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B.E / B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATIONS, APR / MAY 2019

MECHANICAL ENGINEERING

Fourth Semester

ME 8402 THERMAL ENGINEERING- I

(Regulation 2012)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Define cut-off and expansion ratio in Diesel cycle.
2. Which cycle (Otto/ Diesel/ Dual) is more efficient for same heat input?
3. State the effect of clearance on work done in a reciprocating air compressor.
4. Which process requires the least work to compress air for a given condition?
5. State the function of wristpin in an IC engine.
6. Which engine 2S / 4S has higher mechanical efficiency? Why?
7. Define Octane rating of a fuel.
8. What is turbocharging?
9. Which has a higher mechanical efficiency – Gas turbine or IC engine? Why?
10. List some materials used for gas turbine manufacture.

Part – B (5 x 16 = 80 marks)

11. An engine with 200 mm cylinder diameter and 300 mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27°C. The cut-off is 8% of the stroke. Determine: (i) Pressures and temperatures at all salient points. (ii) Theoretical air standard efficiency. (iii) Mean effective pressure. (iv) Power of the engine if the working cycles per minute are 300. Assume that compression ratio is 17 and working fluid is air. Consider all conditions to be ideal and draw p-v and T-s plane. (16)

12. a)i) Broadly classify the compressors. (4)
    ii) Briefly discuss the working of a single stage reciprocating air compressor. (5)
    iii) Derive an expression for work done in a single stage reciprocating air compressor with clearance. (7)

(OR)

b) What is the necessity for multistage compression? Derive an expression for optimum intermediate pressure of a multi-stage compressor with perfect intercooling. Represent the process on p-v plane. Also list the merits and demerits of multistage compression process. (3+7+3+3)

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13. a)i) Draw a neat schematic of a four stroke IC engine and label its salient features. (8)

ii) Draw the theoretical and actual port timing diagram of two stroke SI engine, and comment on the deviation between them. (8)

(OR)

b)i) Discuss the variations between theoretical and actual p-v diagram of a four stroke IC engine with a neat sketch. (8)

ii) Compare SI and CI engines. (atleast 6 important points) (8)

14. a)i) A 4 stroke single cylinder Diesel engine of 16 cm bore and 20 cm stroke, with a fuel consumption of 2.8 kg/h at 400 rpm. The indicator area 300mm^2, length of indicator diagram is 40 mm, spring constant 1 N/mm, load on the brake drum is 370 N, spring balance reading 50 N, and diameter of the brake drum is 1.2 m. The calorific value of the fuel is 41800 kJ/kg. Find i) Brake power & Brake mean effective pressure ii) Indicated mean effective pressure iii) Brake specific fuel consumption iv) Brake and indicated thermal efficiencies. (10)

ii) Deduce the stoichiometric A/F ratio for gasoline and Diesel fuels having molecular formulae- C_8H_{15} and $C_{12}H_{24}$ respectively. (6)

(OR)

b)i) Why knocking takes place in a compression ignition engine? List the factors which affect knocking. (4+4)

ii) A four cylinder four stroke SI engine has a compression ratio of 9, and a bore of 100 mm. stroke length is equal to the bore. Volumetric efficiency is 75%, with the engine speed 4000 rpm and an A/F ratio of 15:1. If the heating value of the fuel is 42 MJ/kg, mean effective pressure 10 bar, and mechanical efficiency 80%, determine the indicated thermal efficiency and brake power. Assume ambient conditions as 1 bar and 310 K. (8)

15. a) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 300K. The pressure of the air after compression is 5 bar. The isentropic efficiencies of compressor and turbine are 80% and. 85% respectively. The air-fuel ratio used is 100 : 1. If flow rate of air is 3 kg/s, find : (i) Power developed. (ii) Thermal efficiency of the cycle. Assume c_p = 1.0 kJ/kg.K and γ = 1.4 of air and. gases Calorific value of fuel = 41800 kJ / kg. Sketch the cycle on T-s and p-v planes. (6+6+4)

(OR)

b) Describe the operation of an open cycle Gas turbine plant with a schematic. Represent the various processes on p-v and T-s planes. Mention the merits and demerits of a gas turbine compared to an IC engine. Also state the methods to improve efficiency of a Gas turbine. (4+4+3+5)