
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1- a)

i) Carnot heat engine is an ideal heat engine and is not possible in practice due to following reasons.

04

i) Alternate adiabatic and isothermal process is not possible.

ii) Heat addition and heat rejection at constant temperature is not possible.

iii) All processes are reversible which is not possible in practice.

ii) Efficiencies related to compressor

i) Mechanical Efficiency

$$\eta_m = \frac{Indicated\ Power}{ShaftPower}$$ 01

ii) Polytropic Efficiency – It is nothing but the isentropic efficiency of one small stage of a multistage compressor this small stage efficiency is supposed to be constant for all stages of compressor with infinite number of stages. 01

$$\eta_{poly} = \frac{n(y-1)}{y(n-1)}$$

iii) Compressor efficiency or isothermal efficiency 01

$$\eta_{iso} = \frac{Isothermal\ Power}{Indicated\ Power}$$

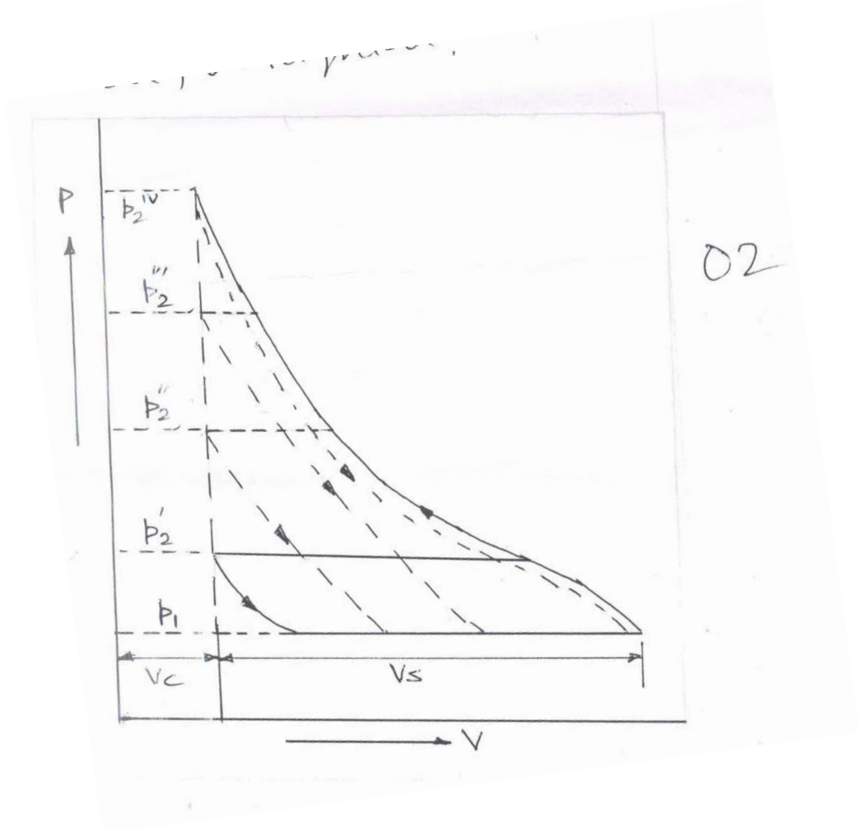
iv) Overall volumetric efficiency

η_{ovol} - Mass of fluid actually discharged in one revolution 01

- Mass of fluid at suction line condition
- Mactual (ms) at suction condition

Volumetric efficiency = Actual quantity of air taken in the compressor / stroke volume of the compressor

iii) Effect of Compression ratio in a single stage reciprocating compressor on PV diagram.



Physical Significance:- If compression in increased (usually it varies from 5 to 8) the final temperature increases and volumetric efficiency decreases flow and it compression ratio increases beyond usual value, compression ratio P_2/P_1 becomes zero as it can be observed from the figure. Increment in compression ratio will increase leakage past the piston and will need robust cylinder. If will also affect the operation of delivery valve and if will reduce lubricating properties of oil. It may increase the risk of ignition in piping and receiver.

iv) Effect of Supercharging on SI and CI engine

Parameters	SI Engine	CI Engine	Marks
Detonation	Increases possibility of detonation	Reduces the possibility of detonation	01
Combustion	Rate of combustion is faster and is prove to knocking *Increased flame speeds and the engine can not run without knocking.*	Combustion is improved complete and smoother *Improves combustion*	01
Fuel Economy	Poor fuel economy as costly fuel needs to be used *Lower thermal efficiency* *Greater fuel consumption*	Better fuel economy	01
Quality of fuel	High quality of fuel is required to reduce **knocking**	Interior quality of fuel can be used	01

Q.1- b)

i) 1) **Friction Power**:- The difference between indicated power and brake power. 01

It is the power lost in friction FP =IP -BP 01

2) **Brake Thermal Efficiency**:- 01

$$\eta_{bTh} = \frac{Heat\ equivalentto\ brake\ power}{Heat\ Supplied}$$

01

$$= \frac{B.P.\ in\ kw}{Mass\ of\ \ fuel\ in\ kg \times C.V.\ in\ \text{sec}.kj/kg}$$

