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Me-601/HPE-II/6th Sem/2017/N

## HEAT POWER ENGINEERING - II

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

PART – A

Marks – 25

All questions are compulsory.

Choose the correct answer from the given options :  $1 \times 25 = 25$

1. The operation of forcing additional air under pressure in the engine cylinder is known as
  - (a) Scavenging
  - (b) Turbulence
  - (c) Supercharging
  - (d) Pre-ignition.

[Turn over

2. An engine indicator is used to determine the following :
- (a) Speed
  - (b) Temperature
  - (c) Volume of cylinder
  - (d) m.e.p. and I.H.P.
3. Compression ratio of I.C. engines is
- (a) The ratio of volumes of air in cylinder before compression stroke and after compression stroke
  - (b) Volume displaced by piston per stroke and clearance volume in cylinder
  - (c) Ratio of pressure after compression and before compression
  - (d) Swept volume/cylinder volume.
4. The air standard efficiency of an I.C. engine is given by (where  $r$  = compression ratio, and  $\gamma$  = ratio of specific heats)
- (a)  $1 - r^{\gamma-1}$
  - (b)  $1 + r^{\gamma-1}$
  - (c)  $1 - (1/r^{\gamma-1})$
  - (d) None of these .

5. Number of working strokes per min. for a four stroke cycle engine are \_\_\_\_\_ the speed of the engine in r.p.m.
- (a) equal to (b) one-half  
(c) twice (d) four-times
6. The theoretically correct air fuel ratio for petrol engine is in the order of
- (a) 6 : 1 (b) 9 : 1  
(c) 12 : 1 (d) 15 : 1
7. In an internal combustion engine, the process of removing the burnt gases from the combustion chamber of the engine cylinder is known as
- (a) Scavenging (b) Detonation  
(c) Supercharging (d) Polymerisation.
8. The ignition of the charge by some hot surface within the engine before the passage of spark is called
- (a) Pre-ignition (b) Detonation  
(c) Ignition delay (d) Auto-ignition.

9. Which of the following medium is compressed in a diesel engine cylinder ?

- (a) Air alone
- (b) Air and fuel
- (c) Air and lubricating oil
- (d) Fuel alone.

10. The inlet valve of a four stroke cycle internal combustion engine remains open for

- (a)  $130^\circ$
- (b)  $180^\circ$
- (c)  $230^\circ$
- (d)  $270^\circ$

11. Flash point of fuel oil is

- (a) Minimum temperature to which oil is heated in order to give off inflammable vapours in sufficient quantity to ignite momentarily when brought in contact with a flame
- (b) Temperature at which it solidifies or congeals
- (c) Temperature at which it catches fire without external aid
- (d) Indicated by 90% distillation temperature, i.e. when 90% of sample oil has distilled off

12. The brake power (B.P.) of the engine is given by (where  $W$  = brake load or dead load in newtons,  $l$  = length of arm in meters,  $N$  = speed of engine in r.p.m.,  $S$  = spring balance reading in newtons,  $D$  = Dia. of brake drum in meters, and  $d$  = Dia. of rope in meters)

- (a)  $B.P. = (Wl \times 2\pi N)/60$  watts
- (b)  $B.P. = [(W - S) \pi DN]/60$  watts
- (c)  $B.P. = [(W - S) \pi (D + d) N]/60$  watts
- (d) All of these.

13. The process of breaking up of a liquid into fine droplets by spraying is called

- (a) Vaporisation
- (b) Carburetion
- (c) Ionization
- (d) Atomization.

14. The power actually developed by the engine cylinder of an I.C. engine is known as

- (a) Theoretical power
- (b) Actual power
- (c) Indicated power
- (d) None of these.

15. In gas turbine, the function of Re-heater is to

- (a) Heat inlet air
- (b) Heat exhaust gases
- (c) Heat air coming out of compressor
- (d) Heat gases coming out of high pressure turbine.

16. Which of the following is not used in four stroke cycle compression-ignition (CI) engines ?

- (a) Fuel pump
- (b) Spark plug
- (c) Fuel injector
- (d) Inlet and outlet valves.

17. During which component of vapour compression refrigeration system, the enthalpy remains constant ?

- (a) Evaporator
- (b) Compressor
- (c) Throttle valve
- (d) None of these.

18. Select the wrong characteristics of refrigerant :

- (a) low latent heat
- (b) low boiling point
- (c) high thermal conductivity
- (d) None of the above.

