

# 17529

**14115**

**3 Hours / 100 Marks**

Seat No.

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- Instructions* –
- (1) All Questions are *Compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. a) Attempt any **THREE** of the following: **12**
- (i) Why does the Carnot heat engine not exist in practice? Give any four points.
  - (ii) Define following efficiencies related to compressors:
    - 1) mechanical efficiency
    - 2) polytropic efficiency
    - 3) compressor efficiency
    - 4) overall volumetric efficiency.
  - (iii) Show the effect of increase of compression ratio in a single stage reciprocating compressor on PV diagram and give its physical significance.

P.T.O.

(iv) Compare the effect of supercharging on S.I. engine and C.I. engine with respect to following parameters:

- 1) detonation
- 2) combustion
- 3) fuel economy
- 4) quality of fuel.

b) **Attempt any ONE of the following:**

**06**

(i) What do you mean by:

- 1) frictional power
- 2) brake thermal efficiency
- 3) BSFC, w.r.to I.C. engine.

(ii) Explain with neat sketch any one catalytic converter.

2. **Attempt any TWO of the following:**

**16**

a) (i) The criterion of the thermodynamic efficiency of a reciprocating compressor is isothermal compression while for rotary compressor it is isentropic compression. Discuss the reason for this.

(ii) Compare reciprocating compressors and centrifugal compressors on the basis of the following parameters:

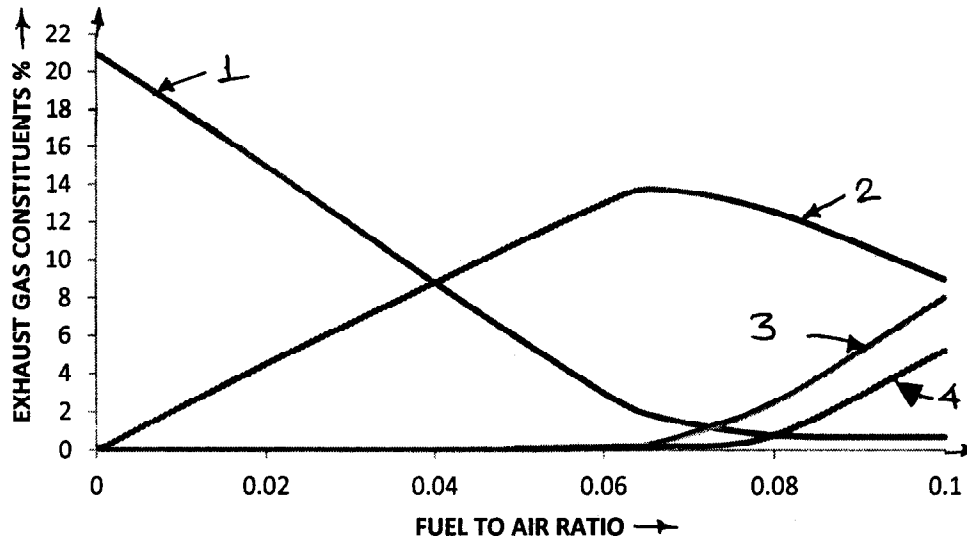
- 1) adaptability
- 2) suitability
- 3) mechanical efficiency
- 4) capacity of delivering volume.

- b) (i) Define:
- 1) DPT
  - 2) WBT
  - 3) DBT
  - 4) moist air.
- (ii) Define following terms:
- 1) specific humidity
  - 2) absolute humidity
  - 3) relative humidity
  - 4) degree of saturation.
- c) During a trial on 4-stroke gas engine following observations were recorded:
- Bore = 300 mm ; Speed = 200 rpm  
Stroke = 400 mm ; Gas used = 11.7 m<sup>3</sup>/h  
Number of explosions/min = 90  
Gauge pressure of gas = 170 mm of water  
Barometer reading = 755 mm of Hg  
Mean effective pressure = 6 bar  
Calorific value of gas used = 21500 KJ/kg at N.T.P.  
Net load on brake = 2 KN  
Brake drum diameter = 1.2 m  
Ambient temperature = 27°C
- Calculate:
- (i) mechanical efficiency
  - (ii) brake thermal efficiency.

3. Attempt any **FOUR** of the following:

16

- a) The results of exhaust gas analysis for petrol engine running at full load and at constant speed are shown in Fig. No. 1. Label the exhaust gases (indicated by 1, 2, 3, 4). Which conclusion can be drawn from this figure.

