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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR

MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION

SESSION

SUBJECT CODE	:	**FRB 30203**
SUBJECT TITLE	:	**APPLIED THERMODYNAMICS**
LEVEL	:	**BACHELOR**
TIME/DURATION	:	**9.00 a.m – 12.00 noon (3 HOURS)**
DATE	:	**09 JANUARY 2014**

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists only one section. Answer ALL questions.**
6. **Answer all questions in English.**
7. **This is an opened book examination.**

THERE ARE 3 PRINTED PAGES OF QUESTIONS, EXCLUDING THIS PAGE

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

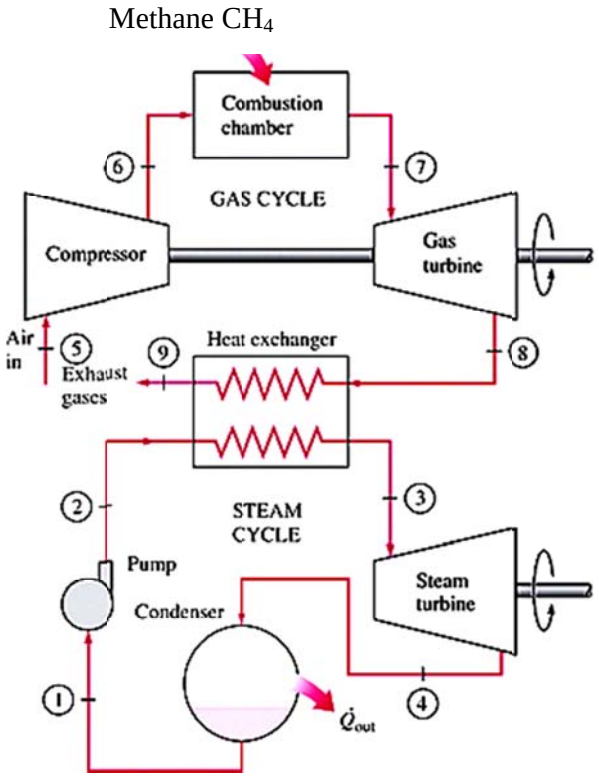

Figure 1

A schematic diagram of a combined gas-steam cycle is given on Fig.1. For the gas cycle, air (M = 29 g/mol) enters the compressor at temperature T5 = 25°C, P5 = 1 bar with the mass flow rate of 495 kg/s and discharge to P6 & T6. The compression ratio is 15.4. The mixture (air + fuel) is burned at constant pressure P6 in an adiabatic combustion chamber. The outlet of the combustion chamber (7) i.e. the product of combustion' properties is similar to air properties. The outlet temperature T7 = 850°C. The fuel is methane (CH_4, M = 16g/mol) and the combustion involved with an excess air (λ) 3.5. The products of combustion T7, P7 =P6 are expanded to pressure P8 = P5 in the turbine at a temperature T8. The net work of the cycle is $W_{turbine} - W_{comp}$. The isentropic efficiency of the compressor is 0.85 and the turbine is 0.9.

The heat intake (Qi_n) for the steam cycle occurs in the heat exchanger and the pump W_{in} = 750 kW. The steam turbine work output drives the pump. Heat is rejected (Q_{out}) to the

condenser at P4 = P1 = 0.02 bar and the condenser is cooled by seawater. It is given that P2 = 145 bar, h2 = 98 kJ/kg, h3 = 3345 kJ/kg and h4 = 2200 kJ/kg. Answer these questions. (Note: Use only Tables in your 'Yunus Cengel' textbook to solve all the questions. You can use water Moiller chart to solve some of the problems. If you're stuck on a question, make a realistic assumption results in order to continue. Show all works in order to qualify for marks. For the properties at the pump, use this formula; $\Delta h = Cp\,\Delta T + v\Delta P$. Cp = 4.187 kJ/kgK)

Question 1

Gas cycle

(a) Determine h, T and P for state 1.

(2 marks)

(b) Write the combustion equation.

(1 marks)

(c) Calculate the required mass flow rate of the fuel.

(2 marks)

(d) Calculate the mass flow of the product of the combustion entering the turbine.

(2 marks)

(e) Calculate the net power developed by the cycle and the cycle efficiency.

(2 marks)

Question 2

Steam cycle

(a) Determine h, T and P for state 1.

(2 marks)

(b) Calculate the temperature T2.

(1 marks)

(c) Calculate the mass flow rate of the steam.

(2 marks)

(d) Calculate the mass flow rate of the sea water required if the sea water is not allowed to rise more than 4°C.

(2 marks)

(e) Calculate the cycle efficiency.

(2 marks)

Question 3

Combined cycle

(a) Calculate the cycle efficiency.

(2 marks)

END OF QUESTIONS