| Roll No. | | | | | | | | | | | | |
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# PRESIDENCY UNIVERSITY
# BENGALURU

## SCHOOL OF ENGINEERING

### TEST - 1

**Even Semester**: 2018-19 **Date**: 06 March 2019

**Course Code**: MEC 208 **Time**: 1 Hour

**Course Name**: Applied Thermodynamics **Max Marks**: 40

**Programme & Sem**: B.Tech (MEC) & IV Sem **Weightage**: 20%

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**Instructions:**

*(i)* ***Read all the questions carefully.***
*(ii)* ***Use of scientific and non-programmable calculator is allowed.***
*(iii)* ***Make proper assumptions wherever applicable.***
*(iv)* ***Take standard values of constant wherever applicable.***

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### Part A

Answer **all** the Questions. **Each** question carries **three** marks. (5Qx3M=15)

1. Write the final expression of thermal (cycle) efficiency of Otto, Diesel, Dual along with symbol meaning.
2. Draw the P-v curve and T-s curve of Dual cycle and clearly mention the processes involved in it.
3. Draw a P-v curve and a T-s curve of combination of Reheating and Intercooling of Brayton Cycle and write the expression of net work output of the system and total heat input to the system in terms of specific enthalpy.
4. A diesel cycle has a compression ratio of 14 and cut-off takes place at 6% of the stroke. Find the air standard efficiency.
5. Explain the irreversibilities in turbine and compressor with the help of T-s curve of Simple Brayton cycle.

### Part B

Answer **both** the Questions. **Each** question carries **five** marks. (2Qx5M=10)

6. Prove that Optimum Pressure ratio for maximum work output of the Simple Ideal Brayton cycle is $r_p = (\frac{T_{max}}{T_{min}})^{(\gamma/2(\gamma-1))}$ where $r_p$, γ are the pressure ratio and specific heat ratio respectively.
7. Does regeneration increase the efficiency of Simple Brayton Cycle? If yes/no, explain with T-s curve and derive the final expression of cycle (thermal) efficiency and effectiveness of Regenerative brayton cycle.

## Part C

Answer **any one** of the Question. Question carries **fifteen** marks. (1Qx15M=15)

**8.** In an air standard Dual cycle, the compression ratio is 16 and compression begins at 1 bar, 50 $^{O}C$. The maximum pressure is 70 bar. The heat transferred to air at constant pressure is equal to that at constant volume. Estimate (a) the pressure and temperature at the cardinal points of the cycle (b) the cycle efficiency, and (c) cut-off ratio (d) the m.e.p. of the cycle and clearly mention the $W_{net}$ of the cycle also. Utilize the air-standard assumptions.

**OR**

**9.** A gas turbine power plant operating on a Regenerative Brayton Cycle has a pressure ratio of 8. The gas temperature is 27 $^{O}C$ at the compressor inlet and 1027 $^{O}C$ at the turbine inlet. Assuming compressor efficiency of 80%, turbine efficiency of 85% and regenerator having effectiveness of 80%. Utilizing the air-standard assumptions, determine (a) the gas temperature at the exits of the compressor and turbine (b) back work ratio (c) Thermal efficiency.

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

# PRESIDENCY UNIVERSITY
# BENGALURU

## SCHOOL OF ENGINEERING

### TEST - 2

**Even Semester**: 2018-19 | **Date**: 16 April 2019

**Course Code**: MEC 208 | **Time**: 1 Hour

**Course Name**: Applied thermodynamics | **Max Marks**: 40

**Program & Sem**: B.Tech & IV sem | **Weightage**: 20%

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**Instructions:**

*(i) Read the questions properly and answer accordingly.*
*(ii) The question paper consists of 3 parts.*
*(iii) Scientific and Non-programmable calculator are permitted.*
*(iv) Properties of saturated water are given in Table A.*

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### Part A

Answer **all** the Questions. **Each** question carries **four** marks. (3Qx4M=12)

1. What is the reversible cycle that represents the simple steam power plant? Draw the flow and T-s diagram of this cycle.
2. What do you understand by mean temperature of heat addition?
3. Explain the vapor compression refrigeration cycle with the help of flow and T-s diagram.

