Fayoum University **Generation of Electrical Power**
Electrical Engineering Department **Time: 3 Hours**

Final Exam (January 2016)

Attempt All Questions. Each question has an equal weight of Marks

(1) (a) What is a hydrograph? What information does it provide? How can the storage requirements for a hydro project be determined?

(b) The weekly discharge of a typical hydroelectric plant is as under:

Day	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Discharge m^3/sec	500	520	850	800	875	900	546

The plant has an effective head of 15 m and an overall efficiency of 85%. If the plant operates on 40% load factor, estimate:

(i) The average daily discharge.
(ii) Pondage size required.
(iii) Installed capacity of proposed plant.

(c) A thermal power plant consists of two 60 MW units each running for 8000 hours and one 30 MW unit running for 2000 hours per year. The energy produced by the plant is 876 x 10^6 kWh per year Determine plant load factor and plant utilization factor. Consider maximum demand s equal to plant capacity.

(2) (a) Differentiate between fixed and operating coasts of power plants. List the items which constitute the fixed and the operating costs.

(b) A 10 MW thermal generating plant has the following data:
Peak load = 8 MW; Annual load factor = 72%; Cost of plant = L.E. 800/ kW installed capacity; Cost of transmission and distribution system = L.E. $350x10^3$
Interest, depreciation on distribution system = 5%
Annual operating cost = L.E. $350x10^3$; Cost of coal = L.E. 6 per kN;
Annual interest, insurance and depreciation = 10%. of the capital cost
Plant maintenance cost = L.E. 30000 / year (fixed)
= L.E. 40000 / year (running)
Coal used = 250000 kN/ year
Assume transmission and distribution costs are to be charged to generation.
(i) Devise a two part tariff, and (ii) The average cost per kWh generated.

(3) (a) Why it is generally not economical to improve the power factor of installation to unity? How can the most economical power factor be determined for a consumer installation?

(b) A 3-phase, 50-Hz, 40 kW, 440 V induction motor operates on full load with a power factor of 0.8 lagging and 90% efficiency. Determine the total kVAR rating of capacitors to raise the power factor to 0.9 lagging. What will be the capacitance of each capacitor per phase if the capacitors are connected in (i) Delta or (ii) Star.

(c) An installed capacity of a power plant is 210 MW and its capital cost is10000 L.E./kW. The fixed cost is 13% of the investment. At full load, the variable cost is 1.3 times the

fixed cost per year. Assuming the variable cost is proportional to the energy produced, find the generating cost when the plan is running at (i) full load and (ii) 50% load.

(4) (a) Define, with diagrams; input-output characteristics, heat rate, and incremental cost in a thermal power plant. Why is it necessary to include transmission line losses in the optimal loading of generating units?

(b) A simple power system consists of two generating plants and a load center. The power losses in the system are negligible, and suppose the costs of generation are:

$C_1 = 0.05\ P^2 + 20\ P_1 + 800$ L.E/h

$C_2 = 0.06\ P^2 + 15\ P_2 + 1000$ L.E/h

If the total received power is 150 MW.

(i) Calculate P_1 and P_2 and cost for optimum operation.

(ii) Find the savings in one day realized from economic allocation of load between the units in comparison with their sharing the output equally when the load is150 MW.

(iii) Suppose that the real power loss is not negligible and can be approximated by:

$P_L = 0.00005\ P^2 + 0.0001\ P^2$ (P's in MW)

Obtain the penalty factors L_1 and L_2 for the two plants in terms of the generated powers.

Given a certain demand, plant 1 generates 65 MW for optimal operation; find the Incremental Cost of power delivered λ, power generated by plant 2, power losses, and power demand.

(5) (a) Draw the schematic diagram and explain the main components of a gas turbine plant. Explain its operation and state the areas of application. What are the advantages, disadvantages, of gas turbine power plants?

(b) What conditions govern the selection of sites for hydroelectric power plants?

(c) A region has a maximum demand of 500 MW at a load factor of 50%. The load duration curve can be assumed to be a triangle. The utility has to meet this load by setting up a generating system, which is partly hydro and partly thermal. The annual cost characteristics are as under:

Hydro plant: 600 L.E. per kW + 3 piaster per kWh

Thermal plant: 300 L.E. per kW + 13 piaster per kWh

Determine: (i) The capacity of hydro plant, (ii) energy generated annually by each station, and (iii) overall generation cost per kWh.