3) BSFC – Brake Specific fuel consumption

= *Fuel consumption in kg/hr / Brake power in kw* 01

01

ii) Catalytic Converter

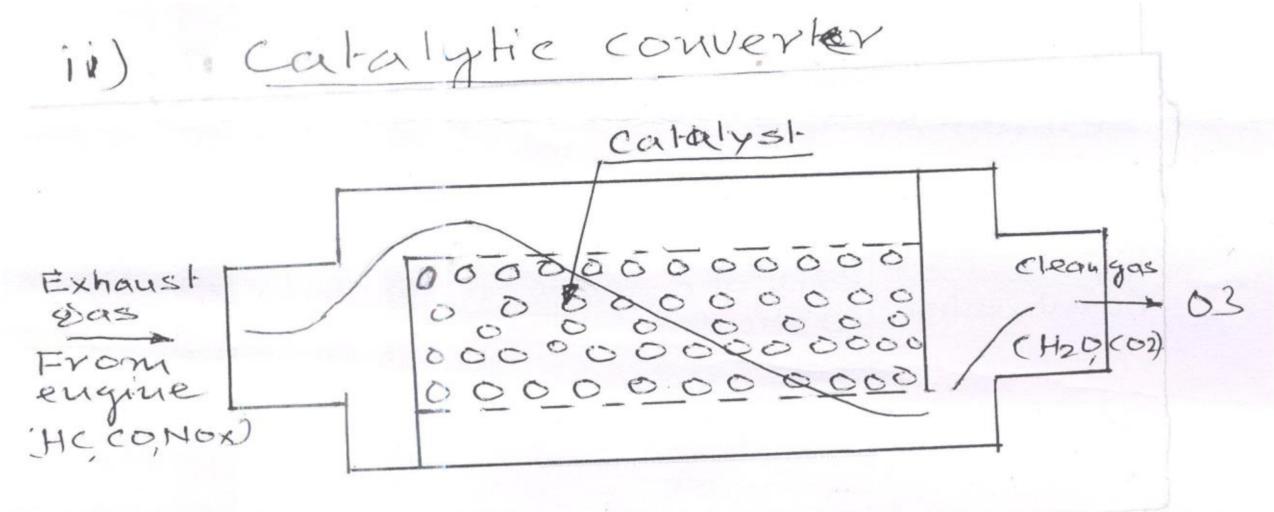


Fig. shows construction of simple catalytic converter exhaust fan as it enters the converter all three pollutions namely HC CO and NOX oxidizes and reduce is to the component which are acceptable to the environment, This occurs due to chemical reaction and at 600 to 700^{0}c temperature.

Q.2- a)

i) The compression process in reciprocating compressor may approach to low speed of compression and cylinder cooling. Therefore isothermal efficiency is used in reciprocating compressor.

But in rotary compressor there is high friction and eddies formation due to high velocity air through the compressor. This causes heating of air during compression process. Therefore temperature of air leaving the impeller is higher than the isentropic compression. The compressor may be as high as 1.7 (n>t). Therefore isentropic efficiency is used in rotary compressor.

ii)

Parameter	Reciprocating compressor	Centrifugal compressor	01
Adaptability	To low speed	To high speed	01
Suitability	Suitability for low medium and high pressure and low medium	Suitability for low and medium	01

	gas volumes *Small quantity of air or gas is required at high pressure.*	pressure and large gas volumes *Large quantity of air or gas is required at relatively low pressure*	
Mechanical efficiency	Low	High	01
Capacity of delivering volume	Small volume	Large volume	01

Q.2- b)

i) DPT – Dew point temperature t_{DP}

- It is the temperature at which air water vapour mixture starts to condense. 01

D.P.T. of mixture is defined as the temperature at which water vapours starts to condense.

WBT - Wet bulb temperature - t_{WB} 01

- It is the temperature recorded by thermometer when its bulb is covered with wet cloth known as wick and is exposed to air.

DBT – Dry bulb temperature - t_{DB} 01

- It is the temperature of air recorded by a ordinary thermometer and it is not affected by the moisture present in air.

Moist Air – It is the mixture of dry air and water vapour 01

ii) Specific humidity:- It is defined as the ratio of mass of vapour to the mass of dry air in a given sample of moist air. 01

$$\therefore \text{Specific humidity} = \frac{mv}{ma}$$

Absolute humidity:- It is defined as the actual mass of water vapour in unit volume of air. Its unit is gm/m^3 01

Relative humidity:- It is defined as the ratio of partial pressure of water vapour in a given volume of mixture to the partial pressure of water vapour when same volume of mixture is saturated at the same temperature.

01

Degree of saturation:- It is defined as the ratio of mass of water vapour associated with unit mass of dry air to the mass of water vapour associated with saturated unit mass of dry air at same temperature. 01

Q.2- c)

Indicated power – IP = $P_{mep}LAN$

Where P_{mep} – 6 bar – mean effective pressure

- 6 x 100 kN/m^2

L – Length of stroke in m

$$\frac{400}{1000}m$$
$$0.4m$$

A – Area of bore in m^2

$$\pi/4\times\left(\frac{300}{1000}\right)^2$$
$$0.07065m^2$$

N – No. of explosion/sec.

- 90/60

- 1.5 explosion/sec.

$\therefore$ IP = 6 x 100 x 0.4 x 0.07065 x 1.5

IP = 25.434 kw 02

Brake Power = (w-s) π D.N.

Where (w-s) – Net load in kN

- 2 kN

π D – Circumference of brake drum in m

- π 1.2
- 3.768 m

N – Speed of engine in RPS

- 200/60
- 3.333 r.p.s.

$\therefore$ Brake Power – BP – 2 x 3.768 x 3.333

BP = 25.117 kW 02

$\therefore$ Mech. Efficiency $\eta_{Mech} = \dfrac{BP}{IP}$

$$\eta_{Mech} = \frac{25.117}{25.434} = 98.75\%$$

Pressure of gas supplied

$$= 755 + \frac{170}{13.6} = 767.5\,mm\ of\ \ Hg$$ 01

$\therefore$ volume of gas used at NTP/sec.

$$= \frac{11.7}{3600}\times\frac{273}{273+27}\times\frac{767.5}{755}$$ 01
$$= 0.00300m^3/\text{sec.}$$

Assuming CV of gas used as 21,500 kj/m^3 at NTP instead of 21,500 kJ/kg at NTH

Heat supplied by fuel in kJ/sec.

= 0.00300 x 21,500

= 64.5 kJ/sec.

