Hall Ticket No | | | | | | | | | | | Question Paper Code: AME013

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER -2

B.Tech V Semester End Examinations, November – 2018

Regulations: IARE-R16

THERMALENGINEERING

(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) Explain working principle of Rankine cycle with a neat sketch. Obtain the efficiency of Rankine cycle. Represent on T-S and h-S diagram. **[7M]**

   b) In a Rankine cycle, the steam at inlet to Turbine is saturated at a pressure of 45bar and the exhaust pressure is 0.5bar. Determine i)the pump work ii) Turbine work iii) Rankine efficiency iv) Condenser heat flow v) the dryness at the end of expansion. Assume flow rate of 10.5kg/sec. **[7M]**

2. a) Derive the expression for efficiency of reheat cycle and compare with Rankine cycle .Represent on T-S diagram and h-S diagram. **[7M]**

   b) The following is the ultimate analysis of a sample of petrol by weight: Carbon =86%, Hydrogen=10%.Calculate the ratio of air to petrol consumption by weight if the volumetric analysis of dry exhaust gas is CO_2=12.5%, CO=1.7%, O_2=0.7% and N_2=82%. Also find percentage excess air. **[7M]**

UNIT – II

3. a) Explain with neat sketches, the construction and working of the La Mont boiler and Benson boiler. **[7M]**

   b) Dry saturated steam enters a steam nozzle at a pressure of 14 bar and is discharged at a pressure of 2.4 bar. If the dryness fraction of discharge steam is 0.96.what will be the final velocity of steam? Neglecting initial velocity of steam **[7M]**

4. a) Explain with neat sketches the following mountings? **[7M]**
   i)water level indicator ii) Pressure gauge iii)Feed check valve iii)Blow-off cock

   b) Steam at a pressure of 13 bar and dryness fraction 0.7 is discharged through a convergent divergent nozzle to a back pressure of 0.112 bar. If the power developed is 250 kW.The mass flow rate is 6kg/kw h. Determine Throat pressure. **[7M]**

UNIT – III

5. a) Derive an expression for condition for maximum efficiency of an impulse Turbine? **[7M]**

   b) In a De Laval turbine, steam issues from the nozzle with a velocity of 1600m/sec, the nozzle angle is 240, the mean blade velocity is 440m/sec and the inlet and outlet of angles are equal. The mass of steam flowing through the turbine per hour is 1090kg. Calculate blade angle, Power developed and blade efficiency. **[7M]**

6. a) Explain the concept of compounding of turbines. What are the advantages and disadvantages of velocity compounded Impulse Turbine. **[7M]**

b) A stage of a steam turbine is supplied with steam at a pressure of 55 bars and 3550C, and exhausts at a pressure of 5 bars. The isentropic efficiency of the stage is 0.82 and the steam consumption is 2420 kg/min. determine the power output of the stage. **[7M]**

UNIT – IV

7. a) Explain the method inter cooling employed to increase the specific output and thermal efficiency of Gas Turbine plant? Draw the T-S diagram for the same. [**7M]**

b) A gas turbine unit has a pressure ratio of 4:1 and maximum cycle temperature of 6150C. The isentropic efficiencies of the compressor and turbine are 0.86 and 0.81 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 160C at the rate of 16kg/s. Take Cp=1.005 kJ/kg K and γ =1.4 for the compression process, and take Cp=1.11kJ/kg K and γ =1.333for the expansion process. **[7M]**

8. a) What is the effect of thermal efficiency of open cycle Gas Turbine with the following operating variables (i)Pressure ratio ii)Turbine inlet temperature iii)Compressor inlet temperature iv)Efficiency of the turbine v)Efficiency of compressor. **[7M]**

b) In a constant pressure open cycle gas turbine, air enters at 1bar and 30^0C and leaves the compressor at 5bar. Using the following data: temperature of gases entering the turbine=580^0C, pressure loss in the combustion chamber= 0.1bar.$\acute{\eta}_{compressor}$ = 85%, $\acute{\eta}_{turbine}$ =70% $\acute{\eta}_{combustion}$= 75%,$\gamma$ =1.4, Cp= 1.02 kJ/kg K for air and gas. Find i) the quantity of air circulation, if the plant develops 1065Kw ii) heat supplied for Kg of air circulation iii) thermal efficiency of the cycle. Mass of the fuel may be neglected **[7M]**

UNIT – V

9. a) Draw the sketch of Turbo-Jet plant with T-S diagram of Turbo-Jet engine and explain **[7M]**

b) A turbojet aircraft is flying at a speed of 289m/sec, where the ambient conditions are 0.7bar and 300C. The compressor pressure ratio is 8.The maximum cycle temperature is not to exceed 1250K, with fuel of calorific value of 44000kJ/kg. The pressure loss in the combustion chamber is 0.16bar. The various efficiencies are listed as Ram air efficiency is 92%, Isentropic efficiency of compressor and turbine are 84% and 82%respectively. Combustion efficiency is 97%, nozzle efficiency is 91%. If the outlet area of the nozzle is 0.11m2. Determine the mass flow rate, the thrust developed and specific fuel consumption. **[7M]**

10. a) What are the advantages and disadvantages of Pulse Jet engines? **[7M]**

b) A turbojet engine flying at a speed of 930km/hour consumes air at the rate of 45.5kg/sec. Calculate i) exit velocity of the jet when the enthalpy change for the nozzle is 210Kj/kg and velocity co-efficient is 0.86. ii) fuel flow rate in kg/sec, when air fuel ratio is 66:1. **[7M]**

COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand ideal and air standard vapor cycle and evaluate the performance in open systems like steam power plant, gas turbine etc.
II	Analyse different air standard cycles specifically related to IC engines and solve problems on the intricacies of performance of the cycle
III	Understand the direction law and concept of entropy increase of the universe.

