Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME204
Course Name: THERMAL ENGINEERING (ME)
Use of Steam Tables Permitted

Max. Marks: 100 Duration: 3 Hours

PART A
Answer any three full questions, each carries 10 marks Marks

1 a) List one advantage and one disadvantage of the reheat cycle and of the regenerative cycle. (2)

b) In a reheat Rankine cycle, steam at a pressure of 40 bar and 300°C is expanded through a turbine to a pressure of 4 bar. It is then heated at a constant pressure to 300^0C and then expanded to 0.1 bar. Estimate the work done per kg of steam flowing through the turbine, the amount of heat supplied during the reheat process and the cycle efficiency. Neglect pump work. (8)

2 a) What is meant by reheat factor? List the parameters influencing the value of reheat factor. (3)

b) Derive the condition for maximum efficiency of a reaction turbine. (7)

3 a) Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300°C. It is then expanded to a pressure of 40 bar. For a mass flow rate of 2 kg/s, calculate the exit velocity of the steam. Use Mollier chart (3)

b) In an equiangular, simple impulse turbine, steam issues from the nozzles with a velocity of 900 m/s. Nozzle angle is 20° and mean blade velocity is 360 m/s. Assuming frictionless blades, for a mass flow rate of 1000 kg/ min, calculate the blade angles, the power developed in kW and the blade efficiency (7)

4 a) With the aid of a neat sketch, explain the working of a Cochran Boiler (7)

b) Explain the metastable flow in a nozzle with h-s diagram. (3)

PART B
Answer any three full questions, each carries 10 marks

5 a) Prove that the efficiency of Sterling cycle and Carnot cycle are equal if they are operating between the same temperature reservoirs. (4)

b) An engine working on ideal Otto cycle has a temperature of 300 K at the beginning of compression. If the ideal air standard efficiency is 50%, calculate the compression ratio of the engine. If the peak temperature of the cycle is 1150K, calculate the heat supplied and net work output of the cycle per kg of air. (6)

6 a) Write four desirable properties of an S.I. engine fuel. (4)

b) A four-cylinder petrol engine has an output of 4.8 kW at 180 rpm. A Morse test is carried out and the brake torque readings with each cylinder cut-off in turn are 177 Nm, 170 Nm, 169 Nm and 173 Nm respectively. For normal running at this speed, the specific fuel consumption is 0.364 kg / kWh with respect to brake power. The calorific value of the fuel is 42 MJ / kg. Calculate the mechanical efficiency and brake thermal efficiency of the engine. (6)

7 a) List 2 major advantages and disadvantages of four stroke engine over two stroke engines. (4)

b) The percentage by composition of a sample of liquid fuel by weight is C=84.8% and H_2= 15.2%. Calculate: (6)
i)The weight of air needed for the combustion of 1 kg of fuel.
ii)The volumetric composition of the products of combustion if 15% excess air is used.

8 a) Describe Retardation test and its application (4)

b) Derive an expression for the efficiency of the air standard Diesel cycle in terms of the cycle compression ratio and cut-off ratio. (6)

PART C

Answer any four full questions, each carries 10 marks

9 a) What is meant by pre-ignition? Does pre-ignition occur in CI engines? Justify your answer. (3)

b) Name the stages of combustion in a C.I. engine and explain with the aid of a pressure – crank angle diagram. (7)

10 a) List any 2 methods for reducing NOx emission and discuss their basic principle (5)

b) Name the factors affecting detonation in S.I. engine and discuss their effect. (5)

11 a) Explain octane rating and cetane rating? (4)

b) In an ideal gas turbine plant, air enters the compressor at 1.03 bar and 35°C. the pressure ratio is 6. The temperature at the turbine inlet is 1200°C. Mass flow rate of air is 10 kg/s. Determine: (6)
i) Power required to run the compressor ii)Turbine power output
iii) Net power output of plant iv)Thermal efficiency
For air, take: Cp = 1.005 kJ/kg.K and ratio of specific heats as 1.4.

12 a) Write short notes on alternative fuels and bio-fuels. (5)

b) With the aid of a diagram, explain the working of an annular combustion for gas turbines. (5)

13 Air is drawn in a gas turbine unit at 15^{o}C and 1.01 bar and pressure ratio is 7:1. The compressor is driven by high pressure (HP) turbine and low pressure (LP) turbine drives a separate power shaft. The isentropic efficiencies of compressor, and the HP and LP turbine are 0.82,0.85 and 0.85 respectively. If the maximum cycle temperature is 610^{o}C, calculate: (10)
i)The pressure and temperature of gases entering the turbine
ii) The net power developed by the turbine
iii) The work ratio
iv)The thermal efficiency of the unit

14 a Derive an expression for the optimum cooling pressure for minimum compressor work for a two-stage compression with perfect intercooling (4)

b Explain any three methods to improve the efficiency of gas turbine. (6)

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