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DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/MANAGEMENT/ COMMERCIAL PRACTICE, APRIL – 2021

THERMAL ENGINEERING

[Maximum Marks: 75] [Time: 2.15 Hours]

PART-A

(Answer ***any three*** questions in one or two sentences. Each question carries 2 marks)

I

1. Define a thermodynamic system.
2. State air standard efficiency.
3. Define super heated steam.
4. List the various modes of heat transfer.
5. Classify IC engines according to the number of strokes. (3×2=6)

PART-B

(Answer ***any four*** of the following questions. Each question carries *6* marks)

II

1. Explain (a) Charles law (b) Joules law.
2. Illustrate the Carnot cycle and derive its air standard efficiency.
3. Define (a) Induced power (IP) (b) Specific fuel consumption
   (c) Indicated thermal efficiency.
4. Illustrate Absorptivity, Reflectivity and Transmissivity.
5. At temperature $t_1 = 15^0$C and pressure $p_1 = 0.98$ bar, the specific volume of a gas equals $0.45 m^3/kg$. Subsequently the pressure drops to $p_2 = 0.6$ bar while the temperature remains constant. Compute the density of gas under the changed conditions.
6. Draw and explain a typical valve timing diagram of a 4 stroke SI engine.
7. Illustrate Morse test on a 4 cylinder diesel engine. (4×6=24)

PART-C

(Answer ***any of the three units*** from the following. Each full question carries 15 marks)

UNIT-I

III (a) Illustrate constant volume process and derive the expressions of the following,
(i) Pressure – volume – temperature relationship (ii) Work done by the gas
(iii) Change in internal energy (iv) Heat transfer (v) Change in enthalpy (9)

(b) A certain gas occupies a space of $0.3m^3$ at a pressure of 2 bar and a temperature of 77^0C is heated at constant volume, until the pressure is 7 bar. Evaluate,

(i) Final temperature of the process (ii) Change in internal energy

(iii) Change in enthalpy during the process

Assume Cp = 1.005kJ/kgK; Cv = 0.712kJ/kgK and R = 0.287kJ/kgK (6)

OR

IV (a) Illustrate Isothermal process and derive expressions of the following,

(i) Pressure – volume – temperature relationship (ii) Work done by the gas

(iii) Change in internal energy (iv) Heat transfer (v) Change in enthalpy (9)

(b) Air at a volume of $0.1m^3$ and a pressure of 1.5 bar is expanded isothermally to $0.5m^3$. Calculate,

(i) Final pressure of air (ii) Heat supplied during the process.

(iii) Work done during the process. (6)

UNIT – II

V (a) Illustrate the working of a 4 stroke petrol engine. (9)

(b) A Carnot engine operating between two reservoirs at T_1 and T_2. The output of the engine is 0.6 times of the heat rejected. The difference of temperatures between the source and sink is 200^0C. Calculate,

(i) Thermal efficiency (ii) Source temperature (iii) Sink temperature (6)

OR

VI (a) Show that air standard efficiency of a Joules cycle is $\eta = 1 - \frac{1}{(r)^{\gamma-1}}$ (9)

(b) List the assumptions made on air standard cycles. (6)

UNIT – III

VII (a) An engine consumes 6.5 kg of fuel per hour of calorific value 30,000 kJ/kg. If the engine produces a Brake power of 22 kW and mechanical efficiency 85%. Evaluate,

(i) Brake thermal efficiency (ii) Indicated thermal efficiency and

(iii) Specific fuel consumption in kg/BP/hour. (9)

(b) Explain the flow of steam through a convergent-divergent nozzle. (6)

OR

VIII (a) Evaluate the quantity of heat required to produce 2 kg of steam at a pressure of 6 bar and at a temperature of 30^0C under following conditions.

(i) When steam is wet and having dryness fraction of 0.9

(ii) When the steam is dry saturated, and

(iii) When steam is superheated at constant pressure and a temperature 250^0 C.

Assume the specific heat of superheated steam as 2.3 kJ/kgK. (9)

(b) Construct a typical Mollier chart for water and steam and show the following lines.

(i) Dryness fraction lines (ii) Constant pressure lines (iii) Isothermal lines (6)

UNIT – IV

IX (a) Classify the heat exchangers and derive the expression for LMTD of a parallel flow heat exchanger. (9)

(b) A boiler is made of iron plates of 12 mm thick. The outside and inside temperatures of the plates are 120^0C and 100^0C respectively. Assuming thermal conductivity (k) of the boiler metal as 84 W/mK and heating area is 5 m^2. Compute the mass of water evaporated per hour. (6)

OR

X (a) Show that Heat transfer between fluids separated by a plane wall, $Q = UA(T_A—T_B)$. Where, T_A & T_B are the temperature at the ends of two thin films of air A and B respectively. (9)

(b) Illustrate the working of a single stage reciprocating air compressor. (6)
