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Total Number of Pages: 02

Course: Integrated Dual Degree (B.Tech and M.Tech)

Sub_Code: RME4D001

4th Semester Regular/Back Examination: 2023-24
SUBJECT: Internal Combustion Engines and Gas Turbines
BRANCH(S): MECH, ME

Time: 3 Hour

Max Marks: 100

Q.Code: P236

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- A certain engine produces 10 kW indicated power. Its mechanical efficiency is 80%. Find the brake power delivered and friction power.
- Define compression ratio. What is the range for (a) the SI engine (b) the CI engine.
- The engine of the Maruti car has three cylinders with total displacement of 796 cm³. The compression ratio is 8.7. Find the clearance volume of each cylinder.
- What are the assumptions made in air standard cycle analysis?
- Discuss the use of LPG as SI engine fuel.
- What is meant by carburetion?
- Discuss the ill effects of detonation.
- What is the importance of 'delay period'?
- Why cooling of an internal combustion engine is necessary?
- What are the basic propellants are used in rockets?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Discuss the differences between ideal and actual valve timing diagram of a SI engine.
- Derive an expression for the mean effective pressure of the Otto cycle.
- What is chemical equilibrium? How does it affect the performance of the engine?
- What are (a) pumping losses, (b) rubbing friction losses?
- A simple jet carburetor is required to supply 6 kg of air per minute and 0.45 kg of fuel of density 740 kg/m³. The air is initially at 1.013 bar and 27°C. Calculate the throat diameter of the choke for a flow velocity of 92 m/s. Velocity coefficient = 0.8. If the pressure drop across the fuel metering orifice is 0.75 of that at the choke, calculate orifice diameter using $C_d = 0.60$.

- f) Discuss the requirement of an ideal injection system.
- g) What are F-head combustion chambers? Discuss the two important F-head designs.
- h) What are the methods of generating swirl in CI engine combustion chambers?
- i) What is EGR? Explain how it reduces NO_x emission.
- j) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325 kPa, 27^oC. The pressure ratio in the cycle is 6. Calculate the maximum temperature in the cycle and the cycle efficiency. Assume $W_T = 2.5 W_C$ where W_T and W_C are the turbine and compressor work respectively. Take $\gamma = 1.4$.
- k) Discuss the relative advantages and disadvantages of closed cycle and opencycle gas turbine plants.
- l) Which engine is more suitable for supercharging – SI engine or CI engine? Why?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) In a SI engine working on the ideal Otto cycle, the compression ratio is 5.5. The pressure and temperature at the beginning of compression are 1 bar and 27^oC respectively. The peak pressure is 30 bar. Determine the pressure and temperatures at the salient points, the air standard efficiency and mean effective pressure. Assume the ratio of specific heat to be 1.4 for the air. **(10)**
- b) What are the advantages and disadvantages of using LPG in SI engine? **(6)**
- Q4** a) What is the function of carburetor in SI engine? Briefly explain with a neat sketch the operation of a simple float type carburetor. **(12)**
- b) What do you understand by ignition timing? **(4)**
- Q5** Discuss the effect of the following engine variables on flame propagation: **(4x4)**
- a) Fuel-air ratio.
 - b) Compression ratio
 - c) Engine load
 - d) Turbulence.
- Q6** a) Explain the working of Axial Flow compressor with neat sketch. **(8)**
- b) In an air standard regenerative gas turbine cycle the pressure ratio is 5. Air enters the Compressor at 1 bar, 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 the adiabatic efficiency of the turbine are each 80%. Assume for air, the ratio of specific heats is 1.4. Also show the cycle on T-S diagram **(8)**