19. COP of a reversed Carnot cycle refrigerator working between higher temperature  $T_2$  and lower temperature  $T_1$

- (a) will increase with increase in  $T_1$  keeping  $T_2$  fixed
- (b) will decrease with increase in  $T_1$  keeping  $T_2$  fixed
- (c) will first increase with increase in  $T_1$  and then decrease with increase in  $T_1$  keeping  $T_2$  fixed
- (d) None of the above.

20. A refrigerating machine working on reversed Carnot cycle takes out 2kW of heat from the cold body while working between the temperature limits of 300K and 200K. The COP and power consumed by the cycle will be respectively.

- (a) 1 and 1kW
- (b) 1 and 2kW
- (c) 2 and 1kW
- (d) 2 and 2kW.

21. A 1 ton capacity water cooler cools water steadily from  $35^{\circ}\text{C}$  to  $20^{\circ}\text{C}$ . The specific heat of water is  $4.18 \text{ kJ/kg-K}$ . The water flow rate will be nearly
- (a) 13.33 liter/hr
  - (b) 33.3 liter/hr
  - (c) 200 liter/hr
  - (d) 250 liter/hr.
22. An Electrolux refrigerator uses
- (a) one pump
  - (b) two pump
  - (c) no pump
  - (d) three pump.
23. The major field(s) of application of gas turbine is (are)
- (a) Aviation
  - (b) Oil and gas industry
  - (c) Marine propulsion
  - (d) All of the above.

24. The ratio of heat actually released by 1kg of fuel to heat that would be released by complete perfect combustion, is called

- (a) Thermal efficiency
- (b) Combustion efficiency
- (c) Engine efficiency
- (d) Compression efficiency.

25. In a gas turbine, intercooler is placed

- (a) before low pressure compressor
- (b) in between low pressure compressor and high pressure compressor
- (c) in between high pressure compressor and turbine
- (d) None of the above.

PART – B

Marks – 45

Answer the following questions :

1. (a) Write short notes on any *two* :  $3 \times 2 = 6$
- (i) Heat balance sheet
  - (ii) Properties of refrigerants
  - (iii) Cooling system in I.C. engine
  - (iv) Knocking in I.C. engine
- (b) Explain battery ignition system in I.C. engine. 4
2. (a) Describe splash lubrication system. 3
- (b) Classify I.C. engine based on six different criteria. 3
- (c) What are the criteria of site selection of a diesel power plant ? 4
3. (a) Draw the valve timing diagram of four stroke petrol engine. 4
- (b) With the help of diagram, explain the working of vapour compression refrigeration system. 6

4. (a) An engine 20 cm bore and 30 cm stroke works on Otto cycle. The clearance volume is 1600 cm<sup>3</sup>. The initial temperature and pressure are 45°C and 1 ata respectively. If the maximum pressure is limited to 25 kgf/cm<sup>2</sup> – abs, find out :

(i) the air standard efficiency of the cycle.

(ii) the pressure at the end of the compression. 2+2=4

Or

Derive an expression for the air standard efficiency of a petrol engine. 4

(b) A single cylinder four stroke cycle gas engine 25 cm in diameter of 45 cm stroke runs at 200 rpm. The following readings were taken :

The number of explosions = 85/min

Load on the brake wheel = 85 kgf

Spring balance reading = 7 kgf

Brake wheel diameter = 152 cm

Mep from indicator diagram = 5.4 kgf/cm<sup>2</sup>

Gas used = 712 m<sup>3</sup>/hr

Calorific value of gas = 5400 Kcal/m<sup>3</sup>.

Find mechanical and brake thermal efficiency. 5

Or

Describe prony brake with a neat sketch. 5

5. In an open cycle constant pressure gas turbine, air enters the compressor at  $27^{\circ}\text{C}$ . The pressure of air after compression is  $4 \text{ kgf/cm}^2$ . The isentropic efficiencies of both compressor and turbine are 80%. The air fuel ratio is 80:1. Find the thermal efficiency of the cycle and power developed if the flow rate of air is  $2.5 \text{ kg/sec}$ . Take  $C_p = 0.24$  and  $\gamma = 1.4$  for air and gases. Calorific value of fuel used is  $10,000 \text{ kcal/kg}$ . 6

Or

Draw a schematic diagram and T-S diagram of an open cycle gas turbine with inter-cooling, reheating and regeneration.  $2 \times 3 = 6$