Reg. No.______________ Name:________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code**: ME204**

Course Name**: THERMAL ENGINEERING (ME)**

Max. Marks: 100 Duration: 3 Hours

PART A

***Answer any three questions*.**

1. Draw neat sketches of a Cochran and Babcock Wilcox boiler. List the boiler mountings and accessories used in a boiler. Compare the merits and demerits of water tube and fire tube boilers. (10)
2. In a Rankine cycle the steam at inlet to turbine is saturated at a pressure of 35bar and exhaust pressure is 0.2bar. Determine i) The pump work ii) The turbine work iii) The Rankine efficiency iv) The condenser heat flow v) The dryness fraction at the end of expansion. Take a flow rate of 10kg/sec (10)
3. a) Derive the relationship for optimum blade speed ratio for an impulse turbine in terms of inlet nozzle angle. Show that maximum blade or diagram efficiency is given by $Cos^2\alpha_1$ (5)

   b) The velocity of steam leaving nozzles of an impulse turbine is 900m/s and the nozzle angle is 20^0. Blade velocity is 300m/s and blade velocity coefficient is 0.7. Calculate for a mass flow rate of 1kg/Sec and symmetrical blading i) The blade inlet angle ii) Driving force on wheel iii) The axial thrust iv) Diagram power v) Diagram efficiency. (5)
4. A Parsons reaction turbine running at 400rpm with 50% reaction develops 75KW per kg of the steam. The exit angle of the blade is 20^0 and the steam velocity at inlet is 1.4 times blade velocity. Determine i) Blade velocity ii) Blade inlet angle. (10)

PART B

Answer any three questions.

5. a. Derive an expression for air standard efficiency of an Otto cycle citing all assumptions involved (4)

   b. In an Otto cycle air at 17°C and 1 bar is compressed adiabatically until the pressure is 15bar. Heat is added at constant volume until the pressure rises to 40bar. Calculate the air standard efficiency, compression ratio and maximum temperature in the cycle. Cv=0.717 KJ/KgK and R_0=8.314 KJ/KmolK. (6)
6. a. Explain the operation of a wankel engine. (4)

   b. Draw line sketch showing the gas flow routes and components and explain the supercharging and turbo charging with respect to IC engines. (4)

   c. Out of CI and SI engines, which engine is more suitable to supercharging? Explain. (2)

7. During brake test of a four cylinder 4 stroke engine coupled to a dynamometer at constant speed, the following results are obtained. BP with all cylinders working=14.7kw. BP with cylinder 1 cut off=10.14kw. BP with cylinder 2 cut off =10.3kw. BP with cylinder 3 cut off =10.36kw. BP with cylinder 4 cut off=10.21kw. Petrol consumption=5.5kg/hr.CV of fuel=42000 Kj/Kg. Diameter of cylinder=8cm, Stroke of piston=10cm, Clearance volume 0.1 litre. Calculate i) The mechanical efficiency ii) Relative efficiency on the basis of IP. (10)
8. a. What are octane and cetane ratings? Mention important doping agents used to control the values of octane number. (4)

   b. Determine the air fuel ratio and the theoretical amount of air required by mass for complete combustion of fuel containing (by mass) 85% carbon, 8% hydrogen, 3% oxygen, 1% sulphur and remaining ash. If 40% excess air is used what is the volume of air at 27°C and 1.03bar. (6)

PART C

Answer any four questions.

9. a. With a p-θ diagram, explain various stages of an SI engine combustion. (4)

   b. Explain the influence of various factors that reduce Knock in SI engine. (6)
10. a. What are the important factors to be considered for the design of CI engine combustion chamber? (4)

    b. With sketches, discuss various designs of Indirect (Divided) Combustion chambers. (6)
11. a. What are various pollutants coming out of an IC engine? (3)

    b. Explains methods for control of NOx. (3)

    c. Explain the operation of a thermal and catalytic converter. (4)
12. Air enters the compressor of an ideal air standard Brayton cycle at 100Kpa, 300K and is compressed to 1000Kpa. The temperature at the inlet to the first turbine is 1400K. The expansion takes is entropically in two stages with reheat to 1400K between two stages at a constant pressure of 300Kpa. Regenerator effectiveness 100%. Determine thermal efficiency of the cycle. (10)
13. a. Show that optimum intermediate pressure for a two stage compressor is given by $(P_1P_2)^{0.5}$ where P_1 and P_2 are initial and final pressures. (6)

    b. Discuss the stability loop of a gas turbine combustion chamber. (4)
14. a. Draw the combustion chamber of a gas turbine showing air entries at various stages. (4)

    b. 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 compressor at 300K and each stage of turbine at 1300K. Determine the work ratio and thermal efficiency of cycle. Assume regenerator efficiency of 100%. (6)

****