∴ Brake thermal efficiency - $\eta_{B.Th}$

$$= \frac{BP\ in\ kw}{Heat\ supplied\ in\ kJ/\sec.}$$

$$= \frac{25.117}{64.5} \times 100$$ 01

$$\eta_{B.Th} = 38.94\%$$

Q. 3 a. (02+02marks)

1- O_2

2- CO_2

3- CO

4- H_2

As fuel to air ratio increases

% of O_2 reduces

% of CO_2 increases upto chemically correct mixture and then it decreases

% of CO increases beyond chemically correct mixture

% of H_2 increases beyond chemically correct mixture

Q. 3 b) Differentiate between Gas Turbine and I. C. Engine. (One mark each)

Sr. No.	Parameters	Gas Turbine	I.C. Engine
1	Mechanical Efficiency	High due to absence of reciprocating parts	Low due to large number of reciprocating parts
2	Starting Trouble	Starting of gas turbine is difficult and needs complex arrangements	Starting of I. C. Engine is simple
3	Weight to power ratio	The weight of gas turbine per kW power developed is low since the working pressures are low requiring lighter construction	The weight of I.C. engine per kW power developed is high since the working pressures are high requiring heavy construction
4	Part load thermal efficiency	Part load thermal efficiency is poor and it is less efficient	They are efficient and part load thermal efficiency is high

Q. 3 C) Applications of Refrigeration (one mark to each) (Actual Practice Examples also consider)

i. To produce Ice in ICE Plant

ii. To Store Vegetable or Domestic materials in Domestic Refrigerator.

iii. To Transport Fish, Fruits etc. in Cold Storage.

iv. To Cool Water in Water cooler.

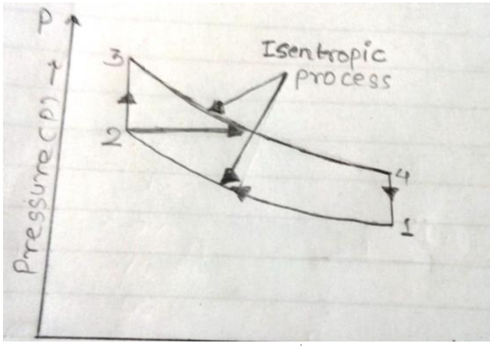
v. Processing of food products.

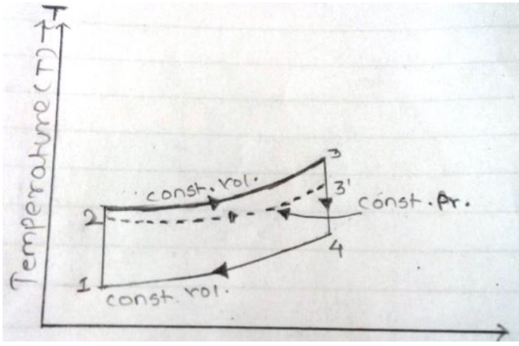
vi. Processing of textiles, printing work, photographic materials etc.

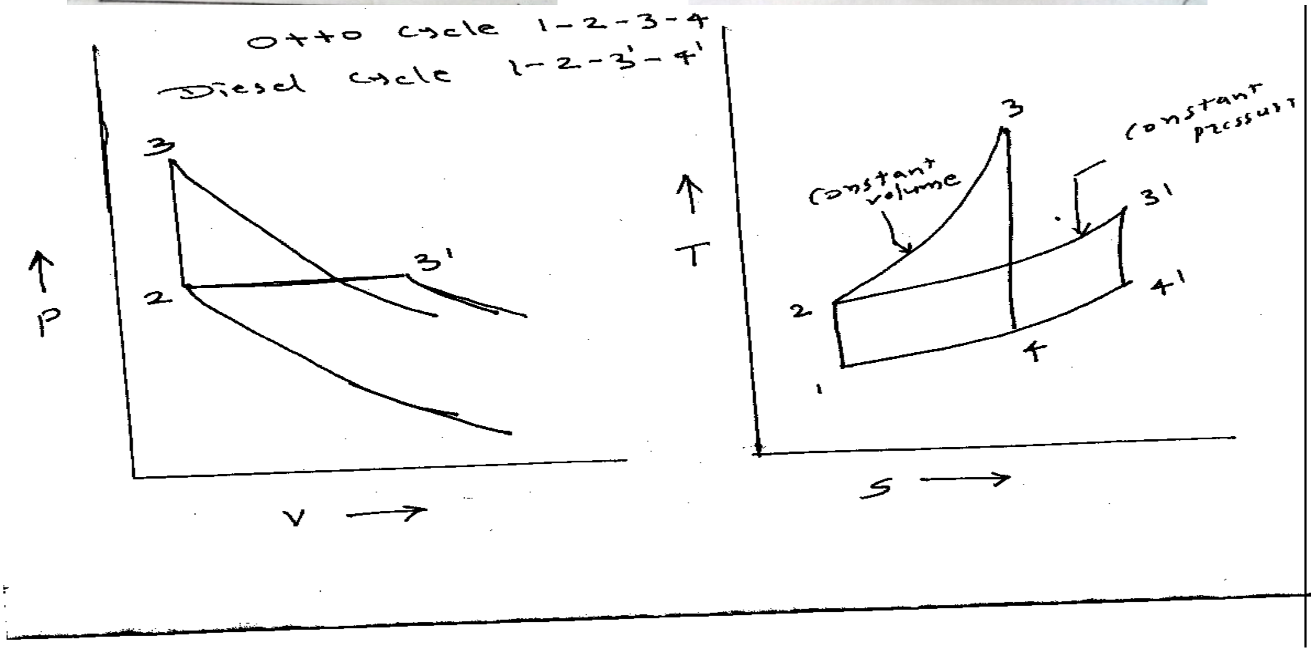
vii. Storage of ice, blood and medicines etc.

viii. Preservation of photographic films , archeological documents etc.

