University of Sargodha
College of Engineering and Technology
Department of Electrical Engineering

Course Syllabus
EE414: Power Generation

Semester / Session: 7th (Fall-2017) / 2017-2021

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Office Hours: 0200hrs to 1600hrs

Course TA: N.A.

Course Description: This course is to learn about different generating power plants as Hydro-electric, wind, thermal, gas, solar thermal, nuclear plants and geothermal. The course will also focus on the comparison between different generating power plants according to their running and fixed costs, their typical ramp, economics and electrical loads in power systems, environmental impacts of power generation and will look at alternative and sustainable generation systems.

Catalog Data:

Course Code:	EE-414
Course Title:	Power Generation
Credit Hours:	3+1
Course Designation:	Core Depth
No of Sessions per week:	2 (Total 32 sessions)
Session Duration:	90 min

Catalog Description: **EE-414 Power Generation, Credits (4)**
Thermal Power Plants: Sources of conventional energy and method of harnessing, special features and cycles used in steam, **gas and diesel** power plants, combine cycle systems and cogeneration. Location of the above plants and selection of units, prime movers and associated equipment. **Hydroelectric Power Plants:** The plants and their equipment, layouts, run of the river and accumulation type station, types of hydroelectric turbines and their stations. **Nuclear Power Plants:** Nuclear reaction, fission and fusion reaction, critical mass chain reaction, moderators, reactor control and cooling, classification of reactors, different types of reactors, radiation damages, shielding of grays neutrons, materials for construction. **Thermoelectric Generators:** Thermoelectric effect, solid state description of thermoelectric effect, analysis and design of thermoelectric generators, figure of merit, device configuration, solar and radioisotope powered generators, applications. **MHD Generators:** Gaseous conductors, analysis and design of MHD generator, problems associated with MHD generation, possible configuration. **Photovoltaic Generators:**

Radiation principles, optical effects in semiconductors and PN junction, analysis and design of converter, fabrication of cells, solar cells in space. **Fuel Cells:** Thermodynamic principles, efficiency of fuel cell factors limiting the performance, design, new development in fuel cells, possibility of future use in electric vehicles. **Wind power generation.**

Prerequisite: NIL

Prerequisites by Topics: NIL

Co-requisite: NIL

Textbook: Prof. Dr. M. N. Arbab, "Power Generation"

References:

1. Arche W. Culp, "Principles of Energy Conversion", Latest Edition.
2. M.M. Wakel, "Power Plant Technology", McGraw-Hill, Latest Edition.
3. V. K. Mehtha, R. Mehtha, "Principles of Power System"
4. Deshpande, "Principles of Power Generation"

Program Learning Outcome: This course is designed in conjunction with the following PLOs.

PLO 1. Engineering Knowledge: An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO 2. Problem Analysis: An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

Course Learning Outcome (CLO):

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

CLO#	CLO Outline	Relevant PLOs	Learning Domain & Level	Assessment
1	Discuss the concepts related to various technologies of power generation and carry out calculations on economics and electrical loads in power generation system	1	C - 3	
2	Analyze and compare various generation technologies with respect to their efficiency and their area of application	2	C - 4	

Course Professional Outcome/ Industrial Usage:

This course is an introductory course on power generations and systems. It is designed for students in electrical engineering. It introduces students to concepts related to various technologies of power generation. It also equips the students with fundamental concepts and analyses skills to evaluate.

Course Outline and Sessions Breakdown:

I. Economics and electrical load in power system (CLO-1)
(06 Sessions)
Introduction, Energy Resources in Pakistan, Methods of Energy Conversion, Development of Energy resources, Environmental Issues of Power Generation, Relative cost of Various Power Plant Interests, salvage, depreciation, loss factor, load factor, diversity, tariff.

II. Thermal Power Station (CLO-2)
(06 Sessions)
Steam power station, Gas power station and diesel power station working principles, components and working.

III. Hydro-Electric Power Station (CLO-2)
(04 Sessions)
Hydro-Electric power station working principles, issues, design and layout, types of Dam, plants and turbines.

IV. Nuclear power station (CLO-2)
(06 Sessions)
Principle, Nuclear reactions, types of reactors, components and working, shielding, hazards

V. Wind and Solar power stations (CLO-2)
(05 Sessions)
Types of turbines, working, solar thermal and photovoltaic power generation.

VI. Thermoelectric and MHD Generators: (CLO-2)
(03 Sessions)
Thermoelectric effect, solid state description of thermoelectric effect, analysis and design of thermoelectric generators, figure of merit, device configuration. Analysis and design of MHD generator, gaseous conductors, possible configuration, and problems associated with MHD generation.

VII. Fuel Cells: (CLO-2)
(02 Session)

Thermodynamic principles, efficiency of fuel cell factors limiting the performance, design, new development in fuel cells, possibility of future use in electric vehicles

Computer Usage: Not applicable unless otherwise stated.

Projects / Design Activities: NIL

Evaluation Criteria:			
	1. Assignments	10%	CLO1 – CLO2
	2. Quizzes	20%	CLO1 – CLO2
	3. Mid-Term Exam	20%	CLO1 – CLO2
	4. Final Exam	50%	CLO1 – CLO2

Policies

(a) No makeup tests or quizzes, except in case of emergency, e.g. illness and accident. For makeup tests, medical certificate is required and the instructor must be notified in advance of the test.
(b) No late assignment will be accepted.
(c) Topics and schedule mentioned here are tentative. They may be slightly changed depending on the interest / pace of class.
(d) **Class notes and Handouts:**

Students must take notes in the class. Equations, expressions and problems would be copied from the board as the instructor writes while, the student should note down important points as the instructor delivers the lecture both as orally and through slides. This body of material would form the most important asset of the student for exam preparation and in obtaining good grades.

