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Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S4 (S,FE) / S2 (PT) (S,FE) Examination May 2024 (2015 Scheme)

**Course Code: ME204**

**Course Name: THERMAL ENGINEERING**

Max. Marks: 100 Duration: 3 Hours

## PART A

***Answer any three questions. Each question carries 10 marks.***

1 a) What is the function of a super heater? List its advantages (3)

b) Steam at a pressure of 25 bar $400^0$ C is expanded through a turbine at first to a pressure of 3 bar.it is then reheated at constant pressure to the initial temperature of $400^0$ C and finally expanded to 0.1 bar . Estimate the work done per kg of steam flowing through the turbine and amount of heat supplied during the process of reheat. Compare the work output when the expansion is direct from 25 bar to 0.1 bar without any reheat. (7)

2 a) Explain about the super saturated flow (3)

b) Determine throat area ,exit area and exit velocity for a steam to pass 0.2 kg/s when the inlet conditions are 12 bar and $250^0$C and the final pressure is 2bar. Assume that the expansion is isentropic and the inlet velocity is negligible. Take n=1.3 for superheated steam. (7)

3 Derive the expression for the maximum efficiency of a reaction turbine (10)

4 a) Define the following terms i)Speed ratio ii)Blade velocity co-efficient iii)Diagram efficiency iv)Stage efficiency (4)

b) Explain any two types of governing used in steam turbines (6)

## PART B

***Answer any three questions. Each question carries 10 marks***

5 a) Explain the working of stratified charge engine (4)

b) Compare the efficiencies of Otto cycle ,Diesel cycle and dual cycles (6)

6 a) Explain Turbocharging (4)

b) The swept volume of a diesel engine working on dual cycle is 0.0053 $m^3$ and clearance volume is 0.00035 $m^3$. The maximum pressure in the cycle is 65 bar. Fuel injection ends at 5% of the stroke. The temperature and pressure at the start of the compression are $80^0$ C and 0.9 bar. Determine air standard efficiency of the cycle. take $\gamma$ for air =1.4 (6)

7 Full load test on a two stroke engine: speed 450 rev/min, brake load 450N, imep =2.9 bar, oil consumption 5.4 kg/h, rise in temperature of jacket water $36.1^0$C, jacket water flow 440 kg/h, air fuel ratio by mass 31,temperature of exhaust gases $355^0$ C, temperature of the laboratory $20^0$ C, barometric pressure76 cm of hg, (10)

cylinder diameter 22cm, stroke 27cm, brake diameter 1.5calorific value of the fuel 44000 kJ/kg, proportion of hydrogen by mass in the fuel 15,R=0.287 kJ/kg for air ,mean specific heat of dry exhaust gases1.005,specific heat of dry steam 2.05 kJ/kgK. Determine i) indicated thermal efficiency ii)The specific fuel consumption iii) volumetric efficiency iv) Draw up a heat balance sheet on percentage basis

8 a) Explain about i) CNG ii) Producer Gas (4)

b) The ultimate analysis of a sample of petrol by weight is carbon 0.835 hydrogen 0.165. Calculate the ratio of air to petrol consumption by weight if the volumetric analysis of the dry exhaust gas is $CO_2$ = 12.1, CO= 1.1, $O_2$= 0.8, Nitrogen 85.4%. Also find the percentage of excess air. (6)

## PART C

***Answer any four questions. Each question carries 10 marks.***

9 a) Define Cetane Number? How the Cetane number affects the delay period (4)

b) Describe the engine variables which affect the flame propagation (6)

10 a) Explain any two methods to reduce exhaust gas HC/CO emissions (4)

b) Show the stages of combustion in a SI engine on a pressure – crank angle diagram and explain the events in each stage (6)

11 a) Explain about the blending of fuels and causes of smoke in diesel engine (4)

b) What are F head combustion chambers? Explain any two important F-head designs (6)

12 a) List the merits of Gas turbines over IC engines (4)

b) Explain the Classifications of gas turbines (6)

13 a) Explain the effect of compressor inlet temperature and turbine inlet temperature on the thermal efficiency of the open cycle gas turbine. (4)

b) A gas turbine has a pressure ratio of 6 and the maximum cycle temperature is $600^0$C. The isentropic efficiencies of compressor and turbine are 0.82 and 0.85 respectively. Calculate the power output in kW of an electric generator geared to the turbine when the air enters the compressor at $15^0$C at the rate of 15kg/s. take $c_p$=1.005kJ/kg and $\gamma$=1.4 for compression process and $c_p$=1.11kJ/kgK and $\gamma$=1.333 for expansion process (6)

14 Air is drawn in a gas turbine unit at $17^0$ C and 1.01 bar and the pressure ratio is 8:1 the compressor is driven by the HP Turbine and the LP turbine drives a separate power shaft. The isentropic efficiencies of the compressor and HP and LP turbine are 0.8, 0.85 and 0.83 respectively. Calculate the pressure and temperature of the gases entering the power turbine, the net power developed by the unit per kg/s of mass flow, the work ratio and the thermal efficiency of the unit. The maximum cycle temperature is $650^0$C. For compression process take $c_p$=1.005 kJ/kg and $\gamma$=1.4 and for combustion and expansion process take $c_p$=1.15 kJ/kgK and $\gamma$=1.333. (10)