TED (06)–4016 Reg. No. .....

(REVISION–2006) Signature .....

FOURTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING—OCTOBER, 2012

THERMAL ENGINEERING

[*Time* : 3 hours

(Maximum marks : 75)

PART—A

(Maximum marks : 15)

Marks

I Answer the following questions in one or two sentences :

1. Define thermal engineering.
2. Define specific heat of a gas at constant pressure.
3. State the function of a carburettor in a petrol engine.
4. Define air standard efficiency.
5. Define absorptivity.
6. What are parallel flow heat exchanger ?
7. Define lower calorific value and higher calorific value of the fuel.
8. Define theoretical air.
9. List the important uses of compressed air for engineering applications.
10. Define volumetric efficiency of a compressor. (10×1½=15)

PART—B

(Maximum marks : 60)

(Answer *one* full question from each unit)

UNIT—I

II (a) Distinguish between intrinsic and extrinsic properties. 2

(b) State Boyle's law and Charle's law and derive the characteristic gas equation. 4

(c) A closed vessel A contains 0.085 m^3 of air at a pressure of 3500 kPa and a temperature of 48.9° C. The vessel is connected through a valve to another vessel B which contains an unknown volume of air at a pressure of 105 kPa and a temperature of 10° C. After the valve is opened, the resulting temperature and pressure become 21.1° C and 1400 kPa respectively. Determine the volume of the vessel B. For air, take R = 0.287 kJ/kgK. 6

OR

Marks

III (a) State Zeroth law of thermodynamic. 2

(b) Classify and explain thermodynamic system. 4

(c) $0.15m^3$ of a gas at 10 bar pressure receives heat at constant pressure until the volume becomes $0.30m^3$. Initial temperature of the gas is 200° C and CP = 1kJ/kgK and Cv = 0.714 kJ/kgK. Find :

(i) Change of internal energy of the gas (ii) external work done. 6

UNIT—II

IV (a) What is cut off ratio ? How does it affect the air standard efficiency of a Diesel engine ? 2

(b) List the assumptions made in the analysis of air standard cycles. 4

(c) The stroke and cylinder diameter of a compression ignition engine are 250 mm and 150 mm respectively. If the clearance volume is $0.0004m^3$ and fuel injection takes place at constant pressure for 5 per cent of the stroke, determine the efficiency of the engine. Assume the engine working on the Diesel cycle. 6

OR

V (a) Define specific fuel consumption and state its importance. 2

(b) List the advantages and disadvantages of two stroke cycle engine over a four stroke one. 4

(c) The following data was recorded during a test run made on a single cylinder, four stroke engine having a compression ratio of 6 :
Bore and stroke = 10 cm and 12.5 cm respectively.
Dead load and spring balance reading = 60 N and 20 N respectively.
Effective radius of brake drum = 40 cm.
Fuel consumption = 1.2 kg/hr.
Calorific value of fuel = 42500 kJ/kg.

If the engine turns 2000 revolution per minute and the indicated mean effective pressure is 0.25 Mpa, determine :

(i) indicated power and brake power
(ii) mechanical, overall and relative efficiencies. 6

UNIT—III

VI (a) State Fourier's law of conduction heat transfer. 2

(b) Explain natural convection and forced convection. 4

(c) A furnace wall is made up of refractory bricks of 300 mm thick. The inner and outer surface of the wall have temperature of 1000° C and 150° C. Find the heat loss per square metre per hour.

If the outside temperature becomes 50° C, the furnace wall is covered with insulating bricks of 200 mm thickness. Find the reduction in heat loss. Take thermal conductivities of refractory and insulating bricks as 4.5 and 0.5 W/m K. 6

OR

Marks

VII (a) List the advantages and disadvantages of recuperation. 2

(b) Explain the concept of A.M.T.D. 4

(c) The flow rates of hot and cold water streams running through a parallel-flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75° C and 20° C respectively. The exit temperature of hot water is 45° C. If the individual heat transfer coefficients on both sides are 650 W/m^2°C. Calculate the area of the heat exchanger. 6

UNIT—IV

VIII (a) Describe with a neat sketch, the Orsat apparatus used for analyzing the flue gases from a boiler. 6

(b) Estimate the higher and lower calorific values of a fuel having the following composition by mass :

C = 88%; H_2 = 10%; O_2 = 3%; S = 2%

N_2 = 20% and the rest is incombustible matter. 6

OR

IX (a) State the advantages and disadvantages of liquid fuel over solid fuel. 6

(b) The following data were recorded during ultimate analysis of 1 kg of coal :

Carbon—87.1 per cent by weight
Hydrogen—4.4 per cent by weight
Oxygen—1.2 per cent by weight
Sulphur—0.3 per cent by weight
Ash—7% by weight

Determine the quantity of air required for the complete combustion of 1 kg of this fuel. 6

UNIT—V

X (a) Classify air compressors. Describe the working of a single stage reciprocating air compressor with a sketch. 6

(b) A single acting single stage reciprocating air compressor compresses 1.2 kg of air per cycle from 1.1 bar to 5.5 bar pressure, the inlet temperature of air being 27° C. Determine the work done by the compressor upon air per cycle when :

(i) compression is adiabatic (ii) compression is isothermal 6

OR

XI (a) Differentiate between reciprocating and rotary air compressors. 6

(b) A single acting 2 stage reciprocating air compressor takes in air at a pressure of 1 bar and 20° C and compresses it to a pressure of 55 bar. The air is cooled in the intercooler at constant pressure of 10 bar to 40° C. The diameter of the low pressure cylinder is 175 mm and length of stroke in both the cylinders is 225 mm. If compression follows the law $PV^{1.25} = C$, find the I.P of the compressor if it runs at 150 r.p.m. 6