



CBCS SCHEME

17AU33

Third Semester B.E. Degree Examination, July/August 2021 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

- 1 a. Differentiate the following :
 - i) Microscopic and Macroscopic approaches
 - ii) Intensive and extensive properties
 - iii) Path and process

(06 Marks)
- b. State and explain Zeroth law of Thermodynamics with suitable example.

(06 Marks)
- c. The temperature t on a certain celcius thermometric scale is given by means of a property through a relation $t = a/n P + b$. Where a and b are constants and P is the property of the fluid. If at the ice point and steam point the values of P are found to be 4 and 20 respectively, what will be temperature reading corresponding to a reading of $P = 16$?

(08 Marks)
- 2 a. Derive an expression for displacement work in various processes.

(10 Marks)
- b. A perfect gas is undergoing a process in which $T \propto V^{2/5}$. Calculate the work done by the gas in going from state 1 in which the pressure is 100 bar and volume is 4m^3 to the state 2 in which volume is 2m^3 . Also calculate the final pressure.

(10 Marks)
- 3 a. State the first law of Thermodynamics. Derive an expression for internal energy for the property of the system.

(10 Marks)
- b. A fluid system undergoes a non-flow frictionless process following the pressure volume relation as $P = \frac{5}{V} + 1.5$, where P is in bar and V is in m^3 . During the process volume changes from 0.15m^3 to 0.05m^3 and the system rejects 45kJ of heat. Determine:
 - i) Change in internal energy
 - ii) Change in enthalpy.

(10 Marks)
- 4 a. Describe with a neat sketch the available energy and derive an expression for unavailable energy.

(10 Marks)
- b. One Kg of ice at -5°C is exposed to the atmosphere, which is at 20°C . The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. Take C_p of ice = 2.093kJ/kg and latent heat of fusion of ice = 334kJ/kg.

(10 Marks)
- 5 a. Derive an expression for efficiency of a diesel cycle with relevant graph.

(10 Marks)
- b. An ideal diesel engine has a compression ratio of 20 and uses air as working fluid. The state of air at the beginning of the compress process is 95KPa and 20°C . If the maximum temperature in the cycle is not to exceed, 2200K, Determine:
 - i) The thermal efficiency
 - ii) Mean effective pressure. Assume constant specific heats for air at room temperature.

(10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 6 a. Describe Williams's time method and Morse Test. (08 Marks)
- b. The following data refer to the test conducted on a two stroke diesel engine run for 20 min at full load. MEP = 3 bar, Speed = 350rpm, Net brake load = 0.65kN, Fuel consumption = 1.52Kg, Cooling water = 160kg, water inlet temperature = 30°C, water temperature = 52°C, A/F ratio = 32, Room Temperature = 25°C, Exhaust temperature = 300°C, cylinder bore = 20cm, stroke = 28cm, Brake drum diameter = 100cm, Calorific value of fuel = 44000kJ/kg, stream formed per kg of fuel in the exhaust = 1.4kg, specific heat of steam in exhaust = 2.09kJ/kg K, Specific heat of dry exhaust gases = 1.0kJ/kg K. Draw heat balance sheet on minute basis. (12 Marks)
- 7 a. A refrigerating unit takes air from a cold chamber at 5°C and compresses it from 1 bar to 6.5bar. The index of compression is 1.25. The compressed air is cooled to a temperature, which is 10°C above the ambient temperature of 30°C before being expanded isentropically in an expander, Neglecting the clearance volume of the compressor and expander find the COP and the amount of air circulated in m³/min, if 2000kg of ice is to be formed per day at 0°C from water at 25°C. What is the tonnage of the unit? (12 Marks)
- b. Derive an expression C.O.P when compression and expansion are Isentropic. (08 Marks)
- 8 a. With a neat sketch describe the use of psychrometry chart. (10 Marks)
- b. With the help of schematic diagram, discuss summer air conditioning system. (10 Marks)
- 9 a. Derive an expression for workdone in a single stage compressor neglecting clearances. (10 Marks)
- b. A two stage, single acting reciprocating air compressor, with complete intercooling, atmospheric at 1 bar and 15°C, compresses it polytropically ($n = 1.3$) to 30 bar. If both cylinders have same stroke, calculate the diameter of the HP cylinder. The diameter of LP cylinder is 300mm. (10 Marks)
- 10 a. With a neat sketch, explain the constant volume gas turbine. (10 Marks)
- b. The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 20°C. The pressure of air after compression is 4bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air to fuel ratio is 90:1. Calorific value of the fuel is 42,000 kJ/kg. If flow rate of air is 3kg/sec. Find i) Power developed ii) thermal efficiency of the cycle. (10 Marks)
