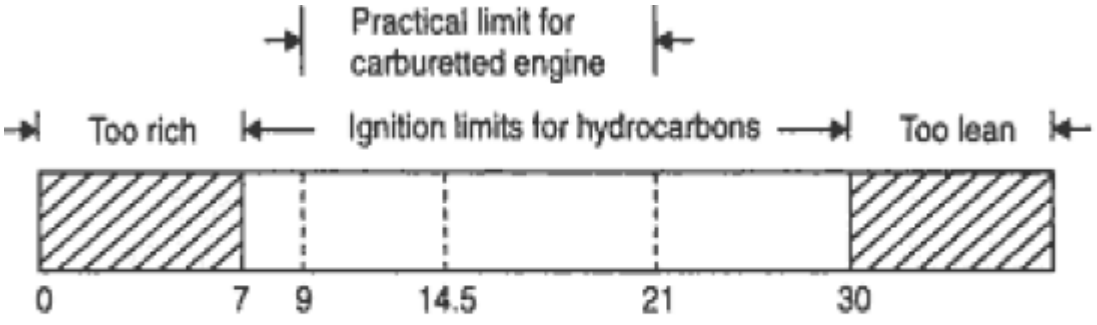
WINTER– 17 EXAMINATION

Subject Name: AAE **Model Answer** **Subject Code:** 17523

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. No.	Sub Q. N.	Answer	Marking Scheme
1	A)	**Attempt any THREE of the following:**	12
	a.	**What is mean by ignition limit? Give ignition limit for SI engine.**	4
		Answer:- Ignition Limit corresponds approximately to that mixture ratio, at lean & rich ends of the scale, where the heat released by spark is no longer sufficient to initiate combustion in the neighboring un-burnt mixture. The flame will propagate only if the temperature of the burnt gases exceeds approximately 1500 K in the case of hydrocarbon-air mixture. The lower & upper ignition limits of the mixture depend upon mixture ratio & flame temperature. The ignition limits are wider at increased temperature because of higher rates of reaction.	2
		 Ignition limits for hydrocarbons. Theoretical Ignition limits for Hydrocarbon fuels are 7:1 to 30:1 Actual Ignition limits for hydrocarbon fuels are 9:1 to 21:1	2

b. Compare carbureted engine with MPFI engine (four points) — **4**

Answer:- *(four points- 1 mark each)* — **4**

Sr.	Carbureted fuel system	Electronic fuel injection system
1	Mal-distribution of charge.	Uniform distribution of charge.
2	Due to resistance in intake manifold volumetric efficiency is lower	Improvement in volumetric efficiency due to less resistance in the intake manifold.
3	Inaccurate metering of charge.	Accurate metering of charge
4	Carburetor Icing may take place.	Formation of ice on the throttle plate is eliminated.
5	Fuel atomization depends upon velocity of air in the venture.	Atomization of fuel is independent of cranking speed therefore cranking is easier.
6	Less atomization and vaporization will make the engine more knock prone.	Better atomization and vaporization will make the engine less knock prone.
7	Fuel need to be more volatile	Less volatile fuel can be used.
8	Fuel injection is take place inside the manifold.	Fuel being injected into or close to the cylinder.

c. Explain four features of CRDI system in brief. — **4**

Answer: *(Any Four 1 mark for each)* — **4**

1) CRDI engine has lower emission. So, it meets latest emission norms. Finely atomized fuel results in an efficient air-fuel mixing & reduced particulate emissions.
2) It gives improved fuel economy.
3) CRDI engine has lower engine noise level. CRDI engines have capability to deliver stable, small pilot injections can be used for decreased NOx emissions and noise.
4) All the cylinders have balanced engine cylinder pressures.(i.e. reduced torsional vibrations).
5) Separation of pressure generation and injection allowing flexibility in controlling both the injection rates and timing of CRDI.
6) In CRDI system, Common rail pressure does not depend on the engine speed and load conditions.
7) In CRDI, High injection pressures (about 1500 bar) and good spray preparations are possible even at low engine speeds and loads.
8) In CRDI system, Fuel pump operates with low drive torque.
9) High pressure accumulator (common rail) provides consistently high pressure fuel to injectors.
10) Use of high pressure pump which allows the fuel to be supply at higher pressure under all operating condition

