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Question Paper Code : 90365

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Fourth Semester
Mechanical Engineering
ME 8493 : THERMAL ENGINEERING – I
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.
Use of Steam Tables and Charts is permitted.

PART – A **(10×2=20 Marks)**

1. What is the use of air-standard cycle analysis ?
2. Draw the Diesel cycle on P-V and T-s diagrams and mark the various processes.
3. What are the advantages of multi stage compression ?
4. What is a rotary compressor ? How are rotary compressors classified ?
5. How are SI and CI engine fuels rated ?
6. What is meant by ignition delay ?
7. What is the necessity of cooling of an IC engine ?
8. What is turbocharging ?
9. How are gas turbine classified ?
10. Depict the influence of pressure ratio on the efficiency of a Brayton cycle.

PART – B **(5×13=65 Marks)**

11. a) In an SI engine working on the ideal Otto cycle, the compression ratio is 5.5. The pressure and temperature of compression are 1 bar and 27°C, respectively. The peak pressure is 30 bar. Determine the pressure and temperature at the salient points, the air-standard efficiency and the mean effective pressure. Assume ratio of specific heats to be 1.4 for air.

(OR)

b) A reheat cycle is working under the following conditions :
Maximum pressure = 150 bar : maximum temperature = 600°C : condense pressure = 0.1 bar and moisture at the condenser inlet = 5.17 5. Assume that steam expands to saturate state in first stage. Consider the cycle to be ideal. Determine (i) the reheat pressure (ii) the cycle efficiency and (iii) the steam flow rate. Draw T-s diagram of the cycle.

12. a) A single-stage single-acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the swept volume. Assuming the index compression and expansion to be 1.3, find (i) volumetric efficiency of the compressor (ii) the power required if the mechanical efficiency is 85% and (iii) speed of the compressor (r.p.m).

(OR)

b) A multi-stage air compressor is to be designed to elevate the pressure from 1 bar to 125 bar such that stage pressure ratio will not exceed 4. Determine (i) Number of stages (ii) Exact stage-pressure ratios (iii) Intermediate pressures.

13. a) Compare the relative advantages and disadvantages of four-stroke and two-stroke cycle engines.

(OR)

b) Explain with neat sketches the phenomena of knocking in S.I. engines.

14. a) Discuss with suitable sketches the magneto-ignition system.

(OR)

b) Explain with neat sketches the working of CRDI engine.

15. a) In a gas turbine the compressor takes in air at a temperature of 15°C and compresses it to four times the initial pressure with an isentropic efficiency of 82%. The air is then passed through a heat exchanger heated by the turbine exhaust before reaching the combustion chamber. In the heat exchanger 78% of the available heat is given to the air. The maximum temperature after constant pressure combustion is 600°C, and the efficiency of the turbine is 70%. Neglecting all losses except those mentioned, and assuming the working fluid throughout the cycle to have the characteristic of air find the efficiency of the cycle. Assume R=0.287 kJ/kg K and $\gamma = 1.4$ for air and constant specific heats throughout.

(OR)

b) The pressure ratio of an open-cycle gas turbine power plant is 5.6. Air is taken at 30°C and 1 bar. The compression is carried out in two stages with perfect intercooling. The maximum temperature of the cycle is limited to 700°C. Assuming the isentropic efficiency of each compressor stage as 85% and that of turbine as 90%, determine the power developed and efficiency of the power plant, if the air flow is 1.2 kg/s. Assume $C_p = 1.005$ kJ/kg. K and $\gamma = 1.4$.

PART – C **(1×15=15 Marks)**

16. a) In a test of a 4-cylinder, 4-stroke engine 75 mm bore and 100 mm stroke, the following results were obtained at full throttle at a particular constant speed and with fixed setting of fuel supply of 6.0 kg/h.

B.P. with all cylinder working = 15.6 kW
B.P. with cylinder no. 1 cut-out = 11.1 kW
B.P. with cylinder no. 2 cut-out = 11.03 kW
B.P. with cylinder no. 3 cut-out = 10.88 kW
B.P. with cylinder no. 4 cut-out = 10.66 kW

If the calorific value of the fuel is 83600 kJ/kg and clearance volume is 0.0001 m^3, calculate :

i) Mechanical efficiency
ii) Indicated thermal efficiency, and
iii) Air standard efficiency.

(OR)

b) In a single-heater regenerative cycle the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find the efficiency and the steam rate of the cycle.