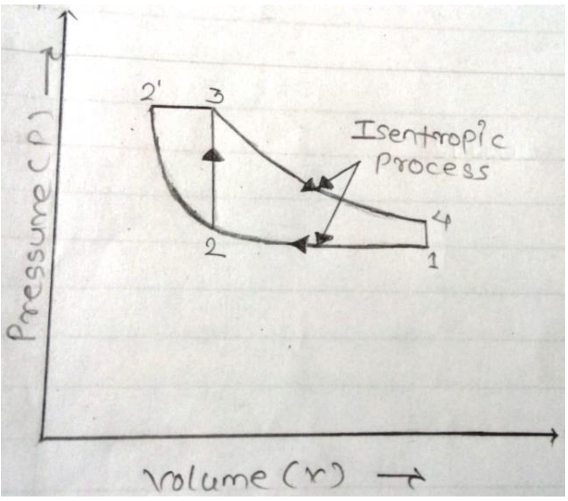
Q. 3. d) i) Same compression ratio and same heat rejected heat rejection. (one mark each graph)

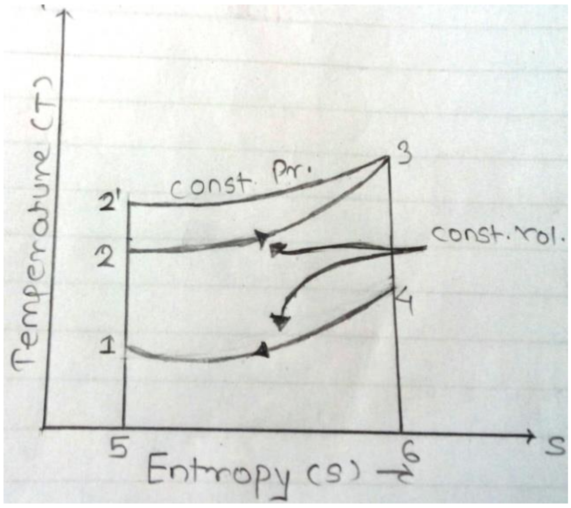




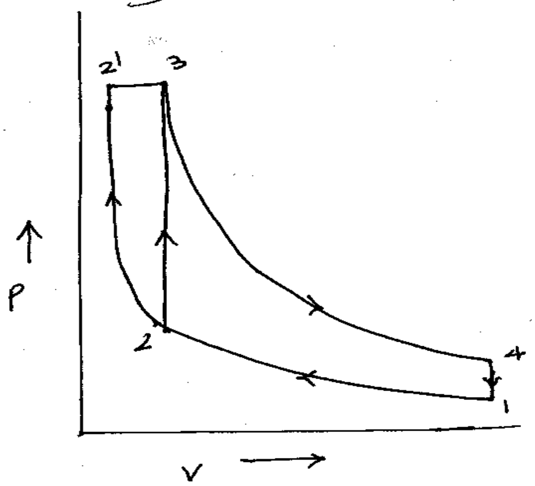


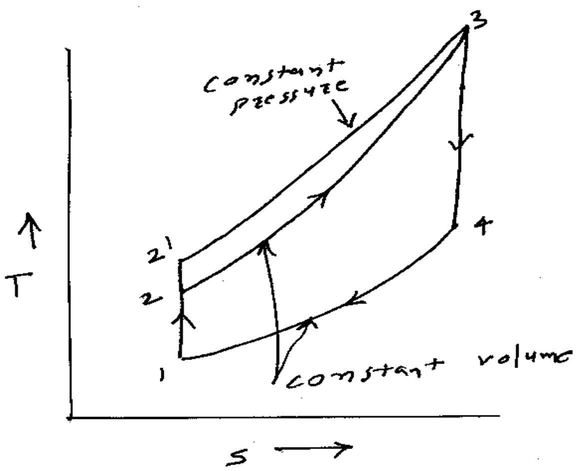
ii) For same maximum pressure and temperature and heat rejection.



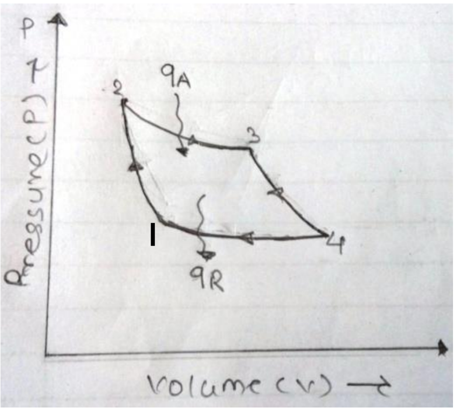


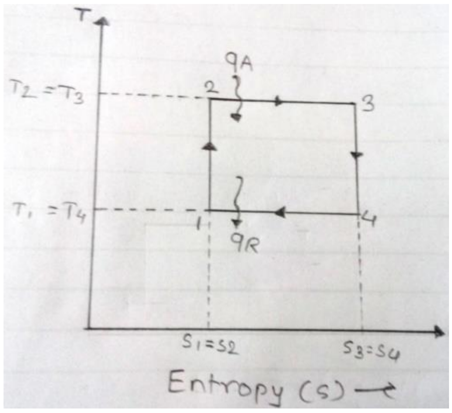
Otto cycle 1-2-3-4
Diesel cycle 1-2'-3-4





Q. 3 e) PV and TS diagram of Carnot cycle (2 marks for dia. And 2 marks for processes)





Process 1-2:- Isentropic or reversible adiabatic Compression process.

Process 2-3:- Reversible Isothermal heat addition process.

Process 3-4:- Isentropic or reversible adiabatic expansion process.

Process 4-1:- Reversible Isothermal heat rejection process.

