INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	**THERMODYNAMICS**
Course Code	**AME003**
Class	III Semester
Branch	MECHANICAL ENGINEERING
Year	2018 – 2019
Course Faculty	Mrs. N. Santhi Sree, Assistant Professor Dr.CH V K N S N Moorthy, Professor, Department of Mechanical Engineering.

OBJECTIVES:

THE COURSE SHOULD ENABLE THE STUDENTS TO:.

I	Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.
II	Develop the concept of properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
III	Understand the direction law and concept of increase in entropy of universe
IV	Knowledge of ideal air standard, vapor cycles and evaluate their performance in open systems like steam power plants engines, gas turbines etc.
V	Solve problems of different types of cycles and their performance which emphasizes knowledge in ic engines and refrigeration cycles.

COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

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.

UNIT-I			
BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS			
PART - A (SHORT ANSWER QUESTIONS)			
S. No.	**Question**	**Blooms Taxonomy Level**	**Course Outcomes**
1	Explain Zeroth law of Thermodynamics.	Understand	CAME003.01
2	Define System, Surroundings and Boundary?	Remember	CAME003.01
3	Distinguish between macroscopic and microscopic point of view?	Remember	CAME003.01
4	Discuss Quasi Static process, what are its characteristics?	Understand	CAME003.01
5	Distinguish between different types of systems with examples.	Remember	CAME003.01
6	Explain the features of constant volume gas thermometer.	Understand	CAME003.01
7	Discuss First law of thermodynamics, explain Joule's experiment.	Understand	CAME003.02
8	Define PMM 1.	Remember	CAME003.02
9	State the causes of irreversibility?	Understand	CAME003.04
10	Derive Steady Flow Energy Equation, when the device is an air compressor.	Remember	CAME003.05
11	State thermodynamic system? How do you classify it?	Remember	CAME003.01
12	State the closed system? Give an example	Understand	CAME003.01
13	Define Intensive and Extensive properties.	Remember	CAME003.01
14	Define equilibrium of a system?	Understand	CAME003.01
15	Define Intensive and Extensive properties.	Remember	CAME003.01
16	Differentiate closed and open system.	Understand	CAME003.01
17	Define Specific heat capacity at constant volume	Remember	CAME003.01
18	Define Specific heat capacity at constant pressure.	Remember	CAME003.01
19	Differentiate closed and open system.	Understand	CAME003.01
20	Classify the properties of system?	Understand	CAME003.01
PART B (LONG ANSWER QUESTIONS)			
1	Differentiate the system, surroundings and boundary Explain in detail.	Remember	CAME003.01
2	Classify the types of systems; explain with examples.	Understand	CAME003.01
3	Distinguish between the macroscopic and microscopic study of thermodynamics?	Understand	CAME003.01
4	Explain the importance of concept of continuum in thermodynamic approach?	Remember	CAME003.02
5	Explain thermodynamic equilibrium in detail?	Understand	CAME003.03
6	Differentiate thermal equilibrium and thermodynamic equilibrium, explain.	Understand	CAME003.03

7	Define property? What are different types of properties? Explain.	Understand	CAME003.03
8	Enumerate the Isobaric process from thermodynamic point of view? And derive its work done under p-V coordinates.	Remember	CAME003.02
9	Represent the Isochoric process from thermodynamic point of view? And derive its work done under p-V coordinates.	Remember	CAME003.02
10	Enumerate the Isothermal process from thermodynamic point of view? And derive its work done under p-V coordinates.	Remember	CAME003.02
11	Represent the adiabatic process from thermodynamic point of view? And derive its work done under p-V coordinates.	Understand	CAME003.02
12	Enumerate the polytrophic process from thermodynamic point of view? And derive its work done under p-V coordinates.	Remember	CAME003.02
13	Derive the expression for piston displacement work with neat diagram?	Understand	CAME003.03
14	State Zeroth law and explain with a example?	Understand	CAME003.04
15	Explain the Joule's experiment with a neat sketch?	Understand	CAME003.03
16	Sketch the constant volume gas thermometer and explain?	Remember	CAME003.01
17	Derive exit velocity for nozzle by considering steady flow energy equation.	Understand	CAME003.01
18	Define path function and Show that work and heat are path functions?	Remember	CAME003.03
19	Explain the first law of thermodynamics applied to closed system when system undergoing a change of state?	Understand	CAME003.04
20	Derive the Steady flow energy equation?	Understand	CAME003.05
PART C(ANALYTICAL QUESTIONS)			
1	When a stationary mass of gas was compressed without friction at constant pressure, its initial state of $0.4m^3$ and 0.105MPa was found to change to final state of $0.20m^3$ and 0.105MPa. There was a transfer of 42.5kJ of heat from the gas during the process. Determine the change in internal energy of the gas?	Remember	CAME003.02
2	0.44kg of air at 180^0 C, expands adiabatically to 3times its original volume and during the process there is a fall in temperature to 15^0C. The work done during the process is 52.5kJ. Calculate Cp and Cv?	Understand	CAME003.03
3	Two thermometers one centigrade and other Fahrenheit are immersed in a fluid, after the thermometers reached equilibrium with the fluid, it is noted that both the thermometers indicate the same numerical values. Find that the identical numerical values shown by the thermometers? Determine the corresponding temperature of the fluid, express in degrees Kelvin and degrees Rankine?	Remember	CAME003.02
4	If a gas of volume 6000 cm^3 and at pressure of 100 kPa is compressed quasi statically according to pV^2 = constant until the volume becomes 2000 cm^3, determine the final pressure and the work transfer.	Remember	CAME003.05
5	A gas of mass 1.5 kg undergoes a quasi-static expansion which follows a relationship p = a + bV, where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa respectively and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation **u = l.5 pV – 85 kJ/kg** .Where p is the kPa and v is in m3/kg.	Understand	CAME003.04

