

	Kafu El-Sheikh UNIVERSITY FACULTY OF ENGINEERING DEPARTMENT OF MECHANICAL POWER ENGINEERING			
	EXAMINATION FOR FRESHMEN (2016 YEAR), STUDENTS OF 3 <sup>th</sup> GRADE MECHANICAL POWER			
	COURSE TITLE:	<b>Thermal Power Stations (1)</b>		COURSE CODE: MEP3111
DATE:	January 24, 2016	TERM: 1 <sup>nd</sup>	TOTAL ASSESSMENT MARKS: 75	TIME ALLOWED (HOURS): 3

**Use of tables and charts of steam is allowed.** مسموح باستخدام خريطة و جداول البخار.

**Answer the following questions. Assume any necessary assumptions.**

**Question (1) (10 Marks)**

- 1- Mention the methods for improving the efficiency of steam cycles and what are the advantages of reheat?
  
- 2- Steam is generated in the boiler of a cogeneration plant at 10 MPa and 450°C at a steady rate of 5 kg/s. In normal operation, steam expands in a turbine to a pressure of 0.5 MPa and is then routed to the process heater, where it supplies the process heat. Steam leaves the process heater as a saturated liquid and is pumped to the boiler pressure. Steam passes through the condenser, which operates at 20 kPa.

**Determine:**

- (a) The power produced and the rate of process heat supplied if only 60 percent of the steam is routed to the process heater and the remainder is expanded to the condenser pressure.

**Question (2) (25 Marks)**

- 1- Discuss the different between natural and forced circulation in the boiler
  
- 2- 500 MW power plant operates with overall efficiency 30%, thermal cycle efficiency 38%. An analysis of coal gives a higher heating value of 42000 kJ/kg. The analysis of coal gives 10% H<sub>2</sub> and the analysis of the flue gas gives the mass of CO is 0.05 kg/kg<sub>f</sub> and refuse coal is 0.1195 kg/kg<sub>f</sub>. The atmospheric air conditions are 50 °C, 0.942 bar, and the relative humidity of 50 percent. The exhaust gas is at 300 °C and 0.891 bar. CP (dry flue gases)= 1.05 kJ/kg °C and the specific heat of water vapour is 1.926 kJ/kg °C. The power required for forced fan is 3000 kW with fan efficiency is 85% and the pressure rise across forced fan is 63 cm water.
  - a) Draw up the heat balance sheet on the basis of one kg of dry coal fired.
  - b) The power required for induced fan efficiency is 85%.

Take  $h_s - h_w = 2492.6 + 1.926T_{g0} - 4.187 T_{gi}$

**Question (3) (20 Marks)**

- 1- Mention the sources of air leakage in the condenser and what are its effects on condenser performance?
  
- 2- A steam turbine of 20000 kW capacity requires 5 kg of steam per hour per kW. The quantity of air leakage into the condenser is 1 kg per 1000 kg of steam used by turbine. The vacuum in the condenser is 70 cm of Hg when the barometer reads 76 cm of Hg. The temperature at the suction of the air pump is 30° C. The surface condenser used is fitted with a separate condensate pump and air pump. **Find:**
  - a) The capacity of air pump required per minute.
  - b) The mass of water vapor carried by air in kg per hour.
  - c) The quantity of cooling water required per minute in tons if the rise in temperature of the water is limited to 8°C. The quality of steam entering the condenser is 0.9 dry and there is no under cooling in the condenser.

**Question (4) (20 Marks)**

- 1- Estimate the main properties of a De Laval turbine?
- 2- Compare between impulse and reaction turbines?
  
- 3- Steam with a velocity of 600 m/s enters an impulse turbine row of blades at an angle of 25° to the plane of rotation. The mean blades speed is 255 m/s. The blade exit angle is 30°. There is a loss of 10% in relative velocity due to friction in the blades. **Determine:**
  - a) The blade inlet angle,
  - b) The blade efficiency,
  - c) The work done per 1 kg/s of steam,
  - d) The end thrust per 1 kg/s of steam.

EXAMINERS	Dr. Magda El-Fakharany	

Best wishes