Q.4 a) i) Function of Components used in battery ignition system (one mark each)

Sr. No.	Name of Component	Function
1	Capacitor	It is used to prevent the arcing and consequent burning of the contact points
2	Ballast Register	To regulate current in primary circuit. For starting purpose this resistor id by passed so that more current can flow in the primary circuit
3	Contact Breaker	When contact beaker points are closed and ignition switch on then current flowing from battery. When contact beaker points are open and ignition switch on or off then current will not flowing from battery.
4	Distributor	To interrupt the flow of current through the primary winding so that high voltage is produced in the secondary winding To distribute the so produced high voltage surge to different plugs at the right moment.

Q.4 a) ii) definition of cut-off ratio

Cut off ratio (ρ):- cut off ratio is defined as the ratio of volume after addition of heat (V_3) to the Volume before addition of heat (V_2) in case of Constant pressure heat addition processes.

Cut off ratio = $\rho = \frac{V_3}{V_2}$

……..**01 mark**

Expression:-

We know that Compression ratio = $r_c = \frac{V_1}{V_2}$ ………………………………………(equation no. 01)

…………………..**01 mark**

We know that Expansion ratio = $r_e = \frac{V_4}{V_3} = \frac{V_1}{V_3}$ ………………………….…………(equation no. 02)

…………………..**01 mark**

When we divide equation no. 01 by Equation no. 2 we get

$$\frac{Compression\ ratio\ (r_c)}{Expansion\ ratio\ (r_e)} = \frac{V_1 / V_2}{V_1 / V_3} = \frac{V_1}{V_2} X \frac{V_3}{V_1} = \frac{V_3}{V_2} = \text{Cut off ratio } (\rho)$$

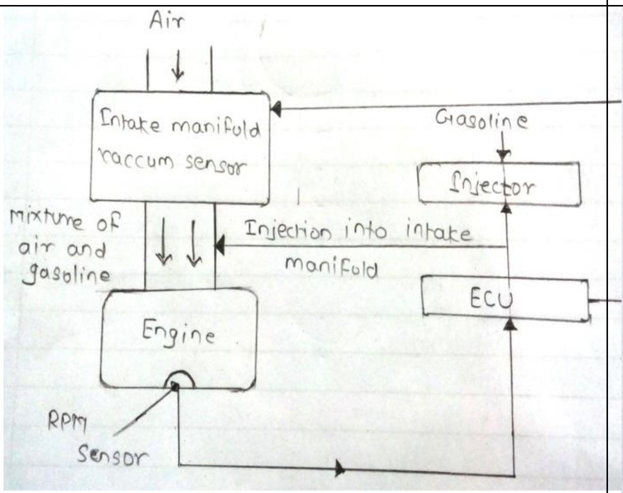
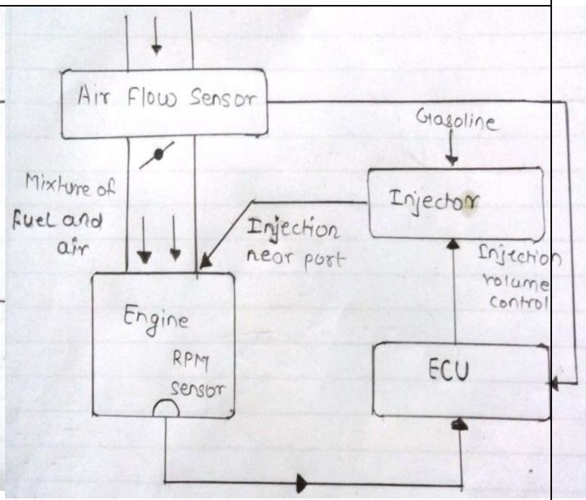
The final relation is

Cut off ratio (ρ) = $\frac{Compression\ ratio\ (r_c)}{Expansion\ ratio\ (r_e)}$

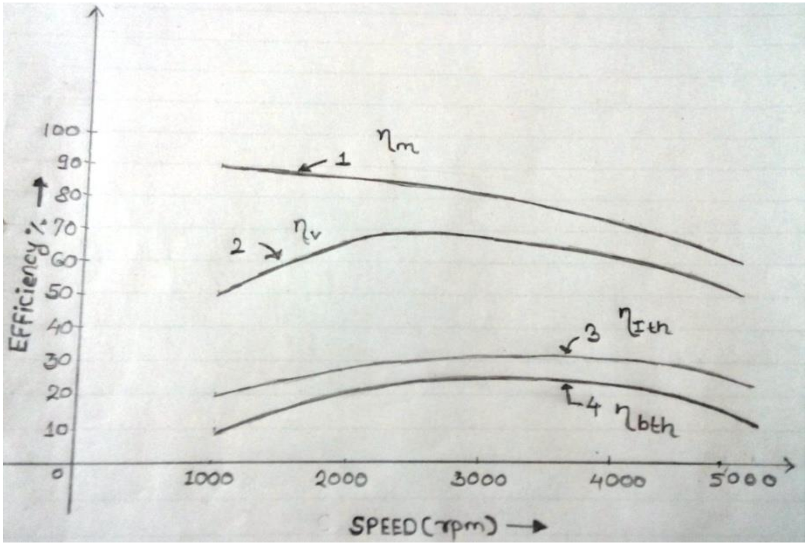
……………………………………………………………………………………….**01 mark**

Q. 4. A) iii) Differentiate between D-MPFI and L-MPFI system (01 mark each)

Sr. No.	D-MPFI System	L-MPFI System

1	It is Manifold injection system	It is Port injection system
2	Vacuum in the intake manifold and volume of air by its density are sensed in this type of MPFI system	Fuel metering is regulated by the engine speed and amount of air that actually enters in the engine.
3		
4	As air enters into intake manifold the manifold pressure is sensor detects the intake manifold vacuum and sends the information to the ECU	As air enters into the intake manifold , the air flow sensor measures the amount of air and sends information to ECU.

