

PRINCE OF SONGKLA UNIVERSITY  
FACULTY OF ENGINEERING

Mid-semester examination: Semester-I

Academic year: 2006

Date: 30/07/2006

Time: 09:00-12:00

Subject: 215-436 and 216-436 Gas Turbine Theory

Room: A401

หมายเหตุ: (จำนวนนักศึกษา 41 คน)

1. ข้อสอบมี 5 ข้อ (ทำทุกข้อ)
2. อนุญาตให้นำตำราเรียนเข้าห้องสอบได้ 1 เล่มเท่านั้นคือ Gas Turbines by V. Ganesan
3. อนุญาตให้นำเครื่องคิดเลขและ Dictionary ทุกประเภทเข้าห้องสอบได้
4. ให้ทำในกระดาษคำถาม (ไม่พอลให้ต่อด้านหลังหรือขอกระดาษเพิ่มได้)
5. คะแนนการสอบคิดเป็น 35% ของทั้งภาคการศึกษา

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	4	
2	4	
3	6	
4	10	
5	11	
รวม	35	



อ.วิริยะ ทองเรือง

ผู้ออกข้อสอบ

ข้อ 1. (4 คะแนน) Prove that how the stagnation temperature in compressible flow machines relates to a working fluid velocity and the velocity of sound.

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ข้อ 3. (6 คะแนน) In a simple gas turbine plant, air at  $15\text{ }^{\circ}\text{C}$  and 1 bar is compressed to obtain a compression ratio of 6 with compressor efficiency of 100%. Air is heated in the regenerator having 100% effectiveness. The maximum temperature of gas is  $750\text{ }^{\circ}\text{C}$ . The pressure drop in a combustion chamber is 0.15 bar. Calculate the thermal efficiency of this cycle. Given,  $\gamma=1.4$ ,  $C_p= 1.005\text{ kJ/kg-K}$

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**ข้อ 4. (10 คะแนน)** In a gas turbine unit, air at temperature of 15 °C is compressed through a compressor with a pressure ratio of 6. The mixture of compressed air and fuel is burned in a combustion chamber giving hot gas at the maximum temperature of 750 °C. Hot gas is expanded through 2 sets of a turbine. Both turbines were designed to operate at optimum pressure ratio. After expanding through the 1<sup>st</sup> set, gas is again reheated to a temperature of 750 °C.

Given:

isentropic efficiency of compressor = 80%

isentropic efficiency of turbines (both set) = 85%

$C_p = 1.005 \text{ kJ/kg-K}$

specific heat ratio ( $\gamma$ ) = 1.4

Determine,

4.1 schematic and T-S diagrams

4.2 work ratio ( $W_{net}/W_T$ )

4.3 cycle efficiency

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ข้อ 5. (11 คะแนน) For a gas turbine operating at a pressure ratio of 8.7 the maximum temperature ratio to be maintained such that the turbine just supports the compressor, which is given by  $t_{min} = 3.0$ . If the compressor inlet total temperature and the turbine efficiency are 300 K and 0.75, respectively. Determine,

5.1 The T-s diagram (2 คะแนน)

5.2 The compressor efficiency (3 คะแนน)

5.3 The temperature ratio at which the compressor work is 80% of the power produced by turbine. Also find the corresponding heat addition and network output per unit mass in the gas turbine. Take  $C_{pa} = 1.005$  kJ/kg-K and  $C_{pg} = 1.147$  kJ/kg-K. (3 คะแนน)

5.4 For the temperature ratio found in 5.3 find the required compressor pressure ratio at which the compressor work and the turbine work are equal. Given  $\gamma_g = \gamma_a$  and  $C_{pg} = C_{pa}$ . (3 คะแนน)

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