SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: ELECTRICAL POWER SYSTEMS

Code No.: ELR 202

Program: ELECTRICAL ENGINEERING TECHNICIAN

Semester: THREE

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Chairperson Date

ELECTRICAL POWER SYSTEM	ELR 202
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PHILOSOPHY/GOALS:

To provide an overall understanding of electrical power generation, transmission and distribution from the energy source to the customer.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Written tests will be conducted at regular intervals.
2. Grading

A - 76 - 100%

B - 66 - 75%

C - 55 - 65%

X - 50 - 55%

R less than 50%

TEXTBOOK(S):

None.

BLOCK 1: SOURCES OF ENERGY AND THERMAL PLANTS

To be able to recall and briefly explain with sketches as appropriate the following:

1. The location and availability of Canada's hydrocarbon reserves, i.e. coal, oil and gas.
2. The location and availability of Canada's uranium sources.
3. The three steps required to turn hydrocarbon fuels into useful heat.
4. The basic layout and functions of the major components of a boiler plant.
5. The basic principles of a central receiver type solar power station.
6. The basic principle of photovoltaic power system.
7. The basic principle of ocean thermal energy conversion.
8. The basic principle of producing electrical energy by windpower.
9. The basic principle of producing electrical energy by wavepower.
10. The basic principle of producing electrical energy from geothermal sources.
11. The basic types of steam turbines and their arrangements as single cylinder; two cylinder, tandem compound, double flow; three cylinder, tandem compound, double flow with reheat; two cylinder, cross compound double flow; four cylinder, tandem cross compound, quadruple flow with reheat.
12. The function of a steam turbine governor and its basic principle c operation.
13. The basic principle of boiler control to meet varying load demands

BLOCK 2: NUCLEAR REACTORS

To be able to recall and explain with the aid of sketches as appropriate.

1. That nuclear energy is the energy within the atom that binds the components together, which when released results in nuclear radiations, and the release of large quantities of heat.

2. That nuclear radiations take the form of gamma rays, nuclear particles such as alpha rays (helium particles), beta rays (electrons), neutrons, positions, protons and gamma rays.

3. That nuclear fission occurs when the nuclei of heavier elements split up into two smaller nuclei.

4. That nuclear fusion occurs when two smaller nuclei of lighter elements combine to form a large nucleus.

5. That in both fission and fusion, the mass of the original nuclei i greater than the total mass of the end product, the mass differenc is released in heat energy.

6. That a chain reaction occurs when a fissionable nucleus is split b a neutron it releases energy and one or more neutrons. These neutrons split other fissionable nuclei releasing more energy and more neutrons making the reaction self sustaining as long as there are enough fissionable nuclei present.

7. The fission only occurs when the nuclei are bombarded by slow neutrons.

8. Fast neutrons may be slowed by a moderator such as carbon, beryllium or heavy water.

9. That heavy water is the combination of two deuterium atoms with an oxygen atom, and is the moderator used in the CANDU reactor system.

10. Uranium fuel consists of 99.28%, ^{238} and 0.71%, ^{235} with a trace of ^{234}. The function of the moderator is to slow the neutrons to achieve a chain reaction of the ^{235}.

11. ^{238} does not fission readily, but absorbs neutrons and forms P_u^{239} (plutonium).

BLOCK 2: NUCLEAR REACTORS - Con't

12. That the fission of 1 lb of ^{235}, releases as much heat as burning 3,000,000 lbs of coal, or 300,000 gallons of fuel oil, or over 10,000,000 cubic feet of natural gas or expressed another way it releases 1250 kilowatt-years of energy.

BLOCK 2: NUCLEAR REACTORS - Con't.

13. The basic construction and principle of operation of:

a) Graphite Moderated, Gas Cooled Reactors
b) Pressurized Water Reactors (PWR)
c) CANDU, Pressurized Heavy Water Reactors (PAW)
d) CANDU, Boiling Light Water Reactors (BLW)
e) CANDU, Organic Cooled Reactors (OCR)
f) Fast Breeder Reactors

14. Nuclear power plants have the following as compared to fossil fuel plants:

Advantages:

1. Operating costs per kWh are significantly less
2. Less auxiliary equipment required
3. Because of fast reactor start-up, there is less standby losses
4. Less site area required.

Disadvantages:

1. High initial capital costs
2. Remote possibility of radiation leakage.

BLOCK 3: HYDRO-ELECTRIC GENERATORS

To be able to recall and explain with the aid of sketches as appropriate:

1. That hydro power developments are of two general types:

   a) Those which dam the river and have a spillway, control gates and a power house in an integrated unit, usually low head plants; and

   b) Those which short circuit a part of the river fall by means of a pipeline, tunnel or canal. In this type the dam and spillway may be some distance from the powerhouse, usually high head plants.

2. That generally heads 20 to 100 feet are called low head, 100 to 600 feet, medium head, and over 600 feet high head.

3. That a pumped storage plant is used principally as a peak load station, and at times of maximum river flow, or during off peak periods, water is pumped back through the turbines into a storage forebay.

4. That there are three basic types of waterwheel turbine runners.

   a) The reaction or Francis turbine, usually used on heads between 70 to 1000 feet

   b) The impulse or Pelton turbine, usually used on heads between 300 to 3000 feet

   c) The Kaplan or variable pitch turbine usually used on heads up to 100 feet

5. The function and principle of operation of the governor and its associated servo control system for controlling waterflow.

6. The principles of construction and advantages and disadvantages of the two bearing and umbrella types of generators.

7. The three types of d-c excitation systems.

8. The basic method of closed cycle ventilation and its advantages.

9. The basic principles of rotor construction and assembly.

10. The function of guide bearings, and the basic principles of a Mitchell thrust bearing.

11. The principle and functions of the hydraulic brake system.

BLOCK 4: TRANSMISSION SYSTEMS AND LINES

To be able to recall and explain with the aid of sketches and phasor diagrams as appropriate, the following:

1. The construction and types of overhead conductors used in transmission lines.
2. The factors determining the spacing of overhead conductors.
3. The fundamental schemes of transmission.
4. The requirements and methods of voltage regulation of a transmission line.
5. The causes of corona, its effects in generators, and transmission lines and the means of reducing the production and damage caused by corona.
6. The properties of a H.T. insulator and the types and applications of insulators.
7. String efficiency and methods of improving string efficiency.
8. The factors determining the type of line structures and location of H.T. transmission lines.
9. The production of lightening and the characteristics of lightning strokes.
10. The function of sky wires, grounding systems, (transmission line) and the construction of Thyrite, Pellet Type and Autovalve lightning arrestors.
11. The factors governing the type of tower structure, and the types of structures in common use for H.T. transmission lines.
12. The types and requirements of line accessories.
13. The types of conductors vibration, their causes, effects and minimization.
14. The types and functions of dead ends.
15. The purpose of line transposition.

To be able to recall and explain with the aid of sketches as appropriate, the following:

1. The functions, requirements and methods of operation of circuit breakers.

2. The three ratings of a circuit interrupting device.

3. The production of a plasma and its characteristics, and its importance in the interruption process.

4. The production of the space charge and its effects.

5. The necessity of cooling the arc.

6. The principle of operation of magnetic breakers and air blast breakers and the methods of arc extinction.

7. The principle of arc extinction in oil circuit breakers and three methods of achieving this.

8. The characteristics and properties of SF_6 circuit breakers.

9. The principle of operation and limitations of vacuum circuit breakers.