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Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)

Sub_Code: RME4D001

4th Semester Back Examination: 2024-25

SUBJECT: Internal Combustion Engines and Gas Turbines

BRANCH(S): MECH

Time: 3 Hours

Max Marks: 100

Q.Code: S597

Answer Q1 (Part-I) 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)

- Describe the significance of mean effective pressure.
- Why the analysis of the fuel-air cycle is important?
- What are the losses considered in the analysis of the actual cycle into those considered in the analysis of the fuel-air cycle?
- What is meant by 'delay period'?
- What do you mean by biodiesel?
- What is the function of a carburettor?
- What do you understand by 'Autoignition'.
- What are the main components required in a fuel-injection system?
- What are the different types of superchargers used in IC engines?
- How is a turboprop different from a turbojet?

Part-II

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

- A two cylinder, four stroke gas engine has a bore of 350 mm and a stroke of 575 mm. At 250 rpm, the torque developed is 5 kN-m. The air/fuel ratio is 7:1 by volume. The estimated volumetric efficiency is 85 % and the calorific value of fuel is 16,800 kJ/m³. Calculate (i) the brake power, (ii) the mean piston speed and (c) the brake mean effective pressure
- What are the assumptions made in analysing the air-standard cycle?
- Explain the mixture requirements for starting, warm-up, and acceleration.
- What are the disadvantages of the SI engine multi-point fuel injection system?
- A simple jet carburettor 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) What do you understand by exhaust blowdown loss? Show the effect of exhaust valve opening time on exhaust blowdown loss.
- g) What are the basic requirements of a good combustion chamber? How can these be achieved?
- h) Briefly describe with the help of a simple diagram the M type combustion chamber for CI engine.
- i) What are the different types of lubrication system in IC engines?
- j) Explain different methods of supercharging.
- k) How is thrust created in ramjets?
- l) Write about rotating stall and surge.

Part-III

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

(16 x 2)

- Q3** A test on a single cylinder, four stroke oil engine having bore 18 cm and stroke 36 cm yielded the following results, speed 285 rpm, brake torque 393 Nm, indicated mep 7.2 bar, fuel consumption 3.5 kg/hr, cooling waterflow 4.5 kg/min, cooling water temperature rise 36 °C, air fuel ratio by mass 25, exhaust gas temperature 415 °C, barometric pressure 1.013 bar, room temperature 21 °C. The fuel has a calorific value of 45200 kJ/kg and contains 15 % by mass of hydrogen. Determine
 (a) the indicated thermal efficiency
 (b) the volumetric efficiency based on atmospheric conditions
 Draw up a heat balance in terms of kJ/min. Take $R = 0.287 \text{ kJ/kgK}$, c_v for dry Exhaust gases = 1.005 kJ/kgK and for superheated steam $c_p = 2.05 \text{ kJ/kgK}$. **(16)**
- Q4** Discuss in detail the problems associated with carburettors and the possible steps to overcome the difficulties caused. List down the main drawbacks of the carburettor which prompted the use of the fuel injection system in SI engine? **(16)**
- Q5** Describe the different stages of combustion in a CI engine. Describe how ignition delay affects knocking in CI engines. Discuss the parameters which affect the ignition delay in CI engines. **(16)**
- Q6** In a gas turbine plant, operating on Joule cycle, maximum and minimum temperatures are 700 °C and 35 °C. The pressure ratio is 4. Calculate the specific work output, cycle efficiency and work ratio. Assume isentropic efficiencies of the compressor and turbine at 85 and 90 percent respectively. What is the heat rate in kJ /Kw-hr? If the rating of the turbine is 1200 kW. What is the mass flow in kg/ sec? Neglect mass flow, of fuel. assume $c_p = 1.005 \text{ kJ/kgK}$. **(16)**