	Calculate the net heat transfer and the maximum internal energy of the gas attained during expansion.		
6	A piston cylinder device operates 1kg of fluid at 20atm pressure with initial volume is $0.04m^3$. Fluid is allowed to expand reversibly following $pV^{1.45}=C$. So that the volume becomes double. The fluid is cooled at constant pressure until the piston comes back. Determine the work done in each process?	Remember	CAME003.04
7	A fluid contain in a horizontal cylinder with a frictionless leak proof piston is continuously agitated by a stirrer passing through the cylinder cover. The diameter of the cylinder is 50cm and the piston is held against the fluid due to atmospheric pressure equal to 100kPa. The stirrer turns 8000 revolutions with an average torque of 1.5Nm. If the piston slowly moves outwards by 60cm. Determine the network transfer to the system?	Remember	CAME003.04
8	A Piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle the sum of all heat transfers is -170kJ. The system completes 100cycles/minute. Complete the following table showing the method for each item and compute net rate of work output in kW.	Understand	CAME003.04
9	A fluid is confined in a cylinder by a spring loaded friction less piston, so the pressure in the fluid is a linear function of volume (p=a+bV).The internal energy of the fluid is given by the following equation U=34+3.15pV. Where U is in kJ, p in kPa and V is in m3. If the fluid changes from initial state of 170kPa, $0.03m^3$ to a final state of 400kPa, $0.06m^3$ with no work other than that done on the piston. Define the direction and magnitude of work and heat transfer.	Remember	CAME003.03
10	Air flows steadily at the rate of 0.5kg/sec through an air compressor, entering at 7m/sec velocity, 100kPa pressure and $0.95m^3$/kg volume and leaving at 5m/sec, 700kpa and $0.19m^3$/kg. The internal energy of air leaving is 90kJ/kg greater than that of air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW.Compute the rate of shaft work input to the air in KW.	Remember	CAME003.04

UNIT-II

LIMITATIONS OF FIRST LAW

PART - A (SHORT ANSWER QUESTIONS)

S. No.	Question	Blooms Taxonomy Level	Course Outcomes
1	State the limitations of first law of thermodynamics?	Remember	CAME003.06
2	Define second law of thermodynamics?	Remember	CAME003.06
3	State PMM 2?	Understand	CAME003.07
4	State the processes of Carnot Cycle?	Remember	CAME003.06
5	State the Clausius inequality?	Understand	CAME003.06
6	Define the absolute temperature scale?	Understand	CAME003.07
7	Define the property of entropy?	Remember	CAME003.08
8	Define an inversion curve?	Remember	CAME003.09
9	Write 1 and 2 Maxwell's relations?	Remember	CAME003.09
10	State the Third law of Thermodynamics?	Understand	CAME003.09
11	Define available energy of a system?	Remember	CAME003.06
12	Write 3 and 4 Maxwell's relations?	Remember	CAME003.06