Q. 4. A) iv) Identify the efficiencies (one mark each)



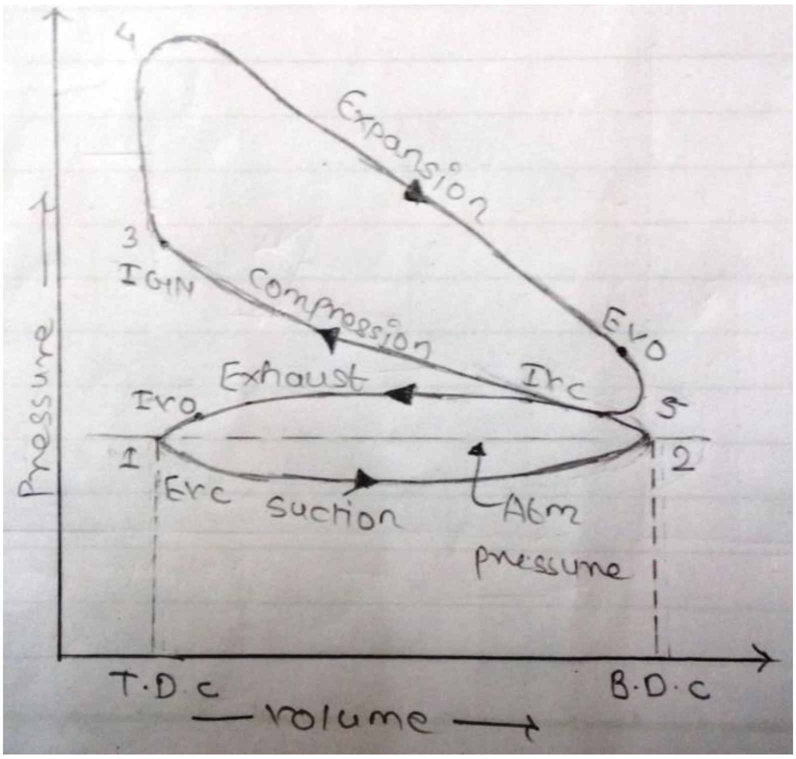
Curve 1:- Mechanical efficiency **Curve 2:-** Volumetric efficiency

Curve 3:- Indicated thermal efficiency. **Curve 4 :-** Brake thermal efficiency

Q. 4) b) i) Role of following lubricant additives (one mark each)

1. **Zinc ditinophosphate: -** Zinc ditinophosphate serves as an anti – oxidant and anticorrosive additive.
2. **Fatty acids: -** This type of additives prevents rusting of ferrous engine parts during and form acidic moisture accumulation during cold engine operation.
3. **Organic Acids: -** This type of additives improves the detergent action of lubricating oil.
4. **Ester: -** To lower the pour point of lubricating oil.
5. **Silicon polymers: -** This additive serves as Antifoam Agent.
6. **Butylene polymers: -** This type of additives added in lubricating oil to increase their viscosity index.

Q. 4. b) ii) Theoretical PV diagram for S.I. Engine
(1 mark for diagram 2 mark for explanation)



i. Four stroke petrol engine works on Otto cycle
ii. In these engines, the mixture of air and fuel is drawn in the engine cylinder, since ignition is due to spark, they are also called as spark ignition (S.I.) engine.
iii. Theoretically it is assumed suction stroke is represented by line 0-1 (I.e. at atmospheric pressure).
iv. As air fuel mixture come inside the cylinder the piston moves in upward direction and reaches to TDC. This compression process is represented by line 1-2.

v. When piston is at TDC the air fuel mixture is come in clearance volume and theoretically it is assumed that spark is ignited in cylinder when piston is at TDC and volume during this combustion is constant (i.e. clearance volume)

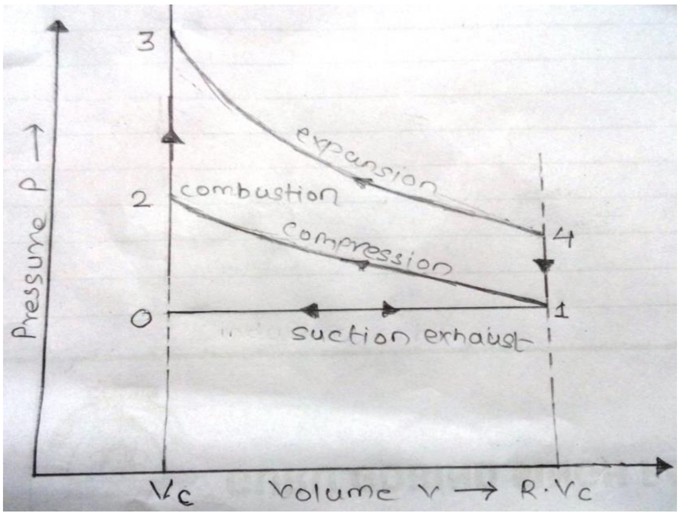
vi. At the end of combustion burnt gases exert pressure on piston and pushes the piston in downward direction. This process is represented by line 3-4, this process is also called as exhaust stroke.

vii. At the end of this stroke exhaust valve is open and this burnt gases are expel out to atmosphere.

viii. This exhaust stroke is represented by line 1-0 at atmospheric pressure.

