UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M Tech / ES	**Semester – III**
Subject (Course): Performance analysis of thermal systems	**Max. Marks : 100**
Course Code : MNEG 821	**Duration : 3 Hrs**
No. of page/s: 3	

Section – A (20 marks).

Q.1: In case of oversized centrifugal pumps, show the effect of throttling process on system curve with the help of head v/s flow diagram. **(5)**

Q.2: Differentiate between the functioning of positive displacement compressor and dynamic compressors. **(5)**

Q.3: Distinguish the working methodology used in tube axial, vane axial and propeller fans.**(5)**

Q.4: Enlist the flow control strategies adopted in fans and blowers. **(5)**

Section – B (40 marks)

Q.5: (a) Enlist the merits and demerit of the direct and indirect method used in the performance analysis of boilers. **(4)**

(b) The following data is obtained for a coal fired boiler. Calculate the efficiency and evaporation ratio using direct method. **(6)**

Quantity of steam generated (output)	8 TPH
Steam pressure / temperature	10 kg/cm^2/180^{0}C
Enthalpy of steam (dry and saturated at given pressure	665 Kcal/Kg
Feed water temperature	85^{0}C
Enthalpy of feed water	85 kCal/kg
Quantity of coal consumed (input)	1. 6 TPH
GCV of coal	4000 kCal/kg

Q.6: For measuring free air delivery (FAD) in compressors using nozzle method**.** , explain its working principle, instruments required and its arrangements. **(10)**

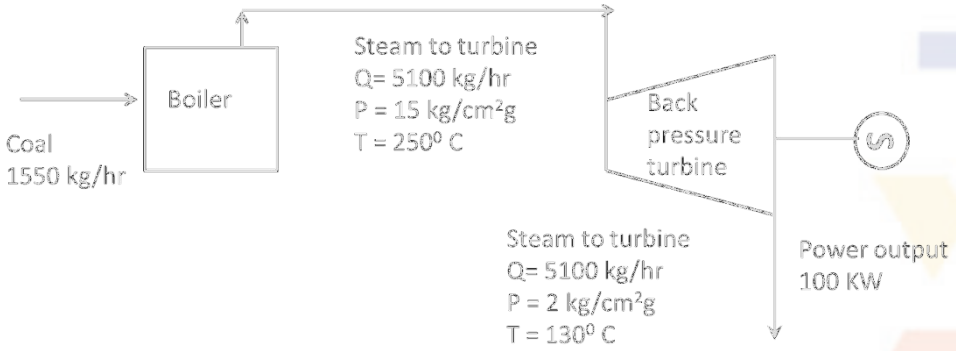
Q.7: Assessing compressed air system study for a plant section gave following results. The compressors on line A, B, C, D, E are all reciprocating type. Obtain the specific power consumption and comment on the results? **(10)**

Compressor Reference	Measured Capacity CMM (@ 7 kg/ cm^2)	'On' Load kW	'Unload' kW	Load Time Min.	Unload Time Min.
A	13.17	115.30	42.3	Full time*	Nil
B	12.32	117.20	51.8	Full time*	Nil
C	13.14	108.30	43.3	Full time*	Nil
D	12.75	104.30	29.8	Full time*	Nil
E	13.65	109.30	39.3	5.88 min.	39.12 min.

Q.8: Explain the methodology of evaluating performance of a gas turbine with a heat recovery steam generator. **(10)**

Section C (40 marks)

Q.9. A distillery plant having an average production of 40 kiloliters of ethanol is having a cogeneration system with a backpressure turbine. The plant steam and electrical demand are 5.1 Tons/ hr and 100 kW. The process flow diagram is shown below. Gross calorific value of coal is 4000 kCal/kg.



Calculate the efficiency of the turbine, coal consumption and overall plant heat rate. **(20)**

Q. 10. (a) The following are the data collected for a boiler using coal as the fuel. Find out the boiler efficiency by indirect method. **(20)**

Ultimate analysis (%)

Fuel firing rate = 5599.17 kg/hr, Steam generation rate = 21937.5 kg/hr
Steam pressure = 43 kg/cm2(g), Steam temperature = 377 °C
Feed water temperature = 96 °C, %CO2 in Flue gas = 14
%CO in flue gas = 0.55, Average flue gas temperature = 190 °C
Ambient temperature = 31 °C, Humidity in ambient air = 0.0204 kg / kg dry air
Surface temperature of boiler = 70 °C, Wind velocity around the boiler = 3.5 m/s
Total surface area of boiler = 90 m^2, GCV of Bottom ash = 800 kCal/kg
GCV of fly ash = 452.5 kCal/kg, Ratio of bottom ash to fly ash = 90:10

Fuel Analysis (in %)

Ash content in fuel = 8.63 , Moisture in coal = 31.6
Carbon content = 41.65, Hydrogen content = 2.0413
Nitrogen content = 1.6, Oxygen content = 14.48
GCV of Coal = 3501 kCal/kg

Or

(b) The following are the data collected for a boiler using oil as the fuel. Find out the boiler efficiency by indirect method:

Ultimate analysis (%)

Carbon = 84 , Hydrogen = 12, Nitrogen = 0.5, Oxygen = 1.5, Sulphur = 1.5
Moisture = 0.5,
GCV of fuel = 10000 kCal/kg
Fuel firing rate = 2648.125 kg/hr
Surface Temperature of boiler = 80 °C
Surface area of boiler = 90 m_2
Humidity = 0.025 kg/kg of dry air
Wind speed = 3.8 m/s

Flue gas analysis (%)

Flue gas temperature = 190°C, Ambient temperature = 30°C
Co_2% in flue gas by volume = 10.8, O_2% in flue gas by volume = 7.4