13	Explain dead state of a system?	Understand	CAME003.06
14	Define the unavailable energy in a system?	Remember	CAME003.08
15	Explain the principle of entropy increase?	Understand	CAME003.08
16	Explain the exergy of a system?	Understand	CAME003.09
17	Explain the Claussius statement?	Understand	CAME003.06
18	State the Kelvin-Plank statement?	Remember	CAME003.06
19	Sketch the PV and TS diagrams of Carnot cycle.	Remember	CAME003.08
20	Classify the processes which constitute the cycle.	Understand	CAME003.06
PART - B (LONG ANSWER QUESTIONS)			
1	Explain the limitations of First law of thermodynamics in detail?	Understand	CAME003.06
2	Define the terms thermal reservoir, source, and sink with a neat sketch?	Understand	CAME003.07
3	Explain the heat engine with a neat sketch?	Understand	CAME003.06
4	Explain the heat pump with a neat sketch?	Understand	CAME003.07
5	List the performance parameters of a system and explain in detail.	Understand	CAME003.06
6	Compare the first law and second law of thermodynamics with suitable examples?	Remember	CAME003.07
7	Explain the second law of thermodynamics with suitable sketches?	Understand	CAME003.06
8	Write the Kelvin-Plank statement and explain with an example?	Understand	CAME003.07
9	Write the Clausius statement and explain with an example?	Remember	CAME003.06
10	Write the Kelvin-Planck and Clausius statements and explain with sketches?	Understand	CAME003.07
11	State PMM1 and PMM2, in which manner both are different?	Remember	CAME003.06
12	Compare the relation with process and cycle? Explain.	Remember	CAME003.07
13	State the Carnot's principle? What is the importance of the principle, explain?	Remember	CAME003.06
14	State the Claussius inequality? Explain.	Understand	CAME003.07
15	Explain the influence of entropy on various parameters?	Remember	CAME003.08
16	Define Gibb's and Helmholtz's functions? Compare the importance of them?	Remember	CAME003.09
17	State the irreversibility and explain.	Understand	CAME003.07
18	Explain the Availability in a thermodynamic system with example.	Understand	CAME003.08

19	Discuss the importance of Maxwell relations?	Understand	CAME003.09
20	State the Third law of thermodynamics? Explain the importance.	Remember	CAME003.09
PART - C (ANALYTICAL QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	A heat engine working on Carnot cycle converts 1/5th of the heat input into work. When the temperature of the sink is reduced by 80^0C, the efficiency gets doubled. Determine the temperature of sink?	Remember	CAME003.06
2	A reversible heat engine is supplied with heat from two constant temperature sources at 900K and 600 K and rejects heat to a constant temperature at 300K to sink. The engine develops work equivalent to 91kJ/s and rejects heat at the rate of 56kJ/sec. Estimate (i) heat supplied by each source(ii) Thermal efficiency of engine.	Understand	CAME003.07
3	A block of iron weighing 100 kg and having a temperature of 100°C is immersed in 50 kg of water at a temperature of 20°C. What will be the change of entropy of the combined system of iron and water? Specific heats of iron and water are 0.45 and 4.18 kJ/kg K respectively.	Remember	CAME003.06
4	A domestic food freezer maintains a temperature of -15^0C, the ambient air temperature is 30^0C, if heat leaks into the freezer at the continuous rate of 1.75kJ/sec. State the least power necessary to pump this heat out continuous?	Remember	CAME003.07
5	A heat engine is operating between two reservoirs 1000K and 300K is used to drive a heat pump which extracts heat from the reservoir at 300K at a rate twice that at which the engine rejects the heat to it. If the efficiency of the engine is 40% of the maximum possible and COP of heat pump is 50% of the maximum possible, then determine the temperature of the reservoir to which the heat pump rejects heat. Also determine the rate of heat rejection from the heat pump, if the rate of heat supply to the heat engine is 50kW?	Remember	CAME003.08
6	Three Carnot engine are arranged in series. The first engine takes 4000kJ of heat from a source at 2000K and delivers 1800kJ of work. The second and third engines deliver 1200kJ and 500kJ of work respectively. Compare the exhaust temperature of second and third Carnot engines?	Remember	CAME003.12
7	Two bodies of equal capacities C and T1 and T2 from an adiabatically closed system. Determine the final temperature, if the system is brought to an equilibrium state. i) Freely, ii) reversibly, Proceed to calculate the maximum work which can be obtained from the system?	Remember	CAME003.08
8	A heat engine is supplied with 2512kJ/min of heat at 650^0C. Heat rejection takes place at 100^0C. Distinguish which of the following heat rejection represent a reversible, irreversible or impossible result. i) 867 kJ/min ii) 1015 kJ/min iii) 1494 kJ/min	Remember	CAME003.07
9	Heat flows from a hot reservoir at 800K to another reservoir at 250K.If the entropy change of overall process is 4.25kJ/K, Compare calculation for the heat flowing out of the high temperature reservoir?	Remember	CAME003.08