Additional study material supplementing the class notes is the text book. The student must always inculcate the habit of book reading for deepening and strengthening the concepts gained in the class.

(e) **Attendance Policy:**

Class attendance is mandatory. You are expected to be present in all classes. The students having their attendance less than 75% will not be allowed to appear in the exam and will be awarded "F" grade hence forth.

(f) **Homework Policy:**

- **You SHOULD NOT** copy homework from classmates. You may consult with the instructors or one of your classmates if there is a homework problem that you find difficult.
- Copying assignment will not carry any benefit because quizzes will be based on assignments and most of the assignments will be marked based on quizzes.
- Late homework is not accepted for any reason.
- Homework papers should have a cover page showing name, ID number, date, problem number and assignment number.

- Class serial number should appear on the top right hand corner of the cover page.
- All problems in an assignment set should be arranged sequentially.
- A4 Paper should be used for Assignments.

(g) **Quizzes:**

These will be held promptly on the designated day. They will cover the material taught the previous weeks. Late arrival or non-attendance without a legitimate excuse will mean that you are ineligible to take that quiz.

(h) **Academic Dishonesty:**

The UOS is an academic community whose purpose is the pursuit of knowledge and the development of its graduates as leading experts in their academic disciplines. All members of this community must be committed to the principles of truth and academic honesty. Academic dishonesty includes the following acts committed knowingly or intentionally by the student:

- **Cheating:** Using or attempting to use unauthorized materials and assistance, such as notes, study aids, electronic communication devices of any sort, or any other forms of unauthorized information or consulting any unauthorized sources, in any academic assignment, exercise, or examination.
- **Fabrication**: Falsifying or inventing research, citations, or any information on any academic assignment, exercise, or examination.
- **Plagiarism:** Representing another's words or ideas as one's own or failing to give proper credit to outside sources of information in any academic assignment, exercise, or examination.
- **Facilitating academic dishonesty:** Aiding or assisting another in cheating, fabrication or plagiarism.

Students who have committed an act of academic dishonesty are subject to one or more of the following penalties:

- A written warning
- A reduction in grade for the assignment
- A zero grade for the assignment
- A reduction of grade for the course, including an **F** grade for the course.
- Suspension from the Wah Engineering College for one or more semesters.
- Expulsion from the Wah Engineering College.

Records of incidents of academic dishonesty will be kept on file at the Wah Engineering College and may be reported to the student's guardian and sponsor.

Students who are in doubt about whether certain academic activities are honest or not should discuss the matter with the course instructor or consult the WEC policy on academic integrity.

Disclaimer:

(i) The instructor reserves the right to change, and adjust the policies and class schedules at any time during the semester.

COURSE DISTRIBUTION ON WEEKLY BASIS

Weeks	Topics	Quiz/

		Assign-ment
WEEK 01 TO WEEK 03	**Introduction** Methods of energy conversion, development of energy resources, environmental issues of power generation, main sources for producing electrical energy with particular reference to Pakistan Brief statements of load factor, demand factor diversity factor their calculation, Interests, salvage, depreciation, cost of generation, fixed and variable operating cost, calculations, tariff calculations.	CLO-1
WEEK 04 TO WEEK 05	**Steam Power Station:** Working principle design and layout. Brief description and types of boiler, turbine, condenser, heat exchanger etc., Operation cycle of steam and flue gases from boiler, special features and cycles used in steam, Efficiency and Cost.	CLO-2 Assignment 01 Quiz 1
WEEK 05	**Gas Power Station:** Open and close cycle plant, working principle and plant operation. Efficiency and Cost.	CLO-2
WEEK 06	**Diesel Power Station:** Introduction and Design of diesel power station, Field and types of use of Diesel engine, Diesel electric generator, Efficiency and Cost.	CLO-2
WEEK 07 TO WEEK 08	**Hydro-Electric Power Station:** Selection of suitable site fur plant, working principle and arrangement layout diagram of hydro-electric plant, Types of dams. Type of hydroelectric plants, types of turbines for hydro-plant, Efficiency and Cost	CLO-2 Quiz 2
WEEK 09	**Mid Term**	CLO-1 to CLO-2
WEEK 10 TO WEEK 12	**Nuclear Power Station:** Advantages, principles of nuclear energy, Design and layout of nuclear power stations, Reactor and reactor control, Brief description of different types of reactors, Nuclear radiations, shielding of equipment, waste disposal, Chain reaction process of uranium, Problems and difficulties of atomic power plant	CLO-2
WEEK 13 TO WEEK 15	**Wind and Solar Power Station:** Introduction to renewable energy sources, Types of turbines, working of Wind power plant,	CLO-2 Assignment 02

	solar thermal and photovoltaic power generation.	
WEEK 15 TO WEEK 16	**Thermoelectric and MHD Generators:** Thermoelectric effect, solid state description of thermoelectric effect, analysis and design of thermoelectric generators, figure of merit, device configuration. Analysis and design of MHD generator, gaseous conductors, possible configuration, and problems associated with MHD generation.	CLO-2
WEEK 17	**Fuel Cells:** Thermodynamic principles, efficiency of fuel cell factors limiting the performance, design, new development in fuel cells, possibility of future use in electric vehicles	CLO-2 Quiz 3
WEEK 18	**Final Examination**	CLO-1 to CLO-4