	d.	**Write four property of diesel as a fuel for C.I. engine.**	**4**
		Answer: *(Any four properties 1 mark each)* **1) Volatility**: - The fuel should be sufficiently volatile in the operating range of temperature to produce good mixing and combustion. Volatility of diesel fuel is:- **2) Viscosity:** Viscosity of a fuel is a measure of its resistance to flow. Viscosity of diesel fuel :- 1.45Cst **3) Flash point:** Flash point is the temperature at which a flammable liquid will produce, with a standardized apparatus and procedure, a mixture of its vapour and air which will ignite to give a visible flash by contact with an open flame. Diesel fuel flash points vary between 52 and 96 °C **4) Fire point:** Fire point is the temperature at which the flash will sustain itself as a steady flame for at least five seconds. **5) Cetane number:** The Cetane rating of a diesel fuel is measure of its ability to auto-ignite quickly when it is injected into the compressed and heated air in the engine. Cetane number of diesel fuel :- 38 **6) Calorific value:** It is about 50 MJ/Kg **7) Pour point (-**40 ^{0}C) The Pour Point is the temperature at which the paraffin in the fuel has crystallized to the point where the fuel gels and becomes resistant to flow. **8) Sulphur:** High sulphur content in diesel fuel causes corrosion, wear of engine parts, especially the cylinder walls, and tends to increase the rate of sticky and sludge - like deposits. **9) Contamination:** The contents of sand and rust particles can clog small openings and abrasive particles can damage injector surface piston rings and cylinder walls. **10) Cloud point:** The temperature below which the wax content of the petroleum oil separates out in the form of a solid is called cloud point. Such waxy solid can clog fuel lines and fuel filters.	**4**
	B)	**Attempt any ONE of the following.**	**6**
	a.	**With the help of suitable sketch describe the working of pressure regulator.**	**6**
		Answer: *(Diagram - 32 marks, Description - 3 marks)* **Working of pressure regulator :** The fuel pump provides more fuel than the maximum required by the engine. Fuel not used by the engine is returned to the fuel tank. The fuel rail supplies all injectors. The pressure regulator keeps the pressure drop across the injector fuel line and the intake manifold as constant. It contains a diaphragm that has intake manifold pressure on one side and fuel rail pressure on the other. Normally, it is mounted at the outlet end of the fuel rail. The diaphragm operated a valve which opens at a differential pressure between 2.0 and 3.5 bar and allows excess fuel to return to the fuel tank.	**3**

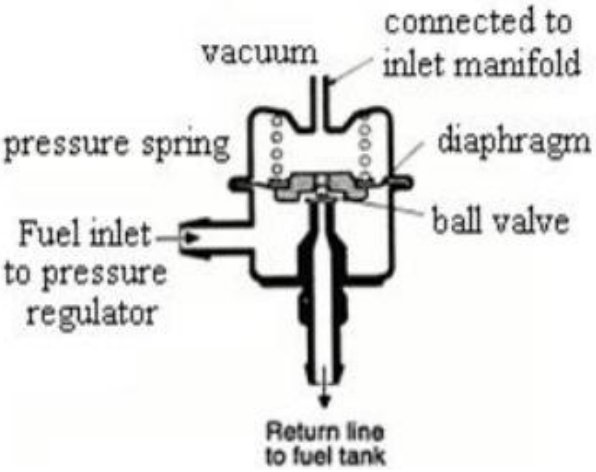


Figure: Fuel Pressure Regulator Operation — **3**

b. Compare C.I. and S.I. engine on the basis of thermodynamic and operating variables. — **6**