10	5 kg of air heated from a temperature of 100 ^{0} C at constant volume till its pressure becomes three times its original pressure. For this process calculate :(i)heat transfer(ii)change in internal energy (iii)Change in enthalpy (iv)changeinentropy for air take Cp=1.005kJ/kg k	Remember	CAME003.09

UNIT-III(A)

PURE SUBSTANCES

PART - A (SHORT ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Define Pure Substance and what do you understand by a saturation stage?	Remember	CAME003.10
2	Draw the phase diagram on p-v diagrams with water as pure substance?	Remember	CAME003.11
3	Explain the concept of p-v-T surface? Represent on p-T coordinates?	Understand	CAME003.11
4	Explain the critical state of water?	Understand	CAME003.11
5	Draw the phase equilibrium diagram for a pure substance on T-s plot with relevant constant property line?	Remember	CAME003.10
6	Draw the phase equilibrium diagram for a pure substance on H-s plot with relevant constant property line?	Remember	CAME003.11
7	Compare isobar on Mollier diagram diverse from one another?	Remember	CAME003.11
8	Explain Mollier chart by representing all the properties on it?	Understand	CAME003.11
9	State the degree of superheat and degree of sub cooling?	Remember	CAME003.11
10	Define dryness fraction? What are the different methods of measurement of dryness fraction?	Remember	CAME003.11

PART - B (LONG ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
	Explain the procedure adopted in Steam calorimetry?	Remember	CAME003.10
2.	Why can not a throttling calorimeter measure the quality, if the steam is wet? Explain how is the quality been measured?	Understand	CAME003.11
3.	Explain the saturation temperature, the changes in specific volume, enthalpy and entropy during evaporation at 1MPa.	Understand	CAME003.11
4.	Compare the enthalpy, entropy and volume of steam at 1.4MPa, 380^{O}C.	Remember	CAME003.11
5.	A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250^{0}C. The mass of the liquid present is 9kg.Find the pressure, mass, specific volume, enthalpy, entropy and internal energy?	Remember	CAME003.11
6.	Steam initially at 1.5MPa, 300^{0}C expands reversibly and adiabatically in a steam turbine to 40^{0}C. Determine the ideal work output of the Turbine per kg of steam?	Understand	CAME003.11
7.	Steam flows in a pipe line at 1.5MPa. After expanding to 0.1MPa in a throttling calorimeter, the temperature is found to be 120^{0}C. Determine the quality of the steam in pipe line?	Remember	CAME003.11

8.	The following data were obtained with a separating and throttling calorimeter. Pressure in pipe line is 1.5MPa. Condition after throttling is at0.1MPa, 110^0C, During 5minutes moisture collected in the separator is 0.15lt at 70^0C .steam condenses after throttling during 5 minis3.24kg, and Determine the quality of steam in the pipe line?	Understand	CAME003.11
9.	Determine the enthalpy and entropy of steam and the pressure is 2MPa and the specific volume is 0.09m^3/kg.	Remember	CAME003.11
10	Saturated steam has entropy of 3.56kJ/kg K. Determine the saturated pressure, temperature, specific volume, enthalpy.	Understand	CAME003.10

PART-C(ANALYTICAL QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1.	1 kg of water fills a 150 L rigid container at an initial pressure of 2 MPa. The container is then cooled to 40 ^{o}C. Determine the initial temperature and final pressure of the water.	Remember	CAME003.11
2.	Saturated steam has entropy of 6.76kJ/kg K. Determine the pressure, temperature, specific volume, enthalpy.	Understand	CAME003.10
3.	A vessel of volume 0.04 m^3 contains a mixture of saturated water and steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, mass, specific volume, enthalpy, entropy.	Remember	CAME003.11
4.	A steam power plant uses steam at boiler pressure of 150 bars and temperature of 550°C with reheat at 40 bars and 550°Cat condenser pressure of 0.1 bar. Find the quality of steam at turbine exhaust, cycle efficiency and the steam rate.	Understand	CAME003.10
5. 5	A large insulated vessel is divided in to two chambers. One is containing 5kg of dry saturated steam at 0.2MPa and other 10kg of steam, 0.8quality at 0.5MPa. If the partition between the chambers is removed and the steam is mixed thoroughly and allow to settle. Determine the final pressure steam quality and entropy change in the process?	Understand	CAME003.11
5. 5.	Ten kg of water 45 °C is heated at a constant pressure of 10 bar until it becomes superheated vapor at 300°C. Find the change in volume, enthalpy, internal energy and entropy.	Remember	CAME003.11

UNIT-III(B)