Actual Valve timing Actual P – V diagram for S.I. Engine

(1 mark for diagram 2 mark for explanation)



Where :

TDC: - Top Dead Centre

BDC: - Bottom Dead Centre

IVO: - Inlet valve opens

IVC: - Inlet valve closes

IGN: - Ignition

EVO: - Exhaust valve opens

EVC: - Exhaust valve closes

i. The actual indicator diagram or P -V diagram is as shown in figure

ii. The suction stroke is shown by line 1-2, which lies below the atmospheric pressure line. It is this pressure difference, which makes the fuel-air mixture to flow into the engine cylinder.

iii. The inlet valve offers some resistance to incoming charge. That is why, the charge cannot enter suddenly into the engine cylinder.

iv. As a result of this, pressure inside the cylinder remains somewhat below the atmospheric during the suction stroke.

v. The compression stroke is shown by line 2-3, which shown that the inlet valve closed (IVC) a little beyond 2 (i.e. BDC).

vi. At the end of this stroke there is an increase in the pressure inside the engine cylinder.

vii. Shortly before the end of compression stroke (i.e. TDC), the charge is ignited (IGN) with the help of spark plug as shown in the figure.

viii. The sparking suddenly increases the pressure and temperature of the product of combustion. But the volume, practically, remains constant as shown by the line 3-4.

ix. The expansion stroke is shown by the line 4-5, in which the exit valve opens (EVO) a little before 5 (i.e BDC) now burnt gases are exhausted into the atmosphere through the exit valve.

x. The exhaust stroke is shown by the line 5-1, which lies above the atmosphere pressure line. It is pressure difference, which makes the burnt gases to flow out the engine cylinder.

xi. The exit valve offers some resistance to the outgoing burnt gases. That is why, the burnt gases cannot escape suddenly from the atmospheric pressure line during the exhaust stroke.

Q.5-a)

Since a minimum temperature of 10^0c is required in evaporator condenser, therefore evaporator temperature would be.

$T_1 = T_4 = -23 - 10 = -33^0 c = -33 + 273 = 240k$ and condenser
$T_2^1 = T_3 = 37 + 10 = 47^0 = 47 + 273 = 320k$

1. Capacity of refrigeration per minute

$$= mg(h_1 - h + 3) = 1$$

$= 1(336.630 - 245.715)$

$= 90.915$

$\therefore$ Capacity of refrigeration $= \frac{90.915}{210} = 0.43\ TR$

Capacity of system $= 0.43\ TR$

2. Power required - work done during compression of refrigeration
$= mg(h_2 - h_1)$

Enthalpy of super head vapour - $h_2 = h_2^1 + cp(T_2 - T_2^1)$

To find T_2 entropy at point 2

$S_2 = S_2^2 + 2.3\ cp\ log\left(\frac{T_2}{320}\right)$

$1.5668 = 1.5386 + 2.3 \times 0.64\ log\left(\frac{T_2}{320}\right)$

$log\left(\frac{T_2}{320}\right) = \frac{1.5668 - 1.5386}{2.3 \times 0.64} = \frac{0.0282}{1.472}$

$= 0.01916$

$\frac{T_2}{320} = 1.01936$

$T_2 = 326\ k$

$h_2 = h_2^1 + cp(T_2 - T_2^1)$

$= 369.48 + 0.64(326 - 320)$

$= 369.48 + 3.84$

$h_2 = 372.96\ kJ/kg$

$\therefore$ power required $= mg(h_2 - h_1)$

$= mg(372.96 - 336.776)$

$= 1(36.184)$

$= 36.20\ kJ/min$

$= \frac{36.18}{60}$

Power required =0.60 kJ/g

3. Cop of cycle $= \frac{h_1 - h_{fs}}{h_2 - h_1} = \frac{336.776 - 245.715}{372.96 - 336.776}$

$= \frac{91.061}{36.18} = 2.5$

Cop of cycle = 2.5

4. Carnot cop $= \frac{T_1}{T_2 - T_1}$

$= \frac{240}{320 - 240}$

$= \frac{240}{80} = 3$

$Carnot\ cop = 3$

Q.5-b)

$m = 0.6\ kg/min$

$= \frac{0.6}{60} kg/min$

=0.01 kg/sec.

$P_1 = 1.1\ bar$

$=1.1 \times 10^5\ N/m^2$

$T_1 = 28 + 273$

$= 301\ ^0k$

1. Assume R = 0.287 kJ/kgk for air

Indicated power $= \frac{n}{n-1} mRT_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$

$$= \frac{1.25}{1.25-1} \times 0.01 \times 0.287 \times 301 \left[\left(\frac{6.1}{1.1}\right)^{\frac{1.25-1}{1.25}} - 1\right]$$

$= 5 \times 0.01 \times 0.287 \times 301[(5.5)^{0.2} - 1]$

$= 5 \times 0.01 \times 0.287 \times 301[1.41 - 1]$

$= 5 \times 0.01 \times 0.287 \times 301[0.41]$

$IP = 1.77 \frac{kJ}{g}$ 02 kw 02 $1770 \frac{J}{g}$ 02 w

If the mechanical efficiency is $85^0/0$

Power required = $\frac{1.77}{0.85}$

Power required = 2.08 kW. It is not affected by clearance volume.

2. $IP = \frac{n}{n-1} P_1 r_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right] \times N/60$

$$1770 = \frac{1.25}{1.25 - 1} \times 1.1 \times 10^5 \times 0.00118 \left[\left(\frac{6.1}{1.1}\right)^{\frac{1.25-1}{1.25}} - 1\right] \times \frac{N}{60}$$

$$1770 = 5 \times 1.1 \times 10^5 \times 0.00118[(5.55)^{0.2} - 1]N/60$$

$$= 5 \times 1.1 \times 10^5 \times 0.0018[0.41] \times N/60$$

$$= 406 \times N/60$$

$$N = \frac{1770 \times 60}{406}$$

$$N = 262\ r.p.m.$$

$$r_1 = \frac{\pi}{4} d_1^2 l$$

$$= \frac{\pi}{4} \times (0.1)^2 \times 0.15$$

$$= 0.00118\ m^3$$

3. Clearance volume =0.03 v_s

$\therefore$ volumetric efficiency $= 1 - \frac{VC}{VS}\left[\left(\frac{P_2}{P_1}\right)^{\frac{1}{1.25}} - 1\right]$

$$= 1 - \frac{0.03\ VS}{VS}\left[\left(\frac{6.1}{1.1}\right)^{\frac{1}{1.25}} - 1\right]$$

