Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: ME204
Course Name: THERMAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

Use of steam table is permitted.
Missing data if any, may be suitably assumed

PART A

Answer any three questions. Each question carries 10 marks.

1	a)	With a schematic, explain working of any one safety valve employed as a boiler mounting.	5
	b)	What do you mean by the term 'Choking' in connection with flow through a steam nozzle? Illustrate the phenomena with the help of mass flow rate vs pressure ratio diagram.	5
2	a)	Draw representative schematic of subsonic and supersonic nozzle. Under what conditions, a convergent-divergent duct behaves as a nozzle?	5
	b)	Steam at an absolute pressure of 10 bar and 250^{o}C expands isentropically in a steam turbine till the pressure drops to 1 bar. Estimate the quality of steam leaving the turbine and work developed per kg of steam. If the actual drop is 90% of isentropic enthalpy drop, and steam flow through the turbine is 500 kg/min, determine the power developed by the turbine. Use Mollier chart.	5
3	a)	Draw blading diagram for a two-row Curtis stage (ie, velocity compounded stage) followed by two reaction stages and plot pressure and velocity variation in axial direction.	5
	b)	Draw Combined Velocity diagram of a Parsons Reaction Turbine operating under maximum blading efficiency condition. Show blade angles, absolute and relative velocity components on the diagram. How can you evaluate axial thrust developed by this reaction stage?	5
4	a)	A four stage steam turbine receives steam at 35 bar and 435^{o}C and exhausts at 0.04 bar. Each stage has same efficiency ratio of 0.76. If the pressure at the end of stages are 5, 1.2 and 0.25 bar respectively, determine (i) Rankine enthalpy drop, (ii) Work done and (iii) Reheat factor.	10

PART B

Answer any three questions. Each question carries 10 marks

5	a)	Define dissociation. Discuss the effect of dissociation on power developed by an Otto cycle with neat sketches.	5
	b)	Discuss the purpose of supercharging with a neat schematic of a supercharged engine.	5
6	a)	Define: (i) Brake power, (ii)Indicated power, (iii) Specific fuel consumption (iv)Volumetric efficiency and (v) Calorific value	5
	b)	Discuss the effect of dopes and additives on performance of IC engines.	5
7	a)	Explain the working of a Stirling engine with the support of thermodynamic cycle on p-v diagram.	5
	b)	With a neat sketch, explain the method of flue gas analysis using an Orsat apparatus.	5
8	a)	The compression ratio of an engine working on Otto cycle is 6 and A:F ratio of the mixture is 15. The Calorific value of the fuel used is 44 MJ/kg. The pressure and temperature of the mixture at the beginning of compression are 1 bar and 60^{o}C. Determine the maximum pressure in the cylinder if the compression follows the law $p\ v^{1.32} = Constant$. Specific heat value is given by, $C_v = 0.71 + (0.0002 * T)$ kJ/kg K, where T is in K.	10

PART C

Answer any four questions. Each question carries 10 marks.

9	a)	Differentiate between knock and pre-ignition.	5
	b)	Write a short note on how Catalytic convertor reduces emission of hydrocarbons and carbon monoxide.	5
10	a)	What are the stages of combustion in a SI engine? Explain with the support of pressure vs crank angle diagram.	5
	b)	Define highest useful compression ratio (HUCR) and Octane Number for an SI engine fuel. How it is evaluated?	5
11	a)	Explain with a neat sketch, Annular combustion chamber of a gas turbine plant.	5
	b)	Explain the effect of regeneration on gas turbine plant output and efficiency.	5
12	a)	Define Swirl, Tumble and Squish. Explain how various types of CI engine combustion chamber is designed to produce swirl, with suitable diagrams.	10
13	a)	Derive an expression for air standard efficiency of a constant pressure gas turbine cycle in terms of pressure ratio. State your assumptions. Discuss the effect of pressure ratio on cycle output and efficiency.	10

14 a) The pressure ratio of a regenerative air standard gas turbine cycle is 5. Air enters the compressor at 1 bar and 300 K and leaves at 490 K. The maximum temperature in the cycle is 1000 K. Calculate the cycle efficiency, given that the efficiency of regenerator and adiabatic efficiency of turbine are each 80 %. Draw T-s diagram. 10