PERFECT GAS LAWS

PART - A (SHORT ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Explain the equation of state?	Understand	CAME003.10
2	Derive the changes in internal energy during a process with variable specific heats.	Understand	CAME003.11
3	Derive the changes in enthalpy during a process with variable specific heats.	Remember	CAME003.10
4	Explain the process of free expansion?	Understand	CAME003.11
5	Explain the process of Throttling?	Understand	CAME003.10
6	State the expression for Vander Wall's equation and determine the constants?	Remember	CAME003.11
7	Explain On what coordinates compressibility charts can be drawn?	Understand	CAME003.10
8	List the molar specific heats, explain?	Understand	CAME003.11

9	Derive the expression for work done in a non-flow process, if the process is adiabatic?	Remember	CAME003.10
10	Discuss briefly the reduced properties?	Remember	CAME003.11
PART - B (LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Enumerate the Perfect Gas Laws and analyze from thermodynamics point of view?	Remember	CAME003.10
2	Explain the equation of State with variations?	Understand	CAME003.10
3	Explain, how the heat and work transfer observed in perfect gas?	Remember	CAME003.10
4	Explain the change in internal energy in perfect gas?	Understand	CAME003.10
5	State Vander Waals equation, what is the importance of it?	Remember	CAME003.10
6	What is compressibility chart, explain the procedure of usage?	Understand	CAME003.10
7	explain about law of corresponding states.	Remember	CAME003.11
8	what are the assumptions for deriving ideal gas equation.	Understand	CAME003.11
9	Derive the Clausius Claperon equation?	Remember	CAME003.10
10	Determine constants of vanderwaall's equation.	Understand	CAME003.10
PART - C (ANALYTICAL QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	The volume of a high altitude chamber is $40m^3$.It is put into operation by reducing pressure from 1bar to 0.4bar and temperature from 25^0C to 5^0C. How many kg of air must be removed from the chamber during the process? Express this mass as a volume measured at 1bar and 25^0C.	Understand	CAME003.10
2	A fluid at 200kPa and 300^0C has a volume of $0.8m^3$ in a frictionless process at constant volume, the pressure changes to 100kPa. Calculate the final temperature and heat transfer, if the fluid is air?	Remember	CAME003.10
3	A fluid at 250^0C and 300kPa is compressed reversibly and isothermally to 1/16th of its original volume. Calculate the final pressure, work done and change of internal energy per kg of fluid, if the fluid is air?	Remember	CAME003.10
4	Solve that for an ideal gas the slope of the constant volume line on the T-S diagram is more than that of the constant pressure line.	Understand	CAME003.10
5	At a temperature of 423K,1 kg of nitrogen occupies volume of 200 liters. The gas undergoes constant expansion with fully resisted to a volume of 360 liters. Then the gas expanded isothermally to a volume of 500 liters. Sketch the process on p-V and T-S diagram. Find out overall change in entropy.	Remember	CAME003.10
6	A reversible polytropic process begins with a fluid at p1=10bar, $T1=200^0C$ and at p2=1bar, the exponent n has the value 1.15. Find the final specific volume, the final temperature and the heat transfer per kg of fluid, if the fluid is air.	Remember	CAME003.10
7	A certain gas has Cp=1.968 and Cv=1.507kJ/kg K. Find its molecular weight and the gas constant?	Remember	CAME003.10
8	A constant volume of $0.3m^3$capacity contains 2kg of this gas at 5^0C. Heat is transferred to the gas until the temperature is 100^0C. Find the work done, the heat transfer and changes in internal	Remember	CAME003.10