Answer: *(Any six points 1 mark each)* — **6**

Parameter	S I Engine	C I Engine
i)Thermodynamic cycle	It work's on Otto cycle.	It work's on Diesel cycle.
ii) Thermal efficiency	Thermal efficiency less due to lower compression ratio	Thermal efficiency more due to higher compression ratio.
iii) Compression Ratio	Compression ratio is low, about 10:1, limited by detonation.	Compression ratio is Higher, about 18:1 to 20:1.
iv) Operating pressure	Compression pressure is 7 bar to 15 bar	Compression pressure is 30 bar to 50 bar
v) Operating Speed	High	Less
vi) Supercharging	Less suitable	More suitable
vii) Fuel distribution	Poor	Excellent
viii) Exhaust temperature	More	Less
ix) Starting	Easy to start	Difficult to start

2 Attempt any FOUR of the following: — **16**

a. Explain four effects of detonation in S.I. engine. — **4**

Answer: *(Any 4- 1 mark each)* — **4**

i. **Noise and roughness:** Mild knock is seldom audible and is not harmful. When intensity of knock increases a loud pulsating noise is produced due to development of a pressure wave. The presence of vibratory motion causes crankshaft vibrations and engines rough.

ii. **Mechanical damage:** Due to rapid pressure waves, rate of wear is increased and piston

head, cylinder head and valves may be pitted.

iii. **Carbon deposits:** Detonation results in increased carbon deposits.

iv. **Increase in heat transfer:** Temperature in detonating engine is higher as compared to non-detonating engine and hence scoring away the protecting layer of inactive stagnant gas. So detonation increases the rate of heat transfer to combustion chamber walls.

v. **Decrease in power output and efficiency**: Due to increase in the rate of heat transfer the power output is decreased.

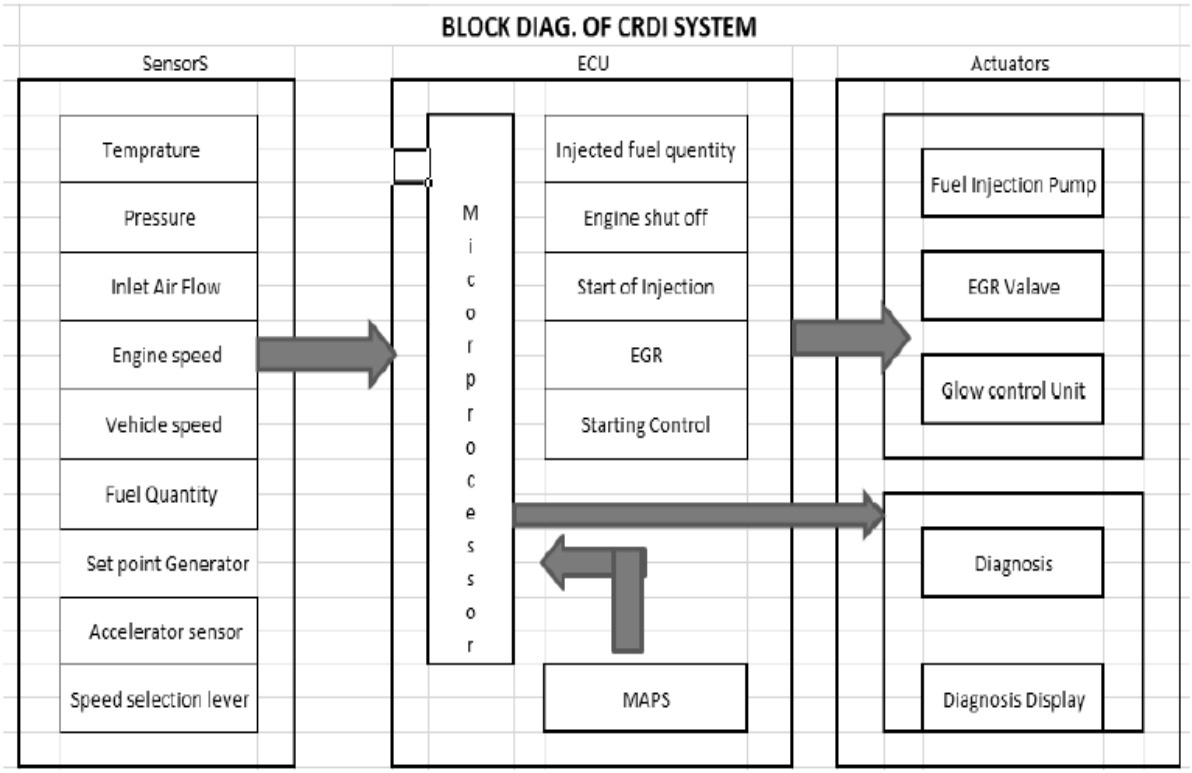
vi. **Pre ignition**: Detonation results in over heating of the sparking plug and combustion chamber wall and this overheating leads to ignite the charge before the passage of spark.

