INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

ASSIGNMENT

Course Name	:	**THERMAL ENGINEERING II**
Course Code	:	**A50518**
Class	:	III B. Tech I Semester
Branch	:	ME
Year	:	2017 – 2018
Course Coordinator	:	Mr. S. Srikrishnan
Course Faculty	:	Mr. S. Srikrishnan, Dr. Ch V K N S N Moorthy

OBJECTIVES

I. To provide the students knowledgeable in steam power plants and their components, performance and analysis of steam turbines, gas turbines.
II. Students can able to understand nozzles and condensers and their performances in industries.
III. Able to understand the concept of jet propulsion and their effects.
IV. To develop to learn the concepts of rockets and propellants.
V. The subject influences the students in research and development.

S No	QUESTION	Blooms taxonomy level	Course Outcomes
	ASSIGNMENT – I		
1	(a) (a) Explain working principle of Rankine cycle? (b) In a Rankine cycle, the steam at inlet to Turbine is saturated at a pressure of 35bar and the exhaust pressure is 0.2bar. 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 9.5kg/sec	Remember	1
2	(a) Classify and explain the classification of fuels. (b) Explain Adiabatic flame temperature. A simple Rankine cycle works between pressures 28bar and 0.06bar. The initial condition of steam is dry saturated. Calculate cycle efficiency, work ratio and specific steam consumption	Remember	1

3.	(a)Explain the Regenerative cycle in detail with a neat sketch (b) A Steam Turbine is fed with steam having an enthalpy of 3100kJ/Kg. It moves out of Turbine with an enthalpy of 2100KJ/Kg. Feed heating is done at a pressure of 3.2bar, with steam enthalpy of 2500KJ/kg. The condensate from a condenser with an enthalpy of 125KJ/kg enters into the feed heater. The quantity of bled steam is 11200Kg/hour. Find the power developed by	Remember	1
4	(a) State the differences between the following boilers? i) Externally fired and internally fired boilers. ii)Forced circulation and natural circulation (b) State the differences between the High Pressure and low Pressure boilers?	Understand	1
3	(a) Explain the concept of discharge through the nozzle (b) Classify nozzles. (c) Dry saturated steam enters a steam nozzle at a pressure of 15 bar and is discharged at a pressure of 2.0 bar. If the dryness fraction of discharge steam is 0.96.what will be the final velocity of steam? Neglecting initial velocity of steam.	Apply	1
4	(a) Derive the conditions for discharge and its maximum value of a nozzle. (b)The nozzles of a Delaval turbine are supplied with dry saturated steam at a pressure of 9 bar. The pressure at the outlet is 1 bar. The turbine has two nozzles with a throat diameter of 2.5 mm. Assuming nozzle efficiency as 90 % and that of turbine rotor 35 %, find the quality of steam used per hour and power developed.	Understand	1
5	(a) Derive the expression for condition for maximum efficiency of an impulse Turbine? (b) The velocity of steam exiting the nozzle of the impulse stage of a turbine is 400 m/s. The blades operate close to the maximum blading efficiency. The nozzle angle is 20 0 .Considering equiangular blades and neglecting blade friction, calculates the steam flow of 0.6 kg/s. the diagram power and diagram efficiency	Apply	1
6	(a) Define the following: Blade efficiency, Stage efficiency, overall efficiency (b) A single stage steam Turbine is supplied with steam at 5bar and 200^0C at the rate of 50Kg/min. It expands into a condenser at a pressure of 0.2bar. The blade speed is 400m/sec. The nozzles are inclined at an angle of 200 to the plane of wheel and outlet blade angle is 30^0. Neglecting friction losses. Determine the power developed , blade efficiency and stage efficiency	Remember	1
7	(a) Explain the concept of pressure compounding. with neat diagram (b) A simple impulse turbine has 1ring of moving blades running at 150m/sec. The absolute velocity of steam at exit from the stage is 85m/sec at an angle of 800 from the tangential direction. Blade velocity co-efficient is 0.8 and the rate of steam flowing through the stage is 2.5kg/sec. If the blades are equi angular, determine blade angle, nozzle angle and axial thrust.	Understand	1