	energy, enthalpy and entropy?		
9	A reversible adiabatic process begins at p1=10bar, T1=300^{0}C and ends with p2=1bar. Find the specific volume and the work done per kg of fluid, if the fluid is air?	Remember	CAME003.10
10	Derive an expression for entropy change of an ideal gas from TdS equations?	Remember	CAME003.10
UNIT-IV			
MIXTURES OF PERFECTGASES AND PSYCHROMETRY			
PART-A(SHORT ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	State Dalton's law of partial pressures?	Remember	CAME003.10
2	Compute the characteristic gas constant and the molecular weight of the gas mixture?	Remember	CAME003.10
3	Derive the expression for internal energy?	Remember	CAME003.10
4	Define mole fraction?	Remember	CAME003.10
5	Explain about volumetric and gravimetric analysis?	Understand	CAME003.10
6	Define dry bulb temperature, wet bulb temperature, dew point temperature and degree of saturation?	Remember	CAME003.13
7	Explain adiabatic saturation temperature?	Understand	CAME003.13
8	Explain psychrometric charts while representing all the properties?	Understand	CAME003.13
9	Locate i) sensible heating ii) sensible cooling iii) heating and iv) Heating and Dehumidification on psychrometric chart?	Remember	CAME003.13
10	Define bypass factors represent adiabatic mixing of two air streams on psychrometric chart?	Remember	CAME003.13
11	State dry bulb temperature?	Remember	CAME003.13
12	State wet bulb temperature?	Remember	CAME003.13
13	Define specific humidity?	Remember	CAME003.13
14	Define relative humidity?	Remember	CAME003.13
15	Explain Psychrometric chart?	Understand	CAME003.13
16	State adiabatic saturation?	Remember	CAME003.13
17	Define degree of saturation?	Remember	CAME003.10
18	Obtain the expression for enthalpy of gas mixture?	Remember	CAME003.10
19	Define mass fraction?	Remember	CAME003.10
20	State the law of additive volumes?	Remember	CAME003.10
PART-B(LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Explain the Mole fraction and Mass fraction in the Mixture of Perfect gas?	Understand	CAME003.10
2	Explain Gravimetric Analysis of mixtures?	Understand	CAME003.10
3	Explain the Volumetric Analysis of mixtures?	Understand	CAME003.10
4	Explain the Dalton's law of partial pressure with an example?	Understand	CAME003.10
5	Explain the Avogadro's laws of additive volumes?	Understand	CAME003.10
6	Compare the Volumetric and Gravimetric Analysis of mixtures?	Understand	CAME003.10
7	Using definitions of mass and mole friction, derive a relation between them.	Understand	CAME003.10
8	Somebody claims that the mass and mole fraction for mixture of COo2 and N2O are identical. Is it true? Why? Explain.	Understand	CAME003.10
9	Explain Equivalent gas constant of a gas mixture?	Understand	CAME003.10

10	Explain Molecular internal energy of a gas mixture?	Understand	CAME003.10
11	Derive the expressions for enthalpy and entropy of a gas mixture?	Understand	CAME003.10
12	Are the dry bulb temperature and dew point temperature are same? Explain when they are same.	Understand	CAME003.10
13	Explain the various properties of psychrometry?	Understand	CAME003.13
14	Compare dry bulb temperature and wet bulb temperature with a sketch?	Understand	CAME003.13
15	Explain the concept of dew point temperature?	Understand	CAME003.13
16	Differentiate the Relation between specific humidity and relative humidity and derive the relation between them?	Understand	CAME003.13
17	Explain the degree of saturation with an example?	Understand	CAME003.13
18	Explain the adiabatic saturation. And compare with degree of saturation.	Understand	CAME003.13
19	Enumerate different psychrometric processes that are taking place.	Remember	CAME003.13
20	How will you construct psychrometric chart?	Understand	CAME003.13
PART-C(Analytical Questions)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	The analysis by weight of a perfect gas mixture at 200C and 1.3bar is 10%O2, 70% N2, 15%CO2 and 5%CO. For a reference state of 00C and 1bar, determine partial pressure of the constituent and gas constant of mixture.	Remember	CAME003.10
2	In an engine cylinder a gas has a volumetric analysis of 13%CO2, 12.5%O2 and 74.5% N2. The temperature at the beginning of expansion is 9500C and gas mixture expands reversibly through a volume ratio of 8:1. According to the law pV1.2=constant. Calculate per kg of gas, the work done and the heat flow. Take Cp for CO2=1.235kJ/kg K and O2=1.088kJ/kg K and N2 is 1.172kJ/kg K.	Remember	CAME003.10
3	The following is the volumetric analysis of a producer gas: CO=28%, H2=13%, CH4=4%, CO2=4%, N2=51%. The values ofCp for the constituent CO, H2, CH4,CO2,N2are29.27kJ/mol.K,28.89kJ/mol.K,35.8kJ/mol.K,37.2 2kJ/mol.K,29.14kJ/ mol.K respectively. Calculate the values of Cp, Cv for the mixture.	Remember	CAME003.10
4	Find the relative humidity and specific humidity for air at 30 ^{0} C and having dew point temperature of 150C.Represent on psychrometric Chart.	Remember	CAME003.10
5	A mixture of hydrogen and oxygen is to be made, so that the ratio of H2 to O2 is 2:1 by volume. If the pressure and temperature are 1bar and 250C, respectively. Calculate mass of oxygen required and volume of the container?	Remember	CAME003.10
6	Air at 10bar and a DBT of 400C and WBT of 360C. Compute degree of saturation, dew point temperature and enthalpy of the mixture?	Understand	CAME003.13
7	Atmospheric air at 1.0132bar has DBT of 320C and a WBT of 260C. Compute partial pressure of the water vapor, specific humidity, dew point temperature and relative humidity?	Understand	CAME003.13
8	Air at 200C, 40% RH is mixed adiabatically with air at 400C, 40%RH in the ratio of 1kg of the former with 2kg of later (on dry basis).Find the final condition of air?	Understand	CAME003.13
9	Saturated air at 210C is passed through a dryer, so that its final	Remember	CAME003.13