b. Distinguish between JBI and PFI system(any four points) **4**

Answer: (*Any 4 points of difference, 1 mark each)*

Sr. No.	TBI system	PFI System
1	Fuel is injected into the center of the throttle body	Fuel is injected into the port.
2	TBI uses bottom feed injector.	PFI uses top feed injector
3	Fuel injector needs to be flushed continuously- to prevent formation of air bubble	Fuel injector need not be flushed
4	1 or 2 Fuel injectors are used.	Fuel injectors are equal to the number of cylinders
5	TBI is comparatively low pressure injection (differential pressure = 0.7 to 1bar).	PFI is comparatively high pressure injection (differential pressure = 2 to 3.5 bar)
6	Cheaper fuel pump is sufficient to generate the required low pressure.	Costly fuel pump is required to generate the required pressure.
7	Mixture mal-distribution may occur.	All cylinders receive equal quantity and quality of air: fuel mixture.
8	Less accurate fuel injection control gives moderate fuel economy.	More accurate fuel injection control is obtained. Therefore increased fuel economy is obtained.
9	This is a cheap system	This is costly system.
10	Exhaust emission is above the permissible emission norms.	Very low exhaust emission is achieved to meet the strict emission norms.
11	Moderate throttle response as the fuel is injected at the throttle body and longer length of travel for fuel to enter the engine cylinder.	Better throttle response as fuel is injected on hot back side of intake valve and shorter length of travel for fuel – to enter the engine cylinder
12	Lower power output due to lower volumetric efficiency caused by bulky injector body at the throttle body.	Hither power output due to low resistance at intake manifold and higher volumetric efficiency.

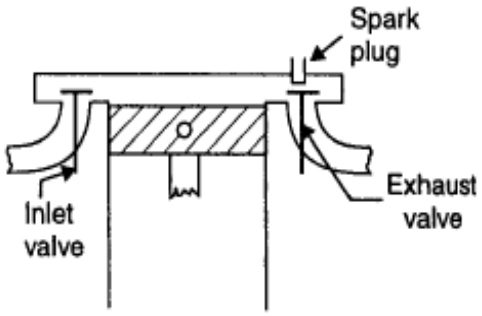
4

	c.	**Draw labelled block diagram of CRDI system.**	**4**
		Answer: Block diagram of CRDI system  	**4**
	d.	**Compare C.I. and S.I. engines on the basis of performance characteristic (any four points)**	**4**
		Answer: *(Any four points:- 1 mark each)* **Parameter** / **S I Engine** / **C I Engine** i) Power Output per unit weight — 2.7 kg/kW, because of lower compression ratio and lower pressure involved — 6.5 kg/kW because of higher compression ratio and higher pressure involved. ii) Power output per unit displacement — High. Requires less space for same power output. Delivers 30KW/lit of piston displacement — Low. Requires more space for same power output. Delivers 15KW/lit of piston displacement iii) Acceleration — Not so good. — Produces best acceleration. iv) Reliability — Good — Good v) Fuel Economy — Less — More vi) Fuel Safety (Fire hazard) — Volatile fuel, more fire hazards. — Less volatile, less hazards.	**4**
	e.	**List four types of combustion chambers used in S.I. engine. Explain any one in detail with neat sketch.**	**4**
		Answer: *(Types :- 2marks, explanation:- 1 marks , sketch- 1 marks)* **Combustion chambers used in S.I. engine:-** 1) T - Head 2) I - Head. 3) F - Head.	**2**

4) L – Head
5) Divided combustion chamber.