8	(a) Explain the concept of pressure compounding. with neat diagram (b)A simple impulse turbine has 1ring of moving blades running at 150m/sec. The absolute velocity of steam at exit from the stage is 85m/sec at an angle of 800 from the tangential direction. Blade velocity co-efficient is 0.8 and the rate of steam flowing through the stage is 2.5kg/sec. If the blades are equiangular, determine blade angle, nozzle angle and axial thrust.	Understand	1
9	(a) How can you convert weight analysis in volumetric analysis? (b) Super heated steam at a pressure of 10bar and 400^0C is supplied to a steam engine. Adiabatic expansion takes place to release point at 0.9bar and it exhaust s into a condenser at 0.3bar. Neglecting clearance, determine for a steam flow rate of 1.5kg/sec. i) quality of steam at the end of expansion and the end of constant volume operation ii) power developed iii) specific steam consumption iv) modified Rankine cycle Efficiency.	Understand	1
ASSIGNMENT – II			
1	(a) What are the types of Condensers? Classify? (b) In a reaction turbine, the blade tips are inclined at 350 and 200 in the direction of motion. The guide blades are of the same shape as the moving blade, but reversed in the direction. At a certain place in the turbine, the drum diameter is 1m and the blades are at 10cm high. At this place the steam has a pressure of 1.75bar and dryness 0.935. If the speed this turbine is 250rpm and steam passes through the blades, without shock, find the mass of the steam flow and power developed in the ring of moving blades.	Understand	5
2	(a). Define degree of reaction and prove that Parsons Reaction turbine is a 50 % reaction turbine. (b) 300kg/min of steam (2bar,0.98dry) flows through a given stage of a reaction turbine. The exit angle of fixed blade as well as moving blade is 200 and 3.68kW of power is developed. If the rotor speed is 360rpm and tip leakage is 5%, calculate the mean drum diameter and the blade height. If the axial flow velocity is 0.8times the blade velocity?	Understand	8
3	(a) Derive the condition for maximum efficiency of reaction turbine with giving assumptions to be followed. (b) A surface condenser is designed to handle 10000kg of steam per hour. The steam enters at 0.08bar abs. And 0.9dryness and the condensate leave at the corresponding saturation temperature. The pressure is constant throughout the condenser. Estimate the cooling water flow rate per hour if the cooling water temperature rise is limited to 10^0C.	Remember	7

4	a) Describe with neat sketch, the working of a simple constant pressure open cycle Gas Turbine? (b) Find the required air-fuel ratio in a gas turbine whose turbine and compressor efficiencies are 85% and 80%, respectively. Maximum cycle temperature is 875^0C. The working fluid can be taken as air (Cp=1.0kJ/kgK, J=1.4) which enters the compressor at 1bar and 27^0C. The pressure ratio is 4. The fuel used has calorific value of 42000kJ/kg. There is a loss of 10% of	Remember	4
5	(a) Explain with a neat sketch, the working of a constant volume combustion Turbine (b) A gas turbine plant consists of two turbines. One compressor turbine to drive compressor and other power turbine to develop power output and both are having their own combustion chambers which are served by air directly from the compressor. Air enters the compressor at 1bar and 288K and is compressed to 8bar with an isentropic efficiency of 76%. Due to heat added in the combustion chamber, the inlet temperature of gas to both turbines is 900^0C.The isentropic efficiency of turbines is 86% and the mass flow rate of air at the compressor is 23kg/s. The calorific value of fuel is 4200kJ/kg. Calculate the output of the plant and the thermal efficiency if mechanical efficiency is 95% and generator efficiency is 96%. Take Cp=1.005kJ/kgK and J =1.4 for air and Cpg = 1.128kJ/kgk and J = 1.34 for	Apply	5
5	(a) Explain the method REHEATING employed to increase the specific output and thermal efficiency of Gas Turbine plant and also draw the T-S diagram for the same (b) The pressure ratio of an open-cycle gas turbine power plant is 5.6. Air is taken at 30^0C and 1bar. The compression is carried out in two stages with perfect inter cooling in between. The maximum temperature of the cycle is limited to 700C. Assuming the isentropic efficiency of each compressor stage as 85% and that of turbine as 90%, determine the power developed and efficiency of the power plant, if the air-flow is 1.2kg/s. The mass of fuel may be neglected, and it may be assumed that Cp= 1.02 kJ/kgK and J = 1.41	Understand	4
6	(a) Draw the sketch of Turbo-Jet plant with T-S diagram of Turbo-Jet engine and explain? (b) A turbojet has a speed of 750km/h while flying at an altitude of 10000m, the propulsive efficiency of the jet is 50% and overall efficiency of the turbine plant is 16%.The density of air at 10000m altitude is 0.173kg/m3. The drag on the plank is 6250 N, the calorific value of the fuel is 48000KJ/Kg. Calculate. i). absolute velocity of the jet . ii) volume of the air compressed per minute	Apply	4

7	(a) Classify rockets and explain solid and liquid propellant rockets (b)A turbojet aircraft is flying at a speed of 287m/sec, where the ambient conditions are 0.5bar and -200C. 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 0.1bar.The various efficiencies are listed as :Ram air efficiency is 90%, Isentrophic efficiency of compressor and turbine are 85% and 80%respectively. Combustion efficiency is 98%, nozzle efficiency is 90%. If the outlet area of the nozzle is 0.1m2. Determine the mass flow rate, the thrust developed and specific fuel consumption.		
8	(a) Explain the working difference between propeller jet ,turbo-jet (b) Explain the function of and turbo prop with a neat sketch?		
9	(a) What are the requirements of an ideal Rocket propellant and applications of Rockets. b) Explain Thrust, Thrust Power, efficiency and Thermal efficiency of Turbo Jet		
10	Explain the function of and turbo prop with a neat sketch? (a)Explain the working difference between propeller jet ,turbo-jet (b) Explain the function of and turbo prop with a neat sketch?		

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HOD, MECHANICAL ENGINEERING DEPARTMENT