Code No: 136CC **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

IC ENGINES AND GAS TURBINES

(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	What is valve timing diagram? Draw the valve timing diagram for four stroke diesel engine.	[2]
b)	Explain octane and cetane number of IC engine fuels. What ON80 represents?	[3]
c)	What is knocking in SI engines?	[2]
d)	Explain the factors that affect the process of carburation.	[3]
e)	What is CRDI engine? Explain.	[2]
f)	List the parameters by which performance of an engine is evaluated.	[3]
g)	Explain the working of gas turbine cycle.	[2]
h)	Draw schematic of gas turbine cycle with regeneration.	[3]
i)	Draw the simple turbojet cycle.	[2]
j)	What are the basic requirements design gas turbine combustion chambers?	[3]

PART – B

(50 Marks)

2.a)	Describe the working principle of the four stroke CI engine. Mention the typical values of valve timings for a four stroke CI engine.	
b)	What is fuel rating? How the petrol is rated? Discuss the methods to improve the fuel rating in SI Engine.	[5+5]

OR

3.a)	How to achieve cold starting in S.I. Engine? Explain the reasons for starting of engine cold conditions.	
b)	How is the SI engine fuels rated in terms of octane number? Define the octane number scale and give the reasons for selecting this scale.	[5+5]
4.a)	Explain the working principle of fuel injector with neat diagram.	
b)	Explain different stages of combustion in CI engines along with a P-θ diagram.	[5+5]

OR

5.a)	Describe the principle of a timed injection system. What are the two methods of fuel injection using timed injection?	
b)	How the antiknock additives prevent detonation in S.I. Engine? What are different additives used in S.I. Engine? Explain.	[5+5]

6.a) Explain the method of conducting retardation test in internal combustion engine and compare this method with Willian's line method.

b) Discuss the various changes in fuel injection system in S.I. engines with neat sketches. [5+5]

OR

7. An eight-cylinder, four-stroke engine of 9 cm bore and 8 cm stroke with a compression ratio of 7 is tested at 4500 rpm on a dynamometer which has 54 cm arm. During a 10 minutes test the dynamometer scale beam reading was 42 kg and the engine consumed 4.4 kg of gasoline having a calorific value of 44000kJ/kg. Air 27 ^{0}C and 1 bar was supplied to the carburetor at the rate of 6 kg/min. Find (a) the brake power delivered (b) the brake mean effective pressure (c) the brake specific fuel consumption (d) the brake specific air consumption (e) the brake thermal efficiency (f) the volumetric efficiency and (g) the air-fuel ration. [10]

8.a) Explain the use of inter cooling, reheating and regeneration of a gas turbine.

b) Air is drawn in a gas turbine at 18^{0}C and 1atm and 1 bar and leaves the compressor at 5 bars. Data observed are: Temperature of gases entering the turbine = 678^{0}C, pressure loss in combustion chamber = 0.1bar. $\eta_{compressor}$ =85%, $\eta_{combustion}$ =85%, $\eta_{turbine}$ =80%, γ= 1.4 Cp = 1.024kJ/kg for gas. Find

i) Quantity of air, if plant develops 1065 kW

ii) Heat supplied/kg of air circulated

iii) Thermal efficiency of cycle. [5+5]

OR

9.a) A gas turbine takes atmospheric air at 1 atm and 15^{0}C. There are two stages with perfect intercooling in between. The total pressure ratio is 8. The maximum temperature of the cycle is 600^{0}C. A regenerator is used which recovers 60% of available heat η_c = 0.83, η_T = 0.86. Determine the thermal efficiency.

b) A gas turbine plant works between temperature limits of 300 K and 900 K and pressure limits of 1 atm and 4 atm. The initial efficiency of the compressor is 0.8 and that of turbine is 0.85. Estimate the thermal efficiency of the plant and the hp available if the fuel consumption is 1 kg/s. The heating value of fuel is 41.840kJ/kg. [5+5]

10.a) Derive an expression for degree of reaction in axial flow gas turbines with the help of velocity triangles.

b) Discuss the combustion process in combustion chamber of a gas turbine engine with the help of a suitable diagram. [5+5]

OR

11. A turbojet aircraft is flying at 800 km/h at 10700 m altitude where the pressure and temperature of the atmosphere are 0.24 bar and -50^{0}C respectively. The compressor pressure ratio is 10:1 and the maximum cycle temperature is 820^{0}C. Calculate the thrust developed and the specific fuel consumption in kg/ kNs using the following information: entry duct efficiency 0.9; isentropic efficiency of compressor 0.9; total head pressure loss in the combustion chamber 0.14bar; calorific value of fuel 43100kJ/kg. Combustion efficiency 98%; isentropic efficiency of turbine 0.92; mechanical efficiency of drive 98%; jet pipe efficiency 0.92: nozzle outlet area 0.08 m^2 Cp and γ for the compression process 1.005kJ/ kg/K and 1.4; Cp and γ for the combustion and expansion processes 1.15kJ/kg/K and 1.333. Assume that the nozzle is convergent. [10]

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