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B. E. (Fourth Semester) Examination, April-May 2020

(New Scheme)

(Mech. & Automobile Engg. Branch)

APPLIED THERMODYNAMICS

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *All questions are compulsory. Part (a) of each question is compulsory. Attempt any* ***two*** *parts from (b), (c) and (d). Use of steam Table and Mollier chart is permitted.*

Unit-I

1. (a) Define Compression Ratio and show the variation of Otto cycle efficiency with Compression Ratio. 2

(b) An air standard otto cycle operates with a Compresison Ratio of 9 : 1. At the begining of the compression process, the pressure is 1 bar and temperature is 17° C. The amount of heat added to the air per cycle is 2000 kJ/kg. Determine (i) Maximum pressure and temperature of air in the cycle (ii) Thermal efficiency of the cycle. 7

(c) An air standard Diesal cycle has a Compression Ratio of 14 : 1. The cut off takes place at 6% of the stroke. The initial condition of the air used in the cycle is 1 bar, 19° C. Determine (a) the cut-off ratio, (b) the network out put/kg of air and (c) thermal efficiency of the cycle. 7

(d) Discuss Dual Combustion cycle with the help of p-v; T-s diagram, determine the expression of efficiency. 7

Unit-II

2. (a) Why Carnot cycle is not considered as practical cycle in vapour cycle? Discuss. 2

(b) How Rankine cycle efficiency can be improved by

(i) Increasing pressure at constant temperature.

(ii) Increasing temperature at Constant Pressure. 7

(c) In an ideal reheat rankine cycle steam at 60 bar 400°C is supplied from a high pressure boiler to a high pressure steam turbine. After it is expanded in the turbine to 10 bar, the steam is reheated under Constant Pressure to 400° C. The steam is then expanded to low pressure to 0·05 bar. Determine per kg of air (i) work done by the high pressure and low pressure turbine (ii) heat required during reheating process (iii) feed pump work (iv) thermal efficiency of the cycle (v) specific steam consumption. 7

(d) Steam is supplied to the turbine at 40 bar and 400° C in an ideal regenerative cycle. The condencing pressure is 0·075 bar. A single mixing type feed water is used where the bled steam mixes with the condensate steam from the condenser at 4·5 bar. Determine (i) the mass of steam to be bled (ii) the cycle efficiency and (iii) specific steam consumption/kWh. 7

Unit-III

3. (a) Define Volumetric Efficiency of compressor. Explain with the help of p-v diagram. 2

(b) Determine the expression of Volumetric Efficiency based on ambient condition. 7

(c) In a single stage air compressor initial pressure is 1 bar and final pressure is 16 bar. The compression is according to the law $pv^{1.3} = C$. Piston speed is 200 m/min, shaft rpm = 350 rpm, indicated power = 30 kW Volumetric efficiency = 0·85. Calculate the cylinder bore and stroke. 7

(d) A two stage single acting reciprocating air compressor, compresses air from 1 bar, 20° C to 40 bar following the law $pv^{1.33} = C$. For perfect intercooling, find per kg of air work done, mass of cooling water to be circulated in the intercooler, if the maximum rise in cooling water temperature is limited to 22° C. If the above compression is done by a single, what will be the work done and estimate the % of work saved. 7

Unit-IV

4. (a) State the advantages of using condenser in a Steam Power Plant. 2

(b) State the sourcess of air leakage into the condenser and its effect on performance of condenser. 7

(c) A vacuum of 710 mm was obtained in a condenser. When the barometer leads 755 mm. The temperature of condensate was 25° C. Determine the pressure of air and steam in condensor and mass of air/kg of steam. Also determine the vacuum efficiency. 7

(d) The following observation were made during a test on surface condenser

Barometer reading	= 760 mm Hg
Condenser vacuum	= 705 mm of Hg, Mean
Temperature of condensate	= 35° C, Condensate
Collected	= 2000 kg/hr ; Quantity of cooling
Water circulated	= 60,000 kg/hr.
Rise in temperature of cooling water	= 16° C,
Hot well temperature	= 28° C.

Determine :

(i) Vacuum Efficiency

(ii) Condenser Efficiency

(iii) Quality of steam entering the condenser

(iv) Mass of air present per m^3 of condenser volume.

Assume, inlet temperature of water as 20° C. 7

Unit-V

5. (a) Define :

(i) Stagnation Properties

(ii) Mach Number 2

(b) A fluid flows under steady state through a CD nozzle, prove that

$$\frac{dA}{A} = \frac{dV}{V}\left(M^2 - 1\right) \quad 7$$

(c) Explain Fanno flow and Rayleigh flow. 7

(d) Air enters a CD nozzle at 600 kPa and 330 K with negligible velocity. If the exit mach number is 2·2 and the throat area is ·003 m^2. Determine

(i) the exit plane condition

(ii) the throat conditions

(iii) the mass flow rate through the nozzle 7