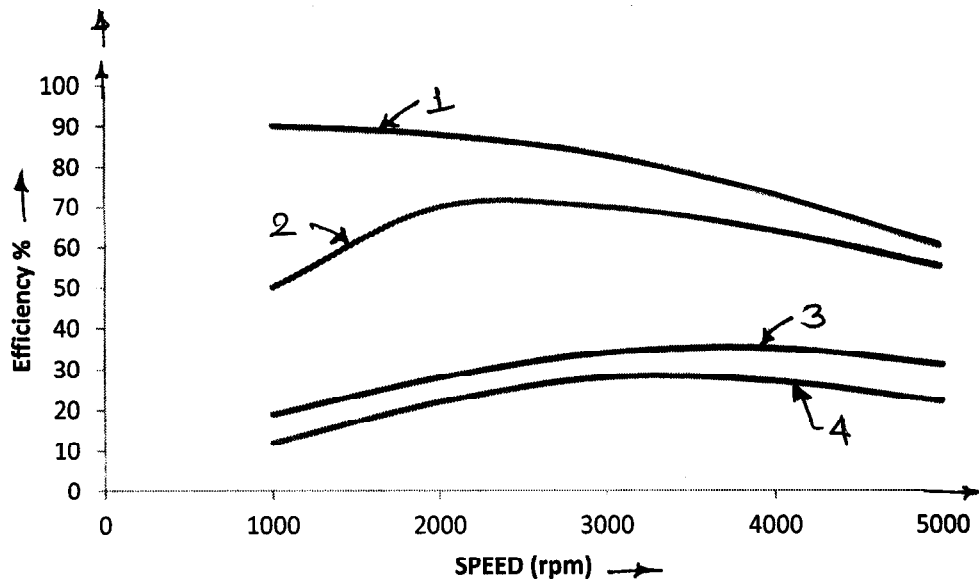
**Fig. No. 1**

- b) State merits/demerits of gas turbine over T.C. engine with respect to following parameters:
- mechanical efficiency
  - starting trouble
  - weight per power
  - part load thermal efficiency.
- c) List any four applications of refrigeration.
- d) Draw super imposed PV and TS diagrams of otto cycle, diesel cycle and dual cycle to compare their efficiencies under the following conditions:
- for same compression ratio and heat rejection
  - for same maximum pressure and temperature and heat rejection.
- e) Draw P-V and T-S diagram for carnot cycle. Name the processes involved in it.

4. a) Attempt any THREE of the following:

12

- (i) State the functions of following components used in battery ignition system:
  - 1) capacitor
  - 2) ballast resistor
  - 3) contact breaker
  - 4) distributor.
- (ii) Define cut off ratio. Express it in terms of compression ratio and expansion ratio.
- (iii) Differentiate between L-MPFI system and D-MPFI system.
- (iv) Various efficiencies of 4-stroke petrol engine run at full throttle over its speed range are plotted in Fig. No. 2. Label different efficiency curves (indicated by 1, 2, 3, 4). Which conclusion can be drawn from this figure.

Fig. No. 2

b) Attempt any ONE of the following:

06

- (i) State the role of following lubricant additives:
- 1) zinc ditinophosphate
  - 2) fatty acids
  - 3) organic acids
  - 4) ester
  - 5) silicone polymers
  - 6) butylene polymers.
- (ii) Draw theoretical and actual P-V diagrams for S.I. engines and explain briefly.

5. Attempt any TWO of the following:

16

- a) A vapour compression machine is used to maintain a temperature of  $-23^{\circ}\text{C}$  in a refrigerated space. The ambient temperature is  $37^{\circ}\text{C}$ . The compressor takes in dry and saturated vapour of R-12. A minimum  $10^{\circ}\text{C}$  temperature difference is necessary at the evaporator and condenser. There is no subcooling of the liquid. If the refrigerent flow rate is  $1\text{ kg/min}$ , find:
- (i) capacity of refrigeration
  - (ii) power required
  - (iii) C.O.P. of cycle
  - (iv) carnot C.O.P.

Properties of R-12 are given below:

Saturation Temp $^{\circ}\text{C}$	Enthalpy KJ/kg		Entropy KJ/kg K	
	hf	hfg	Sf	Sg
-23	159.250	172.682	0.8106	1.5701
-33	170.146	166.630	0.8840	1.5668
37	241.710	128.361	1.1239	1.5487
47	245.715	123.765	1.1520	1.5386

- b) A single stage single acting air compressor delivers 0.6 kg of air per minute at 6.1 bar. The temperature and pressure at the end of suction stroke are 28°C and 1.1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3 % of the swept volume. Assuming index of compression and expansion as 1.25, find:
- volumetric efficiency of compressor
  - power required if mechanical efficiency is 85%
  - speed of compressor in rpm.
- c) Explain the construction and working of Ram jet with the help of neat labelled schematic diagram. State its limitations (any two).

6. Attempt any **FOUR** of the following:

16

- Which is more effective way to increase the C.O.P. of refrigerator, to increase  $T_2$  keeping  $T_1$  constant or to decrease  $T_1$  keeping  $T_2$  constant? ( $T_1 > T_2$ ). Give justification to your answer.
  - Define displacement of compressor for two stage compressor. Why is free air delivered less than displacement of compressor?
  - An engine working on otto cycle has,  $d = 150$  mm,  $L = 225$  mm  $v_c = 1.25 \times 10^{-3} \text{ m}^3$ . Find air standard efficiency.
  - Distinguish between central A/C and unitary A/C systems with respect to following parameters:
    - vibration
    - noise
    - power consumption
    - operating cost
    - ducting
    - failure problem
    - initial cost
    - maintenance cost.
  - In gas turbine plants, Brayton cycle is more suitable than otto cycle, even though both cycles have equal thermal efficiency for same compression ratio. Justify.
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