

Printed Pages—6

ME—602

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4050

Roll No.

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B.Tech.

SIXTH SEMESTER EXAMINATION, 2005-2006

I.C. ENGINES

Time : 3 Hours

Total Marks : 100

- Note :**
- (i) Attempt **ALL** questions.
 - (ii) All questions carry equal marks.
 - (iii) In case of numerical problems assume data wherever not provided.
 - (iv) Be precise in your answer.

1. Attempt *any four* parts of the following : (5×4=20)

- (a) One gram-mole of a hydrocarbon fuel C_8H_{15} is mixed with 1550 g of air. Calculate FUEL-AIR EQUIVALENCE RATIO of the mixture.
- (b) Draw typical VALVE TIMING DIAGRAMS for low speed and high speed 4-STROKE ENGINES. Explain major differences if any, between these two sets of valve timing diagrams.
- (c) Draw a combustion pressure v/s CRANK ANGLE (P-θ) diagram for an SI Engine. Mark on this diagram different phases of combustion process. Give approximate values of energy released in each phase of combustion.

- (d) Explain the effect of change in number of MOLECULES during combustion on maximum pressure in the otto cycle.
- (e) Explain CDI ignition system with a neat sketch.
- (f) Explain briefly Time Loss FACTOR resulting in a lower thermal efficiency of actual cycle compared to air-standard cycle for SI Engines.

2. Attempt *any two* parts of the following : (10x2=20)

- (a) A CARBURETTOR is tested in a factory without air cleaner. Float chamber is vented to atmosphere. The A : F ratio was found to be 14 : 1. The pressure at VENTURI THROAT was 0.834 bar. In case II CARBURETTOR was tested after fitting air cleaner. The pressure loss in air cleaner was 3 cm. of Hg. Assuming airflow being the same and discharge coefficients unchanged, neglecting NOZZLE LIP

Find (i) Pressure at throat after fitting air cleaner

(ii) A/F ratio after fitting air cleaner

- (iii) If air flow rate is 5 kg/min and discharge coefficient of venturi is 0.8, determine venturi throat diameter when air cleaner is not fitted. Take flow is compressible and isentropic. Atmospheric conditions are 1.013 bar and 300 K. For air $C_p = 1.005 \text{ kJ/kg-k}$, $\gamma = 1.4$

- (b) Present in Tabular form the effect of change in the following variables on knocking in SI Engines; ENGINE COMPRESSION RATIO, LOAD, SPEED, A/F RATIO INLET TEMPERATURE, INLET PRESSURE, SPARK ADVANCE, TURBULENCE, CYLINDER BORE, ALTITUDE OF SITE. State briefly the reasons against each variable to justify your answer.
- (c) Give the stepwise procedure to design the combustion chamber of a S.I. engine.
3. Attempt *any two* parts of the following : (10x2=20)
- (a) Write short notes on *any two* of the following :
- (i) Methods of providing SWIRL and TURBULENCE diesel engines giving sketches of the combustion chambers employing these methods.
 - (ii) Effect of A/F ratio on CO, HC and NO_x emissions in SI Engines.
 - (iii) MORSE Test for measurement of FRICTIONAL HORSE POWER IN ENGINES.
- (b) What are different methods of TURBO-CHARGING ? Discuss their relative merits and demerits.

- (c) A 4-Stroke diesel engine operates on A : F ratio = 20. The Bore \times Stroke are 105×127 mm. The volumetric efficiency of engine is 0.8. The condition of air at the beginning of compression is 1 bar and 300 K. Engine speed is 1800 RPM. Injection pressure is 300 bar and the average cylinder pressure during injection is 40 bar. Injection duration is 15° Crank angle. A multihole nozzle with 4 holes is used for each cylinder. Calculate

(i) Amount of fuel injected per cylinder per cycle

(ii) Diameter of nozzle holes.

Take fuel density $P_f = 850 \text{ kg/m}^3$.

Discharge coeft. for nozzle $C_{df} = 0.67$

Gas constant for air = $0.287 \text{ kJ/kg} \cdot ^\circ\text{K}$

4. Attempt *any two* parts of the following : (10 \times 2=20)

(a) Describe an AXIAL FLOW compressor. How is it different than a centrifugal compressor? Draw the VELOCITY DIAGRAMS of an AXIAL FLOW compressor.

(b) A multi stage compressor is to be designed to compress air from 1 to 125 bar pressure such that the stage pressure ratio does not exceed 4. Determine :

(i) Number of stages

(ii) Exact STAGE PRESSURE RATIO

(iii) Intermediate pressures. Assume perfect inter cooling.

(c) Answer *any two* of the following :

- (i) Prove that volumetric efficiency of a single stage reciprocating compressor is given by :

$$\eta_v = 1 + k - k \left(\frac{P_2}{P_1} \right)^{\frac{1}{n}} \quad \text{where } k = \frac{V_c}{V_s} \text{ and}$$

P_1 = inlet pressure, P_2 = outlet pressure,
 n = polytropic index, V_c = clearance volume, V_s = swept volume.

- (ii) Describe briefly a ROOTS Blower

- (iii) Write a short note on inter cooling and its advantages.

5. Attempt *any two* parts of the following : (10x2=20)

- (a) Air at 0.9 bar and 303 K enters the compressor and leaves at 4.5 bar with an isentropic efficiency of 0.85. Its temperature is raised further using exhaust gas passing through a heat exchanger. The maximum temperature of the cycle is limited to 1000°C. The gas then in a gas turbine is expanded to 1.1 bar with isentropic efficiency of 0.80. Effectiveness of heat exchanger is 0.8. Neglect fuel mass and pressure losses in the system. Flow of air is 5 kg/sec.

Find (i) Thermal efficiency of the system

- (ii) Power developed. Properties of air are $C_p = 1.005 \text{ kJ/kg. K}$, $\gamma = 1.4$

- (b) Discuss effect of the following factors on the specific output and thermal efficiency of the open cycle gas turbine at different pressure ratios
 - (i) Compressor inlet temperature
 - (ii) Compressor isentropic efficiency
 - (iii) Turbine inlet Temperature
 - (iv) Turbine isentropic efficiency
- (c) Write short notes on *any two* of the following :
 - (i) RAM JET ENGINE
 - (ii) TURBO - PROP ENGINE
 - (iii) SOLID PROPELLANT ROCKETS

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