to recognize, analyze and troubleshoot different elements in electric power generation systems. It deals with conventional energy systems like thermal and nuclear power stations. This course also introduces non-conventional energy systems like solar energy (radiation, collection, storage, and application), Hydro and Wind energy. This course will also discuss some environmental impacts of power generation and also look at alternative and sustainable energy resources**.**

II. COURSE OBJECTIVES:

The students will try to learn:

I The fundamental concepts of power generation and gain knowledge about thedifferent renewable and non-renewable energy sources.

II Thorough theory on the construction and working principle of thermal, hydro-electric, nuclear and gas power plants.

III The key aspects in solar and wind power energy systems and analyze theirenvironmental aspects in the present-day scenario to obtain clean energy.

IV The various factors affecting cost of generations and the different Tariff methodsfor electrical energy consumption to attain optimum utilization of generated electrical energy.

V The ability to incorporate the knowledge of electrical power generation in workingwith minor and major projects and to take up research work in future.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the operating principle of thermal and nuclear powerstations to evaluate the significance.	Understand
CO 2	**Elucidate** the working principle and layout of hydroelectric power station (HPS) along with its multi-purpose utility.	Understand
CO 3	**Paraphrase** the solar power generation using photovoltaic effect and its applications.	Understand
CO 4	**Explain** the working principle of wind energy system (WES), types ofturbines and the importance of WES.	Understand
CO 5	**Maintain** the optimized working of wind power plants.	Apply
CO 6	**Interpret** the effect of role of tariff on the cost of power generation.	Apply

IV. SYLLABUS:

MODULE-I: CONVENTIONAL POWER GENERATION SYSTEMS (09)

Thermal Power Stations: Evaluation of power systems, present day scenario, Line diagram of thermal power station (TPS) showing paths of coal, steam, water, air, ash and flue gasses; Brief description of TPS components: Economizers, boilers, super heaters, turbines, condensers, chimney and cooling towers. Nuclear power stations: Nuclear fission and chain reaction, nuclear fuels, principle of operation of nuclear reactor, reactor components, moderators, control rods, reflectors and coolants, radiation hazards, shielding and safety precautions, types of nuclear reactors and brief description of PWR, BWR and FBR; Gas power stations: Principle of operation and components (Block diagram approach only).

MODULE-II: HYDROELECTRIC POWER STATIONS (09)

Hydroelectric Power Stations: Elements of hydro electric power station, types, concept of pumped storage plants, storage requirements, mass curve (explanation only), estimation of power developed from a given catchment area,

heads and efficiencies; Hydraulic turbines: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, working proportions, work done, efficiencies, hydraulic design, draft tube theory, functions and efficiency.

MODULE-III: SOLAR ENERGY (09)

Solar radiation: Environmental impact of solar power, physics of the sun, solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation, solar radiation data, solar concentrators, collectors, thermal applications, design of standalone solar systems, simple problems.

Photovoltaic systems: Photovoltaic effect, semiconducting materials, band gap theory, photo emission of electrons, cell configuration, types of solar cells, cell properties, device physics, electrostatic field across the depletion layer, voltage developed, I-V characteristics, module structure and fabrication, output power and efficiency, fill factor, maximum power point tracking (MPPT), solar grid connected inverters, simple problems.

MODULE-IV: WIND ENERGY (09)

Wind energy: Sources and potential, power from wind, Betz criterion, components of wind energy conversion system, types of turbines, horizontal and vertical axis wind turbines, aerodynamics, momentum theory (actuator disk concept), operational characteristics, blade element theory, types of generating systems for wind energy, permanent magnet generators, DC generators, induction generators, doubly fed induction generators, applications of wind energy, safety and environmental aspects, simple problems.

MODULE-V: ECONOMIC ASPECTS OF POWER GENERATION (09)

Terms commonly used in system operation, various factors affecting cost of generations; load curves, connected load, maximum demand, peak load, base load and peak load power plants, load factors, plant capacity factor, plant use factor, demand factors, diversity factor, cost of power plant, tariffs.

V. TEXT BOOKS:

1. C L Wadhawa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Limited, New Delhi, 3rd Edition, 2005.
2. G D Rai, "Non-Conventional Energy Sources", Khanna Publishers, 1st Edition, 2011.
3. G N Tiwari, M K Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publications, New Delhi, 1st Edition, 2007.
4. Chetan Singh Solanki, "Solar Photovoltaics", PHI Publications, 2nd Edition, 2011.
5. M L Soni, P V Gupta, U S Bhatnagar and A Chakraborti, "A text book on Power system engineering", Dhanpat Rai and Co. Pvt. Ltd, 1999.

VI. REFERENCE BOOKS:

1. J B Gupta, "A Course in Electrical Power", S K Kataria and Sons, New Delhi, 15th Edition, 2013.
2. M V Deshpande, "Elements of Power Station design", Prentice Hall India Learning Private Limited, New Delhi, 1st Edition, 1992.
3. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 1st Edition, 1999.
4. V K Mehta and Rohit Mehta, "Principle of Power Systems", S Chand & Company, Ltd, New Delhi, 3rd Edition, 2005.

VII. WEB REFERENCES:

1. https://www.solarpowernotes.com
2. https://www.electrical4u.com/power-plants-types-of-power-plant
3. https://www.iare.ac.in

VIII. E-TEXT BOOKS:

1. https://www.amazon.in/Electrical-Power-Engineering-Reference-Applications
2. https://www.nitt.edu
3. https://www.textbooksonline.tn.nic.in