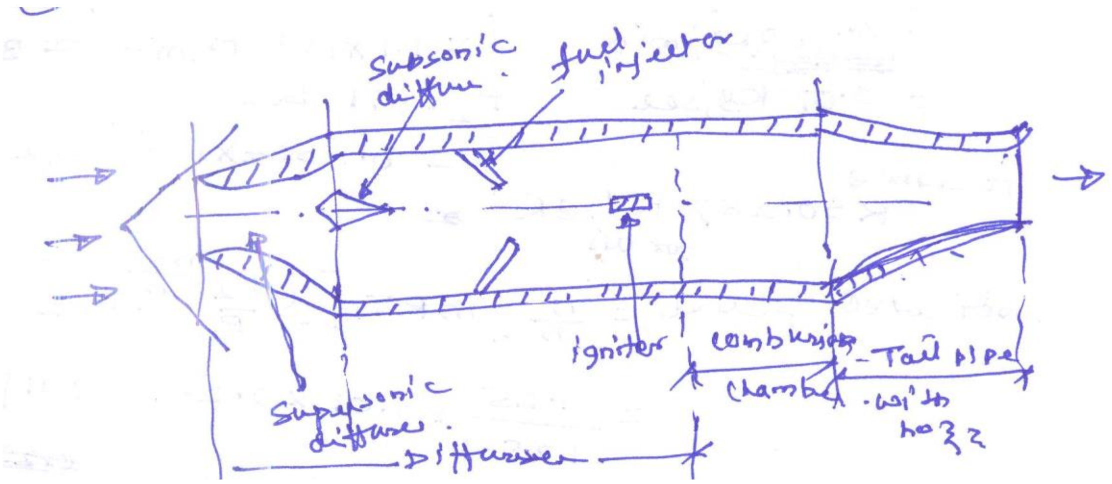
$= 1 - 0.03[(5.55)^{0.8} - 1]$

$= 1 - 0.03[3.93 - 1]$

$= 1 - 0.088$

$volumetric = 0.91 = 91\%$

Q.5-c)



Ramjet – it consist of inlet difference, combustion chamber and tail pipe (exist nozzle)

Ramjet has no compressor as the entire compression depends upon compression. Function of supersonic & subsonic difference to convert the kinetic called the ram pressure.

Working:- The air entering into ram jet with sup sonic speed is slowed down to sonic velocity in the air pressure is further increase in the sup sonic different increasing also the temperature of air. The diffuser section is designed to get correct ram effect its into decrees the velocity & increase pressure of in cooling air. The duel injected into combustion chamber is burned with help of igniter the high tress engine temperature garb are passed through the nozzle converting into pressure energy into kind energy. The high velocity gas leaving the nozzle provide required toward thrust to ramjet. <u>Limitation</u>

1. Ramjet engine be launched from an air plane flight.
2. Fuel consumption is too large. The fuel consumption lower decrees flight need.

Q.6-a)

COP (R) $= \frac{T_1}{T_2 - T_1}$

Where $T_1 = lower\ Temperature$

$T_2 = Higher\ Temperature$

C.O.P. $_{Refr.}$ = $T_2 / T_2 - T_1$

To improve or more effective way to increase the cop of refrigerator by.

1. Decreasing the higher temperature (i.e. Temp. of hot body T_2)
2. Increasing the lower temperature (i.e. Temp. of cold body T_1)

It is not possible to increase the cop by

a. Increasing T_2 keeping T_1 constant, because T_2 is temperature of cooling water or air available for rejection of heat & lower temperature (T_1) is the temperature to maintain in refrigerator.
b. Decreases T_1 keeping T_2 constant – it is not possible after during T_2 is will be heat the temp. at T_2.

b) Define :-

Displacement is the product of piston displacement and working stroke per minute is bared on low pressure only and the amount air passing through the other cylinder for two stage compressor. When free air wave from low pressure cylinder to high pressure cylinder through intercooler there is reduction of volume of air because of perfect cooling so free air delivered is less than displacement of compressor. (Pl check)

c) Given data:- d = 150 mm = 0.15 m

L = 225 mm = 0.225 m

$V_C = 1.25 \times 10^{-3}\ m^3 = 0.00125\ m^3$

Swept volume = $\pi/4\ d^2 l = \pi/4 (0.15)^2 \times 0.225$

$Vs = 0.00398\ m^3$

Compression ratio $= \frac{Vc+Vs}{Vc} = \frac{0.00125+0.00398}{0.00125}$

$r = \frac{0.00523}{0.00125} = 4.18$

$r = 4.18$

A.S.E $= 1 - \frac{1}{(r)^{r-1}} = 1 - \frac{1}{(4.18)^{1.4-1}} = 1 - \frac{1}{(4.18)^{0.4}}$

$= 1 - \frac{1}{1.77} = 1 - 0.564$

$A.S.E = 436\%$ A.S.E. = 43.6 %

d)

Parameter	Central A/C	Unitary A/C
1. Vibration	Vibration is more	Vibration is less
2. Noise	Noise of A/C unit is more	Noise of A/C unit is less
3. Power consumption	More air flow rate therefore power consumption is more	Power consumption is less
4. Operating cost	For central A/C operating cost is high	For unitary A/C operating cost is less
5. Duct	It require duct design & installation	No duct design & installation
6. Failure problem	If there is failure or fault in A/C plant all rooms air conditioning affects	If there is failure particular rooms affected
7. Initial cost	Initial cost is high	Initial cost is less
8. Maintenance cost	Maintenance cost is higher	Maintenance cost is low

e) In gas turbine plant – it works on brayton cycle where the heat added & heat rejected at constant pressure. It consists of compressor, combustion chamber & a turbine. The efficiency of Brayton cycle rotor cycle is same for but efficiency is of gas it temperature & pressure is increasing. High temperature & pressure require for ignition & fuel consumption for bray ton cycle. It is not possible in Oto cycle because the heat added & rejected at constant volume so bray ton cycle is most suitable than Otto cycle for gas turbine plant.