Hall Ticket No | | | | | | | | | | | Question Paper Code: AME003

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech III Semester End Examinations, November – 2018

Regulations: IARE-R16

THERMODYNAMICS

(MECHANICAL ENGINEERING**)**

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1.	a)	A stationary mass of gas is compressed without friction from an initial state of 0.3m3 and 0.105 MPa to a final state of 0.15m3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6kJ of heat from the gas during the process. How much does the internal energy of the gas change?	**[7M]**
	b)	Internal energy of the system is the measure of the heat of the system. Prove that internal energy is a property of a thermodynamic system	**[7M]**
2.	a)	A reversible engine with 45% thermal efficiency discharges 1500 kJ/min at 300C to a pond. Find the temperature of the source which supplies heat to the engine and power developed by the engine.	**[7M]**
	b)	Air at a pressure of 50 bar and a volume of 0.25 m3 is expanded at constant pressure until the volume is doubled. It is then expanded according to $PV^{1.3}$=constant, until the volume is 0.85 m3. Calculate the work done in each process	**[7M]**

UNIT – II

3.	a)	Can you use the same plant as a heat pump in winter and as a refrigerator in summer? Explain	**[7M]**
	b)	An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400K, rejects 42MJ at a temperature of 200K and delivers 15kwh of mechanical work. Would you advise investing money to put this engine in the market	**[7M]**
4.	a)	Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator?	**[7M]**
	b)	Determine the expansion for the heat transfer in a closed system isochoric process?	**[7M]**

UNIT – III

5.	a)	Find the saturation temperature, the changes in specific volume and entropy during evaporation and the latent heat of vaporization of steam at 1MPa.	**[7M]**
	b)	A rigid vessel of volume 0.86m3 contains 1 kg of steam at a pressure of 2 bar. Evaluate the specific volume, temperature, dryness fraction, internal energy, enthalpy and entropy of steam.	**[7M]**

6. a) What is quality of steam? What are the different methods of measuring quality? Explain any one with neat diagram. **[7M]**

   b) A closed vessel of 1.5 m^3 capacity contains steam at 3 bar and 0.8 dryness fraction. Steam at 10 bar and 0.9 dryness fraction is supplied until the pressure inside the vessel reaches 5 bar. Calculate the mass of steam in the vessel **[7M]**

UNIT – IV

7. a) Gas from a bottle of compressed helium is used to inflate an inelastic flexible balloon, originally folded completely at to a volume of 0.65 m3. If the barometer reads 760 mm Hg, what is the amount of work done upon the atmosphere by the balloon? Sketch the system before and after the process [**7M]**

   b) Describe the processes involved in Psychrometric chart. Represent the chart on coordinates and also define the terms related to psychrometric **[7M]**

8. a) Mathematically Dalton's Law of Partial Pressures can be written as Plot = P1 + P2 + P3 + … When we apply the ideal gas law to mixtures of gases each component gas will have its own P and n, but all of the component gases will have the same T and V. Substantiate with an example. **[7M]**

   b) How throttling helps in estimating the dryness fraction of steam. Derive Cp – Cv = R for an ideal gas. **[7M]**

UNIT – V

9. a) Derive an expression for the mean effective pressure of an Otto cycle. **[7M]**

   b) A petrol engine with compression ratio of 5 develops 24 kW indicated power and consumes 8 liters of fuel per hour. The specific gravity of fuel is 0.78 and its calorific value is 45 MJ/kg. Calculate the indicated thermal efficiency and relative efficiency. **[7M]**

10. a) Describe vapor compression system with the help of P-V and T-S diagram. Derive an expression for its cop. **[7M]**

    b) Derive air standard efficiency of a Diesel engine cycle. **[7M]**

MAPPING OF MODEL QUESTION PAPER QUESTIONS TO THE ACHIEVEMENT OF COURSE OUTCOMES

S. No.	Description
CAME003.01	Understand the concepts of conservation of mass, conservation of energy.
CAME003.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes,
CAME003.03	Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.
CAME003.04	Derive the first law of Thermodynamics from the concept of conservation of energy
CAME003.05	Discuss the nature of steady and unsteady processes under the influence of time
CAME003.06	Develop the second law of thermodynamics from the limitations of first law.
CAME003.07	Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations based on Carnot Cycle
CAME003.08	Understand the inter relationship between thermodynamic functions and an ability to use such relationships to solve practical problems
CAME003.09	Knowledge of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems
CAME003.10	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.
CAME003.11	Discuss pressure-temperature, volume-temperature, pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.
CAME003.12	Develop the Third Law of Thermodynamics from the concept of absolute thermodynamic scale and describe its significance.
CAME003.13	Understand the process of psychrometry that are used in the analysis of engineering devices like air conditioning systems
CAME003.14	Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.
CAME003.15	Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application.
CAME003.16	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.

SEE Question No.		Course Outcomes		Blooms Taxonomy Level
1	a	CAME003.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes.	Understand
	b	CAME003.01	Understand the concepts of conservation of mass, conservation of energy.	Understand
2	a	CAME003.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes,	Remember
	b	CAME003.03	Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.	Understand
3	a	CAME003.04	Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.	Remember
	b	CAME003.04	Derive the first law of Thermodynamics from the concept of conservation of energy	Remember
4	a	CAME003.05	Develop the second law of thermodynamics from the limitations of first law.	Understand
	b	CAME003.05	Develop the second law of thermodynamics from the limitations of first law	Understand
5	a	CAME003.07	Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations based on Carnot Cycle	Understand
	b	CAME003.06	Discuss the nature of steady and unsteady processes under the influence of time	Understand
6	a	CAME003.10	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components	Remember
	b	CAME003.11	Discuss pressure-temperature, volume-temperature, pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.	Remember
7	a	CAME003.10	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.	Understand
	b	CAME003.13	Understand the process of psychrometry that are used in the analysis of engineering devices like air conditioning systems	Understand
8	a	CAME003.10	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components	Understand
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9	a	CAME003.15	Introduction to concepts of power and refrigeration	Understand

			cycles. Their efficiency and coefficients of performance.	
	b	CAME003.14	Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application	Understand
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	b	CAME003.15	Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.	Remember

Signature of Course Coordinator

Mrs N SanthiSree,
Assistant Professor,
Department of Mechanical Engineering
IARE, Dundigal, Hyderabad.

HOD, Mechanical Engineering