UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	ELECTRIC POWER GENERATION
COURSE CODE	:	BEK 4243
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	APRIL/MAY 2011
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF FOUR (4) PAGES

Q1 (a) Explain, with the aid of a diagram:

(i) Why steam need to be superheated before sending to the turbine

(ii) Why outlet from the high pressure turbine need to be reheated before delivering to the intermediate pressure turbine

(6 marks)

(b) A steam power plant is designed to operate on a Rankine cycle with operating pressures of 10 kPa and 3 MPa (all pressures are gauge). Given that the maximum operating temperature is 450 °C, do the following:

(i) Draw a diagrammatic representation of the power plant

(ii) Produce the T-S diagram showing the operation of the Rankine cycle with the following markings: 1 to 2 pump, 2 to 3 boiler, 3 to 4 turbine, 4 to 1 condenser

(iii) Calculate the power needed to operate the pump

(iv) Calculate the energy required from the boiler

(v) Calculate the power output of the turbine, and

(vi) Determine the thermal efficiency of the power cycle

(19 marks)

Q2 (a) Draw and label a diagram with the inclusion of the automatic voltage regulator (AVR), showing the components making up a brushless AC generator. Explain briefly how voltage is built up after the generator is driven by the prime-mover to speed.

(8 marks)

(b) A 6 pole round rotor 3 phase star connected synchronous machine has the following test results:

Open circuit test: 4000 V line to line at 1000 rev/min, 50 A rotor current
Short circuit test: 300 A at 500 rev/min, 50 A rotor current

Neglect the stator resistance and core losses, and assuming a linear open circuit characteristic, plot a graph and calculate:

(i) The machine synchronous reactance at 50 Hz

(ii) The rotor current required for the machine to operate as a generator on an infinite bus of 3.3 kV line to line when delievering 1500 kVA at 0.8 power factor lagging

(iii) The load angle for (ii) above and

(iv) Sketch the phasor diagram for (ii) above

(17 marks)

Q3 (a) Explain pitch factor and distribution factor as regards to the synchronous machine winding.

(8 marks)

(b) Determine useful flux per pole of a turbo-alternator with sinusoidal flux distribution. It is a 3 phase, star connected, 50 Hz, 2 pole alternator having 54 slots with 4 conductors per slot. The coil pitch is 2 slots less than pole pitch. The machine generates 6.6 kV between lines on open circuit.

(8 marks)

(c) Explain, with the aid of suitable graph/diagram, how two AC generators, having similar kVA rating of 150, after paralleling, could share the loads of :

(i) 120 kW equally between themselves
(ii) 100 kW at one generator but 20 kW on the next generator

(9 marks)

Q4 (a) Explain the working of a Brayton cycle utilizing intercooling, reheating and regeneration with the aid of a layout diagram and a T-s diagram.

(10 marks)

(b) A stationary power plant operating on an ideal Brayton cycle has a pressure of 8. The gas temperature is 300 K at the compressor inlet and 1250 K at the turbine inlet. Utilizing the air-standard assumptions, determine:

(i) The gas temperature at the exits of the compressor
(ii) The gas temperature at the exits of the turbine
(iii) The back work ratio
(iv) The thermal efficiency of the Bryton cycle

(15 marks)

Q5 (a) Explain the function of a moderator and list three types of substance used as moderator in modern power reactor.

(6 marks)

(b) Describe briefly on thermal shielding

(6 marks)

(c) Describe the physical safety features built in a modern nuclear reactor

(6 marks)

(d) Describe briefly, with the aid of neat sketch, the working of a pressurized water reactor plant. List two of its advantages as compared to the boiling water reactor.

(7 marks)

Q6 (a) Describe briefly, with the aid of neat sketch, the working of a coal power plant.
(6 marks)

(b) Explain the actions taken to overcome the problem of particulates in a coal power plant.
(6 marks)

(c) Explain the methods used to get rid of sulphur dioxides in a coal power plant.
(6 marks)

(d) Discuss briefly the ways to handle the coal storage, transportation, pulverization and the handling of ash.
(7 marks)