	relative humidity is 20%. The dryer uses silica gel absorbent. The air is then pass through a cooler until its final temperature is 210C without a change in specific humidity. Find out i)the temperature of air at the end of the drying process, ii) the relative humidity at the end of the cooling process, iii)The dew point temperature at the end of the drying process?		
10	An air water vapor mixture enters an adiabatic saturator at 30^0C and leaves at20^0C, which is the adiabatic saturation temperature? The pressure remains constant at 100kPa. Determine the relative humidity and humidity ratio of the inlet mixture.	Remember	CAME003.13
UNIT-V			
POWERCYCLES			
PART-A(SHORTANSWER QUESTIONS)			
S. No.	**Question**	**Blooms Taxonomy Level**	**Course Outcomes**
1	Classify the assumptions to be made for the analysis of all air standard cycles?	Understand	CAME003.14
2	State the Processes in Otto cycle and represent on P-V and T-S diagrams?	Understand	CAME003.14
3	State the Processes in Constant pressure cycle and represent on P-V and T-S diagrams?	Understand	CAME003.14
4	What are the variable factors used for comparison of cycles?	Understand	CAME003.14
5	Draw the modified Otto cycle? How it differs from Otto cycle?	Understand	CAME003.14
6	Derive the air standard efficiency of Diesel cycle?	Understand	CAME003.14
7	Define mean effective pressure?	Understand	CAME003.14
8	List functional parts of simple vapor compression system represents the processes on T-S diagram?	Remember	CAME003.15
9	Sketch P-V and T-S diagrams of Bell-Coleman cycle while representing process and hence deduce its COP?	Remember	CAME003.15
10	Discuss limited pressure cycle, represent the processes of it on P-V diagram?	Understand	CAME003.14
11	Compare Otto cycle with Diesel cycle?	Understand	CAME003.14
12	Define the unit of refrigeration?	Understand	CAME003.15
13	Define COP of refrigeration?	Understand	CAME003.15
14	Draw the PV diagram of Otto Cycle?	Remember	CAME003.14
15	Represent Otto cycle on TS diagram.	Understand	CAME003.14
16	Draw the PV diagram of diesel Cycle?	Remember	CAME003.14
17	Draw the TS diagram of diesel Cycle?	Remember	CAME003.14
18	Write the processes involved in Brayton cycle.	Remember	CAME003.15
19	Evaluate the performance of refrigeration cycle?	Understand	CAME003.15
20	Draw the PV and TS diagrams of dual combustion cycle?	Understand	CAME003.14
PART-B(LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define compression ratio. What is the range for (a) SI engines (b) the CI engine? What factors limit the compression ratio in each type of engine?	Understand	CAME003.14
2	What is an air standard cycle? What are the limitations of air standard cycle? State the assumptions to be taken for its analysis	Understand	CAME003.14
3	Obtain an expression for the air standard efficiency on a volume basis of an engine working on the Otto cycle. And represent the processes on p-V and T-S diagrams.	Understand	CAME003.14

4	State the characteristic of air cycles? And what is the use of air standard cycle analysis	Remember	CAME003.14
5	Define air standard efficiency of an Otto cycle and show that the efficiency of Otto cycle is lower than that of Carnot cycle.	Understand	CAME003.14
6	Derive an expression for mean effective pressure of the Otto cycle?	Understand	CAME003.14
7	Derive an expression for air standard efficiency of diesel cycle	Understand	CAME003.14
8	Derive an expression for air standard efficiency of dual cycle	Understand	CAME003.14
9	What is the difference between Otto and Diesel cycle? Show that the efficiency of Diesel cycle is always lower than the efficiency of the Otto cycle for the same compression ratio.	Understand	CAME003.14
10	Show by graphs how the efficiency of Diesel cycle varies with compression ratio and cutoff ratio.	Understand	CAME003.14
11	Explain the dual combustion cycle? Why the cycle is also called limited pressure cycle? Represent on p-V and T-S diagrams.	Understand	CAME003.14
12	What are the processes involved in Otto cycle. Explain their standard efficiency of Otto cycle.	Understand	CAME003.14
13	Compare the Otto and Diesel cycles for same constant maximum pressure and same heat input.	Understand	CAME003.16
14	Compare the thermal efficiency of Otto and dual and diesel cycles on the basis of same compression ratio and same heat input?	Understand	CAME003.16
15	In an Otto cycle, the pressure at the beginning of the compression is 1 bar and pressure at the end of compression is 15 bar. Calculate the pressure ratio and the air standard efficiency of engine.	Remember	CAME003.14
16	Determine the air standard efficiency of the diesel engine having a cylinder with a bore of 250 mm and a stroke of 375mm and a clearance volume of 1500 cc. with fuel cutoff occurring at 5% of the stroke.	Remember	CAME003.14
17	Describe the components of vapour compression system with the help of P-V and T-S diagram.	Remember	CAME003.15
18	Explain the following (i)Wet Compression (ii)Dry compression (iii)sub cooling (iv)superheating	Understand	CAME003.15
19	Derive cop of Bell-Coleman cycle with the help of processes representing on p-V and T-S diagram?	Understand	CAME003.15
20	Derive the expression for air standard efficiency of Brayton cycle.	Understand	CAME003.14