### Part B

Answer **both** the Questions. **Each** question carries **eight** marks. (2Qx8M=16)

4. A vapor-compression heat pump cycle with R-134a as the working fluid maintains a building at 20°C when the outside temperature is 5°C. The refrigerant mass flow rate is 0.086 kg/s. Additional steady state operating data are provided in the table. Determine the (a) compressor power, in kW, (b) heat transfer rate provided to the building, in kW, (c) coefficient of performance.

| State | 1 | 2 | 3 |
|---|---|---|---|
| $h$ (kJ/kg) | 244.1 | 272.0 | 93.4 |

(Where state 1 and sate 2 are inlet and exit of compressor respectively, state 3 is the end of condensation process)

5. Determine the work required to compress steam isentropically from 100 kPa to 1000 kPa, assuming that at the initial state the steam exists as (a) saturated liquid, and (b) saturated vapor. Neglect changes in kinetic and potential energies.
Take Enthalpy at 1000 kPa and s=7.3594 = 3195.5 kJ/kg

## Part C

Answer the Question. The Question carries **twelve** marks. (1Qx12M=12)

6. Water is the working fluid in an ideal Rankine cycle. The condenser pressure is 6 kPa, and saturated vapor enters the turbine at 10 MPa. Determine the heat transfer in kJ per kg of steam flowing, for the working fluid passing through the boiler and condenser and calculate the thermal efficiency.

**Or**

Refrigerant 134a is the working fluid in an ideal vapor-compression refrigeration cycle that communicates thermally with a cold region at 0°C and a warm region at 26°C. Saturated vapor enters the compressor at 0°C and saturated liquid leaves the condenser at 26°C. The mass flow rate of the refrigerant is 0.08 kg/s. Determine (a) the compressor power, in kW, (b) the refrigeration capacity, (c) the coefficient of performance, and (d) the coefficient of performance of a Carnot refrigeration cycle operating between warm and cold regions at 26 and 0°C, respectively.

| **State** | **1** | **2s** | **3** | **4** |
|---|---|---|---|---|
| **$h$ (kJ/kg)** | **241.35** | **272.39** | **91.49** | **91.49** |

(Where state 1 and sate 2 are inlet and exit of compressor respectively, state 3 is the end of condensation process)

### Table A.

**Saturated Pressure Water Table**

| | | Specific Volume, $m^3/kg$ | | Enthalpy, kJ/kg | | | Entropy, kJ/kg.K | | |
|---|---|---|---|---|---|---|---|---|---|
| **Press (kPa)** | **Sat Temp $T_{sat}$ (°C)** | **Sat Liquid $v_f$** | **Sat Vapor $v_g$** | **Sat Liquid $h_f$** | **Evap $h_{fg}$** | **Sat vapor $h_g$** | **Sat Liquid $s_f$** | **Evap $s_{fg}$** | **Sat vapor $s_g$** |
| 6 | 36.16 | 0.001006 | 23.739 | 151.53 | 2415.9 | 2567.4 | 0.5210 | 7.8094 | 8.3304 |
| 100 | 99.61 | 0.001043 | 1.6941 | 417.51 | 2257.5 | 2675.0 | 1.3028 | 6.0562 | 7.3589 |
| 10000 | 311.1 | 0.001452 | 0.01803 | 1407.6 | 1317.1 | 2724.7 | 3.3596 | 2.2545 | 5.6141 |

9. Derive First Tds equation and second Tds equation.
10. An air compressor takes in air at 0.98 bar and 20°C and compressing it according to $PV^{1.2}$=constant. It is then delivered to a receiver at constant pressure of 9.8 bar. Determine temperature at the end of compression, work done per kg of air, heat transferred during compression



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**PRESIDENCY UNIVERSITY**
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## SCHOOL OF ENGINEERING

## END TERM FINAL EXAMINATION

| | |
|---|---|
| **Even Semester**: 2018-19 | **Date**: 23 May 2019 |
| **Course Code**: MEC 208 | **Time**: 3 Hours |
| **Course Name**: Applied Thermodynamics | **Max Marks**: 80 |
| **Program & Sem**: B.Tech & IV Sem | **Weightage**: 40% |

**Instructions:**

*(i) Read all the questions carefully.*
*(ii) Use of scientific and non-programmable calculators is allowed.*
*(iii) Use proper assumptions wherever applicable.*
*(iv) Use following values for Air: $C_p$= 1.005 KJ/Kg K, $C_v$= 0.717 KJ/Kg K, R= 0.287 KJ/KgK*

### Part A

Answer **all** the Questions. **Each** question carries **one** mark. (20Qx1M=20M)

1.

I. Heat addition in Diesel cycle takes place by
   a. Constant Volume
   b. Constant Pressure
   c. Constant Entropy
   d. Constant Temperature

II. Which of the following thermodynamic cycle has highest thermal efficiency
   a. Otto cycle
   b. Dual Cycle
   c. Rankine Cycle
   d. Carnot Cycle

III. The thermal efficiency of Carnot cycle depends upon
   a. Type of working fluid used
   b. End temperature conditions
   c. Pressure ratio
   d. Specific heat ratio

IV. What kind of energy output is obtained from a 'Steam Power Plant'?
   a. Heat energy
   b. Sound energy
   c. Electricity
   d. Thermal energy

V. The components of a Steam Power Plant are
   a. Evaporator, Condenser, Boiler, Expansion valve
   b. Evaporator, Condenser, Boiler, Turbine
   c. Boiler, Turbine, Condenser, Pump
   d. Boiler, Turbine, Pump, Expansion valve

VI. The efficiency of Carnot Cycle is always____________one.
  a. greater than
  b. less than
  c. equal to
  d. Data insufficient

VII. During a refrigeration cycle, heat is rejected by the refrigerant in a ______.
  a. Compressor
  b. Condenser
  c. Evaporator
  d. Expansion valve

VIII. One tonne of refrigeration is equal to
  a. 21 kJ/min
  b. 210 kJ/min
  c. 420 kJ/min
  d. 620 kJ/min

IX. On which of the following cycles, Gas Turbine plants work on
  a. Stirling Cycle
  b. Brayton Cycle
  c. Rankine Cycle
  d. Dual Cycle

X. Which of the following is the working fluid in a Simple Brayton Cycle?
  a. Steam
  b. Water Vapour
  c. Air
  d. Ammonia

XI. With increase in pressure ratio ($r_p$) in a Brayton Cycle, the thermal efficiency of the cycle
  a. Increases
  b. Decreases
  c. Remains Constant
  d. Depends on the working fluid

XII. In a simple Brayton Cycle, the head addition process occurs at
  a. Constant Entropy
  b. Constant Temperature
  c. Constant Pressure
  d. Constant Volume

XIII. What is the use of intercooling in a Gas Turbine?
  a. It increases the Turbine work
  b. It decreases the Turbine work
  c. It increases the compressor work
  d. It decreases the compressor work

XIV. Minimum work input to compressor is obtained in
  a. Polytropic compression
  b. Isentropic compression
  c. Isothermal compression
  d. None of these

XV. The expression for volumetric efficiency is
  a. $1+C-C(P_2/P_1)^{1/n}$
  b. $1+C-C(P_2/P_1)$
  c. $1-C-C(P_2/P_1)^{1/n}$
  d. None of these

  Where n= Polytropic index; $P_2$=Pressure after Maximum compression; $P_1$=Pressure before compression; C=clearance ratio



XVI. Maximum work is done in compressing air when the compression is
  a. Isothermal
  b. Adiabatic
  c. Polytropic
  d. Any of the above

XVII. Isothermal work of compression is given by
  a. $-P_1V_1\ln(P_2/P_1)$
  b. $-P_1V_1\ln(P_1/P_2)$
  c. $-P_1V_1$
  d. None of these

XVIII. With increase in Pressure ratio, the volumetric efficiency of an air compressor
  a. Increases
  b. Decreases
  c. Constant
  d. None of these

XIX. Isothermal efficiency of compressor is
  a. Actual Work/Isothermal Work
  b. Isothermal Work/Actual work
  c. Isentropic Work/Actual Work
  d. Actual Work/Isentropic Work

XX. Cooling effect is produced in the
  a. Condenser
  b. Expansion valve
  c. Evaporator
  d. None of these

## Part B

Answer **all** the Questions. **Each** question carries **five** marks. (6Qx5M=30M)

2. Derive the expression for thermal efficiency of an Otto cycle. Neatly draw both P-V and T-S curve.
3. Draw the block diagram of equipment's of Regenerative Rankine Cycle and clearly mention the processes involved with T-S diagram of the same.
4. Derive the equation for work done in reversible adiabatic compression process for air compressor.
5. What is the function of a compressor? What are the different types of compressors? Also, mention difference between different types of compressors.
6. Find the power required to compress and deliver 2 kg of air per minute from 1 bar and 20°C to a delivery pressure 7 bar when the compression is carried out in single stage compressor. The compression follow the law $PV^{1.4}$=constant.
7. Derive all four Maxwell relationS.

## Part C

Answer **all** the Questions. **Each** question carries **ten** marks. (3Qx10M=30M)

8. A single stage reciprocating air compressor is required to compress 60 $m^3$ of air from 1 bar to 8 bar at 22 degree Celsius. Find work done by compressor if compression of air is;
   A. Isothermal,
   B. Isentropic with gamma=1.4,
   C. Polytropic process with n=1.25

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# PRESIDENCY UNIVERSITY
# BENGALURU

## SCHOOL OF ENGINEERING

## SUMMER TERM/ MAKE UP END TERM EXAMINATION

| | |
|---|---|
| **Summer Term**: Summer Term 2019 | **Date**: 24 July 2019 |
| **Course Code**: MEC 208 | **Time**: 2 Hours |
| **Course Name**: Applied Thermodynamics | **Max Marks**: 80 |
| **Program & Sem**: B.Tech (MECH) & IV Sem (2016 Batch) | **Weightage**: 40% |

**Instructions:**

i. *Read the question properly and answer accordingly.*

**ii.** *Question paper consists of 3 parts*

**iii.** *Scientific and Non-programmable calculators are permitted.*

### Part A

Answer **all** the Questions. **Each** question carries **five** marks. (6Q×5M=30M)

1. Draw the PV curve of diesel cycle and write the various processes. Also write the expression for thermal efficiency of the same.
2. Define 1 TR. Write the value of 1 TR in KJ/min and Kcal/min.
3. Draw the TS curve of a simple Rankine Cycle and write the various processes.
4. Write any five differences between a VCRS and VARS.
5. Write any five desirable properties of a refrigerant.
6. Define Psychrometry and show any four psychrometric process on the psychrometric chart.

### Part B

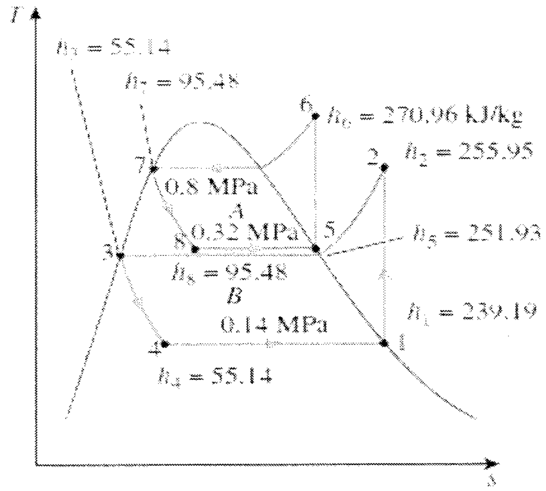
Answer **both** the Questions. **Each** question carries **ten** marks. (2Qx10M=20M)

7. Explain VARS with a neat diagram.
8. Define Dry Bulb temperature, Wet Bulb temperature, specific humidity, relative humidity and dew point temperature.

**Part C**

Answer **both** the Questions. **Each** question carries **fifteen** marks. (2Qx15M=30M)

9. Consider a two-stage cascade refrigeration system operating between the pressure limits of 0.8 and 0.14 MPa. Each stage operates on an ideal vapor-compression refrigeration cycle with refrigerant-134a as the working fluid. Heat rejection from the lower cycle to the upper cycle takes place in an adiabatic counter-flow heat exchanger where both streams enter at about 0.32 MPa. If the mass flow rate of the refrigerant through the upper cycle is 0.05 kg/s, determine (a) rate of heat removal from the condenser of upper cycle (b) rate of heat removal from evaporator of upper cycle (c) rate of heat removal from condenser of lower cycle (d) the mass flow rate of the refrigerant through the lower cycle, (e) the rate of heat removal from the refrigerated space (f) power input to the compressor, and (g) the coefficient of performance of this cascade refrigerator.




10. Consider an air standard cycle in which the air enters the compressor at 1.0 bar and 20°C. The pressure of air leaving the compressor is 3.5 bar and the temperature at turbine inlet is 600°C. Determine per kg of air : (i) Efficiency of the cycle, (ii) Heat supplied to air, (iii) Work available at the shaft, (iv) Heat rejected in the cooler, and (v) Temperature of air leaving the turbine. For air $\gamma = 1.4$ and Cp = 1.005 kJ/kg K.