**KUMARAGURU**
college of technology
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## GENERAL INSTRUCTIONS TO THE CANDIDATES

1. Candidates are instructed to answer the questions as per Bloom's Taxonomy knowledge level ($K_1$ to $K_6$)

2. Candidates are strictly instructed not to write anything in the question paper other than their roll number.

3. Candidates should search their pockets, desks and benches and handover to the Hall Superintendent/ Invigilator if any paper, book or note which they may find therein as soon as they enter the examination hall.

4. Candidates are not permitted to bring electronic watches with memory, laptop computers, personal systems, walkie-talkie sets, paging devices, mobile phones, cameras, recording systems or any other gadget / device /object that would be of unfair assistance to him / her.

5. Corrective measures as per KCT examination policies will be imposed for malpractice in the hall like copying from any papers, books or notes and attempting to elicit the answer from neighbours.

**B.E DEGREE EXAMINATIONS: DEC 2015**

(Regulation 2014)

Third Semester

**AERONAUTICAL ENGINEERING**

U14AET303: Thermodynamics and Heat transfer

*(Use of approved thermodynamic tables and HMT data Books are allowed)*

**Time: Three Hours**                                                                 **Maximum Marks: 100**

**Answer all the Questions:-**
**PART A (10 x 1 = 10 Marks)**

1. The correct sequence of processes in vapour compression refrigeration system is                [$K_2$]

   1.Compression   2. Expansion   3. Cooling   4. Evaporation                                        CO5

   a)   4-1-2-3                                      b)   4-3-2-1

   c)   1-3-2-4                                      d)   3-2-1-4

2. In supersonic flow, mach number is                                                               [$K_2$]

                                                                                                   CO3

   a)   Greater than one                           b)   Less than one

   c)   Equal to one                               d)   Less than or equal to one

3. In isentropic flow through nozzle, when the mass flow reaches…………….value is called        [$K_2$]

   choke                                                                                           CO3

   a)   Minimum                                     b)   Maximum

c) Zero        d) Average

4. Which of the following is not a specific heat relation     [K₁]

CO1

  1. $c_p - c_v = R$    2. $c_p / c_v = \gamma$   3. $h = u + pv$

  a) 1,2        b) 3 only

  c) 2,3        d) 2 only

5. The device which when working in a cycle transfers heat from low temperature to high   [K₂]

temperature is        CO4

  a) Heat pump      b) Heat engine

  c) Compressor      d) Nozzle

6. Assertion (A):Properties are the coordinates to describe the state of a system   [K₂]

Reason (R):The succession of states passed through during a change of state is called the   CO1

path of the change of state

  a) Both A and R are individually true and R   b) Both A and R are individually true
   is correct explanation of A      and R is not the correct explanation
              of A

  c) A is true but R is false     d) A is false but R is true

7. The volume of air dealt by the compressor per unit time is_____   [K₁]

CO4

  a) clearance ratio      b) free air delivered

  c) volumetric efficiency     d) compression ratio

8. Heat addition in otto cycle follows ……………process     [K₁]

CO2

  a) Isothermal       b) constant pressure

  c) constant volume      d) Isentropic

9. For the same compression ratio and heat addition     [K₂]

CO2

  a) Duel cycle is more efficient than otto   b) Duel cycle lies always between otto
   cycle          and diesel cycle

  c) Diesel cycle lies always between otto and   d) Otto cycle lies always between duel
   dual cycle         and diesel cycle

10. Match list I with list II and select the correct answer using the codes given below   [K₂]

CO5

| List I | List II |
|---|---|
| A. Conduction | i. Newton's law of cooling |

| B. Convection | ii. Stefan Boltzmann law |
|---|---|
| C. Radiation | iii. Fourier's law |
| D. Air conditioning | iv.Dalton's law of partial pressures |

|    | A | B | C | D |
|----|---|---|---|---|
| a) | i | ii | Iii | iv |
| b) | iv | i | ii | iii |
| c) | iii | i | ii | iv |
| d) | ii | iii | iv | i |

## PART B (10 x 2 = 20 Marks)
### (Answer not more than 40 words)

| | | | |
|---|---|---|---|
| 11. | State second law of thermodynamics | CO1 | [K$_1$] |
| 12. | Explain thermodynamic system with examples | CO1 | [K$_3$] |
| 13. | Differentiate between compression ratio and cut off ratio in a diesel cycle | CO2 | [K$_2$] |
| 14. | Draw the p-v and T-s diagram of Brayton cycle | CO2 | [K$_1$] |
| 15. | Brief about thrust rocket | CO3 | [K$_2$] |
| 16. | What is dynamic temperature? | CO3 | [K$_1$] |
| 17. | State Buckingham's $\pi$-theorem | CO4 | [K$_1$] |
| 18. | Classify compressors,fans and blowers | CO4 | [K$_1$] |
| 19. | Restate the concept of radiation | CO5 | [K$_2$] |
| 20. | Compare the properties of any two refrigerants | CO5 | [K$_4$] |

## Answer any FIVE Questions:-
## PART C (5 x 14 = 70 Marks)
### (Answer not more than 300 words)

**Q.No. 21 is Compulsory**

21. Steam at 1.8MPa and 400$^0$C steadily enters a nozzle whose inlet area is 0.02m$^2$.The mass flow rate of steam through the nozzle is 5kg/s. Steam leaves the nozzle at 1.4MPa with a velocity of 275m/s. Heat losses from the nozzle per unit mass of the steam are estimated to be 2.8 kJ/kg. Determine  a) inlet velocity   b) exit temperature of the steam    [K$_3$]   CO1

22. An ideal gas turbine cycle with two stages of compression and two stages of expansion has an overall pressure ratio of 8.Air enters each stage of the compressor at 300K and each stage of the turbine at 1300K. Determine the back work ratio and the thermal efficiency assuming  a) no regenerators   b) an ideal regenerators   with 100% effectiveness.

[K$_3$]

CO2

23. Air enters a converging-diverging nozzle at 1 MPa and 800K with a negligible velocity. The flow is steady, one dimensional and isentropic with $\gamma$ =1.4. For an exit mach number of  2 and a throat area of 20cm$^2$, determine the throat conditions, exit plane conditions and the mass flow rate of the nozzle

[K$_4$]

CO3

24. i) A single cylinder single acting reciprocating compressor has a piston diameter of 50mm and a stroke of 350mm and runs at 400rpm. Air is drawn at 1bar pressure and is delivered at 7bar pressure. The law of compression is pV$^{1.3}$=constant and clearance volume is 5 percent of stroke volume. Determine the mean effective pressure and the power required to drive the compressor

(10)

[K$_3$]

CO4

ii) Derive an expression for work of compression with clearance

(4)

25. Hot air at temperature of 65$^0$C is flowing through a steel pipe of 120 mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60 mm and 40 mm and their corresponding thermal conductivities are 0.24 and 0.4 w/m-k respectively. The inside and outside heat transfer coefficients are 60 and 12 w/m$^2$-k. The atmosphere is at 20$^0$C. Find the rate of heat loss from a 60m length of pipe

[K$_2$]

CO5

26. Discuss vapour absorption refrigeration  system with neat sketch

[K$_2$]

CO5

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