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# Question Paper Code : X10699

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
AND APRIL/MAY 2021
Fourth/Sixth Semester
Mechanical Engineering
ME 8493 – THERMAL ENGINEERING – I
(Common to Mechanical Engineering (Sandwich))
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.
State clearly any assumption made with justification

PART – A **(10×2=20 Marks)**

1. How the efficiency of diesel engine varies for different cutoff ratios and for which cutoff ratio the efficiencies of Otto and Diesel cycles become identical ?
2. How does Brayton cycle work ?
3. How air compressors are classified ?
4. What is swept volume ? Write down its mathematical expression for single acting air compressor.
5. Why petrol engines and diesel engines are called as SI and CI engines respectively ?
6. Write any 2 disadvantages of 2-stroke cycle engines over 4-stroke cycle engines.
7. What is indicated thermal efficiency of IC engine ?
8. Why specific fuel consumption in petrol engine is higher than diesel engine ?
9. What are the basic requirements to be considered for the selection gas turbine working fluid ?
10. Why Brayton cycle is more suitable than Otto cycle for gas turbine plants ?

PART – B **(5×13=65 Marks)**

11. a) In a compression ignition engine, working on a dual combustion cycle, pressure and temperature at the start of compression are 1 bar and 300 K respectively. At the end of compression, pressure reaches a value of 25 bar. The heat is supplied at 420 kJ per kg of air during constant volume heating and pressure becomes 2.8 bar at the end of isentropic expansion. Estimate the ideal cycle efficiency. Take $C_p$ = 1005 J/(kg.K) and $C_v$ = 712 J/(kg.K).

(OR)

b) A certain quantity of air at a pressure of 1 bar and temperature 343 K is compressed reversibly and adiabatically until the pressure is 7 bar in an Otto cycle engine. At constant volume, if 460 kJ of heat per kg of air is added, then determine : (i) compression ratio of the engine (ii) temperature at the end of compression and iii) temperature at the end of heat addition. Take for air, $C_p$ = 1000 J/(kg.K) and specific heat ratio = 1.414.

12. a) For a single stage reciprocating air compressor (without clearance volume), with the help of p-v and T-s diagrams compare the work done during isothermal, polytropic and isentropic compression.

(OR)

b) Discuss the various differences between reciprocating compressor and screw compressor.

13. a) i) How reciprocating internal combustion engines are classified ? Discuss. **(5)**

ii) With a neat sketch discuss the essential parts of an IC engine. **(8)**

(OR)

b) i) Draw a theoretical and actual valve timing diagram of a 4-stroke petrol engine. **(5)**

ii) With a neat sketch explain the operation of 2-stroke diesel engine. **(8)**

14. a) What is the need of Multi Point Fuel Injection system (MPFI) ? Discuss the function of basic arrangements of MPFI system.

(OR)

b) An I.C. engine uses 6 kg of fuel having calorific value 44 MJ/kg in one hour. The IP developed is 18 kW. The temperature of 11.5 kg of cooling water was found to rise through 25 deg.C per minute. The temperature of 4.2 kg of exhaust gas with specific heat 1 kJ/(kg.K) was found to rise through 220 deg.C. Draw the heat balance sheet for the engine.

15. a) Draw a schematic of closed cycle gas turbine plant and discuss its function. Also suggest fuels that are especially required for closed cycle gas turbine plant.

(OR)

b) A constant pressure open cycle gas turbine plant works between temperature range of 15 deg.C and 700 deg.C and pressure ratio of 6. Find the mass of air circulating in the installation, if it develops 1100 kW. Also find the heat supplied by the heating chamber.

PART – C **(1×15=15 Marks)**

16. a) The following data are obtained while testing a 4 stroke, 4 cylinder, petrol engine :

Air fuel ratio (by weight) = 15:1

Calorific value of fuel = 45000 kJ/kg

Mechanical efficiency = 85%

Air standard efficiency = 53%

Relative efficiency = 65%

Volumetric efficiency = 80%

Stroke bore ratio = 1.3

Suction conditions = 1 bar, 30°C

Engine speed = 3000 rpm

Power at brakes = 75 kW

Calculate i) compression ratio (ii) indicated thermal efficiency (iii) brake specific fuel consumption (iv) bore and stroke of the engine.

(OR)

b) A gas turbine plant of 800 kW capacities takes the air at 1.01 bar and 15°C. The pressure ratio of the cycle is 6 and maximum temperature is limited to 700°C. A regenerator of 75% effectiveness is added in the plant to increase the overall efficiency of the plant. The pressure drop in the combustion chamber is 0.15 bars as well as in the regenerator is also 0.15 bars. Assuming the isentropic efficiency of the compressor 80% and of the turbine 85%, determine the plant thermal efficiency. Neglect the mass of the fuel.

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