1. T Head Type Combustion chambers. This was first introduced by Ford Motor Corporation in 1908. This design has following disadvantages.

1. Requires two cam shafts (for actuating the in-let valve and exhaust valve separately) by two cams mounted on the two cam shafts. **1**
2. Very prone to detonation. There was violent detonation even at a compression ratio of 4. This is because the average octane number in 1908 was about 40 -50.

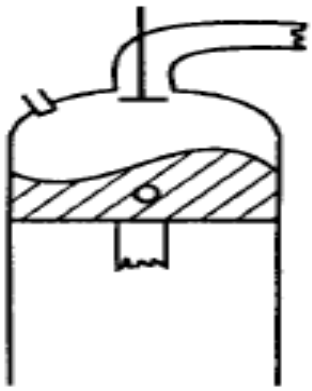


1

2. I head combustion chamber

This type of combustion chamber has both the inlet valve and the exhaust valve located in the cylinder head. An overhead engine is superior to side valve engine at high compression ratios. The overhead valve engine is superior to side valve or L-head engine at high compression ratios, for the following reasons:

1. Higher volumetric efficiency from larger valves or valve lifts.
2. Less distance for the flame to travel and therefore greater freedom from knock.
3. Lower surface-volume ratio and, therefore, less heat loss and less air pollution.



3. F - Head

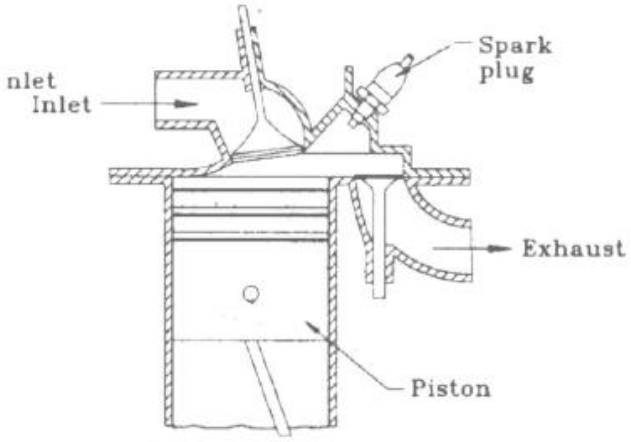
In F-head combustion chamber one valve is in head and other in the block. This design is a compromise between L-head and I head combustion chambers.

Advantages are :

- High volumetric efficiency.
- Maximum compression ratio for fuel of given octane rating.
- High thermal efficiency.
- It can operate on leaner air-fuel ratios without misfiring.

Drawback

- This design is the complex mechanism for operation of valves and expensive special shaped piston.



4. L Head Type Combustion chambers

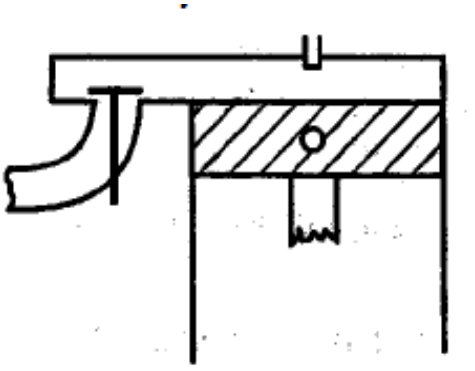
It is a modification of the T-head type of combustion chamber. It provides the two valves on the same side of the cylinder, and the valves are operated by a single camshaft.

Advantages:

1. