UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ELECTRIC POWER GENERATION
COURSE CODE	:	BEK 4243/BEX 44903
PROGRAMME	:	BEE
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) A 16 pole, three phase synchronous generator has star connected winding with 144 slots and 10 conductors/slot. The flux/pole is 0.035 wb and has speed of 375 rpm. It has coil pitch of 8 slots. Calculate:

(i) The number of slots per pole
(ii) The number of slots per pole per phase
(iii) Distribution factor
(iv) Pitch factor
(v) Frequency
(vi) EMF induced per phase

In addition, plot the layout of the winding for the Red-phase only over three consecutive poles. Clearly show the connections between coils.

(12 marks)

(b) A three-phase star connected synchronous generator is rated at 1500 kVA, 13 kV. It has an armature resistance of 1.2 Ω and a synchronous reactance of 24 Ω/phase. Assuming that the generator is supplying full load at power factor of 0.8 lagging:

(i) Show the equivalent circuit per phase of the generator
(ii) Show the vector diagram of the generator at the load condition
(iii) Calculate the full load current and its associated phase angle with respect to the terminal voltage
(iv) Determine the induced emf in phase and line value
(v) Obtain the torque angle
(vi) Calculate the % voltage regulation of the generator

(13 marks)

Q2 (a) Generator with rating exceeding 100's of megawatt required DC excitation to be fed to the generator rotor. State any two types of excitation used in present day power plant and briefly describe each of the methods used.

(8 marks)

(b) When two AC generators are connected in parallel to supply power to the load, describe, with the aid of a diagram or diagrams, the way to share the load:

(i) Equally
(ii) In proportion to their kVA or power rating

(8 marks)

(c) All AC generators have their limitations as to how power or current that they can supply. List such limitations and show it on a power (P)-reactive power (Q) diagram.

(9 marks)

Q3 (a) Explain, with the aid of a diagram or diagrams:

(i) The reasons that steam need to be superheated before sending to the hp turbine

(ii) The reasons that 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 pressure of 6 MPa at 400 °C to the high pressure turbine. It also incorporate reheating to the same boiler temperature at pressure of 3 MPa before expansion to the low pressure turbine. Given that the maximum operating temperature is 400 °C, and the pressure at the exit of the low pressure turbine as 10 kPa:

(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 high pressure turbine, 4 to 5 reheating, 5 to 6 low pressure turbine, 6 to 1 the condenser

(iii) Calculate the power needed to operate the pump

(iv) Calculate the total energy required from the boiler

(v) Calculate the total power output of the high pressure and low pressure turbines, and

(vi) Determine the overall thermal efficiency of the power cycle

(19 marks)

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

(7 marks)

(b) Describe a combined cycle scheme in electric power generation. Briefly explain how the efficiency of the gas turbine when working alone can be increased while in the combined cycle scheme.

(8 marks)

(c) A stationary power plant operating on an ideal Brayton cycle has a pressure ratio 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 exit of the compressor

(ii) The gas temperature at the exit of the turbine

(iii) The back work ratio

(iv) The thermal efficiency of the Brayton cycle

(10 marks)

Q5 (a) Explain briefly the function of a moderator. List three types of elements used as moderator in modern nuclear power reactor.

(6 marks)

(b) Describe the physical safety features that are built in a modern nuclear reactor.

(6 marks)

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

(6 marks)

(d) The CANDU nuclear reactor has many different features as compared to the American BWR or the PWR type of reactors. Highlight in detail three of the most important features of CANDU that are different from that of the American reactors.

(7 marks)

Q6 (a) Describe in brief with the aid of neat sketch, the working of a coal power plant.

(7 marks)

(b) Explain how the coal power plant overcome the problem of particulates

(5 marks)

(c) Explain how the power plant gets rid of the sulphur oxides and the nitrous oxides?

(5 marks)

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

(8 marks)