**BITS, PILANI- DUBAI**
**Second Semester 2007- 08**

**APPLIED THERMODYNAMICS ME UC211** 2nd Year

**COMPREHENSIVE EXAMINATION (CLOSED BOOK)**

**Max. Marks: 80** **Weightage: 40%** **Date: 21-05-08** **Duration: 180 min**

**Instructions.**

Answer all the questions.

- Answer all questions sequentially.
- ***Steam, Refrigeration, gas tables and Psychrometric charts*** are allowed
- Draw neat sketches wherever necessary

Make suitable assumptions if required and clearly state them

**1. a**. Show that the efficiency of the ***Otto cycle*** depends only on the compression ratio:- **[3M]**

**b**. An isentropic air turbine is used to supply 0.1kg/s of air at 0.1MN/m$^2$ and at 285 K to a cabin. The pressure at inlet to the turbine is 0.4 MN/m$^2$. Determine the temperature at turbine inlet and the power developed by the turbine. *Assume $C_p$=1.0kJ/kg K*

**2. a**. Explain ***Morse test*** on an IC engine.

**b**. The bore and stroke of a water-cooled, vertical, single cylinder, four stroke diesel engine are 80 mm and 110 mm respectively. Its rating is 4 kW at 1500 rpm. Calculate the brake mean effective pressure ***[bmep]*** of the engine. **[4M]**

**3. a.** Explain the process of ***cooling*** and ***dehumidification*** and show it on the psychrometric chart **[3M]**

**b**. Saturated air at 21$^0$C is passed through a drier so that its final relative humidity is 20%. The drier uses silica gel adsorbent. The air is then passed through a cooler until its final temperature is 21$^0$C without a change in specific humidity. Find out (a) the temperature of air at the end of the drying process.(b) the heat rejected in kJ/kg dry air during the cooling process.(c) the relative humidity at the end of the cooling process and (d) the dew point temperature at the end of the drying process. **[6M]**

**4. a.** What is ***stagnation*** state? Show stagnation properties in a ***h-s*** diagram for an isentropic process. **[4M]**

**b**. Explain the effect of area change in ***subsonic*** and ***supersonic*** flows **[4M]**

5.a. Define ***volumetric efficiency*** of a compressor. **[3M]**

b. A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm, and is driven at a speed of 1200 rpm. It is compressing $CO_2$ gas from a pressure of 120 kPa and a temperature of $20^0C$ to a temperature of $215^0C$. Assuming polytropic compression with n = 1.3, no clearance and volumetric efficiency of 100%, calculate (a) pressure ratio, (b) indicated power, (c) shaft power, with mechanical efficiency of 80%. **[6M]**

6.a Derive ***any two*** Maxwell's equations. **[4M]**

b. Derive ***any one*** of the TDS equations **[2M]**

7.a. What is ***tonne*** of refrigeration? **[3M]**

b. A refrigerator uses R-134a as the working fluid and operates on an ideal vapour compression cycle between 0.14 MPa and 0.8MPa. If the mass flow rate of the refrigerant is 0.06 kg/s, determine (a) the rate of heat removal from the refrigerated space, (b) the power input to the compressor, (c) the heat rejection rate in the condenser and (d) the COP **[7M]**

8.a. Explain briefly one type of ***jet condenser*** **[3M]**

b. State the comparison between ***jet*** and ***surface*** condenser **[3M]**

9.a. Using neat sketches, enumerate and explain the various parts of a ***steam engine***: **[3M]**

b. A double acting single cylinder steam engine is required to develop 70 kW at 250 rpm. Using steam supplied at 11 bar dry saturated, and exhausting into a condenser at 0.85 bar. The cut-off ratio is 0.25 and the stroke/bore ratio is 1.3:1. The mechanical efficiency of the engine can be taken as 85%. Calculate on the basis of a hypothetical diagram, the stroke and the bore of the engine, assuming diagram factor to be 0.8. **[5M]**

10. a. What is a ***cogeneration plant ?*** What are the thermodynamic advantages of such a plant? **[4M]**

**b.** In a reheat cycle of a steam power plant, the initial steam pressure and the maximum temperature are 150 bar and $550^0C$ respectively. If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5%, and assuming ideal processes, determine (a) the reheat pressure, (b) the cycle efficiency. **[5M]**

**BITS, PILANI – DUBAI,**
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**SECOND SEMESTER 2007-2008**
**ME UC211 APPLIED THERMODYNAMICS**
**TEST – 2(OPEN BOOK)**

**Date: 20- 04 -2008;** **Duration: 50 min.;** **Maximum Marks: 20**

*Notes:*

1. *Answer all the questions*
2. *Assume any missing data suitably and mention the same at appropriate place in your answer*
3. *Draw neat sketches wherever necessary*
4. *Steam tables and Refrigeration tables are allowed*
5. *Only Text book and hand written notes are allowed.*

**1.** **a**. Explain how the quality at Turbine exhaust gets restricted? **2 M**

**b.** In a regenerative cycle the inlet conditions are 40 bar and 400$^0$C. Steam is bled at 10bar in regenerative heating. The exit pressure is 0.8bar. Neglecting pump work determines the efficiency of the cycle:- **4 M**

2. **a.** "***Reciprocating steam engine is an intermittent power Engine.***" Commend on this statement:- **3 M**

**b**. Calculate a suitable admission pressure for a double-acting single cylinder steam engine of 230 mm bore and 300 mm stroke to develop 27 kW at a speed of 210 r.p.m. The exhaust pressure is 1.3bar and expansion ratio is 2.5. Assume a diagram factor of 0.8 **4 M**

**3.** **a**. " ***Refrigerants have high boiling point.***" Say Whether the statement is true or false with proper reasons. **3 M**

**b.** A heat pump is used for heating the interior of a house in cold climate. The ambient temperature is -5$^0$C and the desired interior temperature is 25$^0$C. the compressor of heat pump is to be driven by a heat engine working between 1000$^0$C and 25$^0$C. treating both cycles as reversible, Calculate the ratio in which the heat pump and heat engine share the heating:- **4 M**

GOOD LUCK

**BITS, PILANI – DUBAI,**
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**SECOND SEMESTER 2007-2008**
**ME UC112 APPLIED THERMODYNAMICS**
**TEST – 1(CLOSED BOOK)**

**Date: 02- 03 -2008;** **Duration: 50 min.;** **Maximum Marks: 25**

*Notes:*

1. *Answer all the questions*
2. *Assume any missing data suitably and mention the same at appropriate place in your answer*
3. *Draw neat sketches wherever necessary*

1. What are the four processes which constitute the ***Stirling Cycle***? Show that the Stirling cycle has the same efficiency as the Carnot cycle:- **4M**

2. What is a ***Spark Ignition*** (S.I) engine? What is the air standard cycle of such an engine? What are its four processes? **4M**

3. Derive the expression of optimum pressure ratio for maximum net work output in an Ideal ***Brayton cycle***:- **5M**

4. Explain the effects of inter cooling on ***Brayton cycle***:-

5. An air standard dual cycle has a compression ratio of 16, and compression begins at 1 bar, $50^0$C. The maximum pressure is 70 bar. The heat transferred to air at constant pressure is equal to that at constant volume. Estimate (a) the ***pressures*** and ***temperatures*** at the cardinal points of the cycle,(b) the ***cycle efficiency*** and (c) the ***m.e.p*** of the cycle, take $c_v$ =0.718KJ/kg.K,$c_p$ =1.005 KJ/kg.K **8M**

GOOD LUCK