PARTC-(ANALYTICAL QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	An air refrigeration open system operating between 1 M Pa and 100 k Pa is required to produce a cooling effect of 2000 kJ/min. Temperature of the air leaving the cold chamber is – 5°C and at leaving the cooler is 30°C. Neglect losses and clearance in the compressor and expander. Determine : (i) Mass of air circulated per min. (ii) Compressor work, expander work, and cycle work (iii) COP and power in kW required	Understand	CAME003.15
2	An engine working on Otto cycle has a volume of 0.45m^3 pressure 1bar and temperature 30^{0}C at the beginning of the compression stroke. At the end of the compression stroke the pressure is 11bar. 210kJ of heat is added at constant volume. Determine efficiency and mean effective pressure.	Remember	CAME003.14
3	An engine with 200mm cylinder diameter and 300mm stroke working on theoretical diesel cycle. The initial pressure and temperature of air used are 1bar and 27^{0}C. The cut of is 8% of the stroke. Determine air standard efficiency, mean effective pressure and power of the engine if the working cycles per minute are 300?	Remember	CAME003.14

	Assume the compression ratio is 15 and the working fluid is air.		
4	a) Determine the Compression ratio, if efficiency of an Otto cycle is 60% and ɣ = 1.5? b) An inventor claims that a new heat cycle will develop 0.4kw for a heat addition of 32.5kJ/min. The temperature of heat source is 1990K and that of sink is 850K. Is his claim possible?	Understand	CAME003.15
5	A perfect gas undergoes a cycle which consists of following processes. i) heat rejection at constant pressure ii) adiabatic compression from 1bar and 270C to 4 bar iii) heat addition at constant volume to a final pressure of 16bar iv) adiabatic expansion to 1bar. Calculate work done per kg of gas and efficiency of the cycle. Take Cp = 0.92 and Cv=0.7.	Remember	CAME003.14
6	The stroke and cylinder diameter of Compression Ignition engine are 250mm and 150mm respectively. If the clearance volume is 0.0004m3 and fuel injection takes place at constant pressure for 5% of the stroke. Determine the efficiency of the engine. Assume the engine working on Diesel cycle?	Remember	CAME003.14
7	An engine of 250mm bore and 375mm stroke works on Otto cycle. The clearance volume is 0.00263m^3. The initial pressure and temperature are 1bar and 50^{0}C. The maximum pressure is limited to 25 bars. Find the air standard efficiency and the mean effective pressure of the cycle? Assume ideal conditions?	Remember	CAME003.14
8	28tonnes of ice from and at 0^{0}C is produced per day in an Ammonia refrigerator. The temperature range in the compressor is from 25^{0}C to - 15^{0}C. The vapor is dry and saturated at the end of the compression and expansion valve is used. Assuming the C.O.P of 62% of the theoretical. Calculate power required to drive the compressor?	Remember	CAME003.14
9	A Bell-Coleman refrigerator operates between pressure limits of 1bar and 8bar. Air is drawn from the cold chamber at 9^{0}C, compressed and then it is cooled to 29^{0}C before entering the expansion cylinder. Expansion and compression follow the law $pV^{1.35}$=C. Calculate theoretical C.O.P of the system. Take ɣ of air is 1.4.	Remember	CAME003.15
10	The swept volume of a Diesel engine working on Dual cycle is 0.0053m^3 and clearance volume is 0.00035m^3. The maximum pressure is 65bar. Fuel injection ends at 5% of stroke. The temperature and pressure of the start of the compression are 80^{0}C and 0.9bar. Determine air standard efficiency of cycle? Take ɣ of air is 1.4.	Remember	CAME003.14

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