COURSE OUTCOMES (COs)

COs	Course Outcome
CO1	Discuss the Carnot vapor cycle and basic concept of steam power plant working cycle & modification of Rankine cycle.
CO2	Understand the working principles of different types of steam generators, mounting and accessories and also understand the types of nozzles as well as turbines
CO3	Understand the shape of blades, there work output of typical turbine stages with its velocity diagram and also working principles of condensers. Understand the turbine design and its applications.
CO4	Explore the concept of heat transfer principles in gas turbines and Carry out performance calculations of real Gas turbines
CO5	Understand the fundamentals of jet propulsion and understand the concepts of Rocket propulsion and its classification

COURSE LEARNING OUTCOMES (CLOs):

CLO Code	At the end of the course, the student will have the ability to:
AME013.01	Discuss the basic concepts of thermodynamics in the analysis for Carnot vapor power cycle.
AME013.02	Determine the efficiency and output of a basic and modern Rankine cycle steam power plant from given data.
AME013.03	Determine the efficiency of a modified Rankine cycle including superheat, reheat, and regeneration techniques.
AME013.04	Discuss the concept of stoichiometric analysis of fuels and combustion.
AME013.05	Discuss different types of steam generators and its working principles.
AME013.06	Discuss mountings and accessories of boilers.
AME013.07	Understand the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it.
AME013.08	Classify different types of steam turbines and working of impulse turbine and its performance parameters and methods of compounding to reduce rotor speed of an impulse turbine.
AME013.09	Explain the blade shapes, and calculate work output of typical turbine stages with its velocity diagrams.
AME013.10	Demonstrate different types of condensers and its working principles.

CLO Code	At the end of the course, the student will have the ability to:
AME013.11	Recognize the different gas turbine arrangements, their advantages and disadvantages and different applications application.
AME013.12	Applying the relation between gas turbine design, application and environment.
AME013.13	Applying the basic thermodynamic and heat transfer principles in performance calculation of industrial gas turbines
AME013.14	Recognizing the differences of a real cycle (from the theoretical ones)
AME013.15	Carry out performance calculations of real Gas turbines
AME013.16	Examine the effect of various design parameters on the GT performance (pressure ratio, temperature ratio, pressure drop, polytrophic efficiency ...etc.).
AME013.17	Explain the fundamentals of jet propulsion and basic propulsion cycle
AME013.18	Examine the effect of various design parameters of the jet propulsion performance and its efficiency etc.
AME013.19	Discuss the concepts of Rocket propulsion and its classification.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AME013.02	Determine the efficiency and output of a basic and modern Rankine cycle steam power plant from given data.	CO 1	Understand
	b	AME013.02	Determine the efficiency and output of a basic and modern Rankine cycle steam power plant from given data	CO 1	Understand
2	a	AME013.03	Determine the efficiency of a modified Rankine cycle including superheat, reheat, and regeneration techniques	CO 1	Remember
	b	AME013.04	Discuss the concept of stoichiometric analysis of fuels and combustion	CO 1	Understand
3	a	AME013.05	Discuss different types of steam generators and its working principles.	CO 1	Remember
	b	AME013.07	Understand the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it.	CO 2	Remember
4	a	AME013.06	Discuss mountings and accessories of boilers.	CO 2	Understand
	b	AME013.07	Understand the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it.	CO 2	Understand
5	a	AME013.08	Classify different types of steam turbines and working of impulse turbine and its performance parameters and methods of compounding to reduce rotor speed of an impulse turbine.	CO 2	Understand
	b	AME013.09	Explain the blade shapes, and calculate work output of typical turbine stages with its velocity diagrams	CO 3	Understand
6	a	AME013.10	Demonstrate different types of condensers and its working principles.	CO 3	Remember

	b	AME013.09	Explain the blade shapes, and calculate work output of typical turbine stages with its velocity diagrams.	CO 3	Remember
7	a	AME013.11	Recognize the different gas turbine arrangements, their advantages and disadvantages and different applications application.	CO 3	Understand
	b	AME013.13	Applying the basic thermodynamic and heat transfer principles in performance calculation of industrial gas turbines.	CO 4	Remember
8	a	AME013.15	Carry out performance calculations of real Gas turbines	CO 4	Understand
	b	AME013.16	Examine the effect of various design parameters on the GT performance (pressure ratio, temperature ratio, pressure drop, polytrophic efficiency ...etc.).	CO 4	Understand
9	a	AME013.17	Explain the fundamentals of jet propulsion and basic propulsion cycle	CO 4	Understand
	b	AME013.18	Examine the effect of various design parameters of the jet propulsion performance and its efficiency etc.	CO 5	Understand
10	a	AME013.19	Discuss the concepts of Rocket propulsion and its classification.	CO 5	Understand
	b	AME013.18	Examine the effect of various design parameters of the jet propulsion performance and its efficiency etc.	CO 5	Remember

Prepared By,
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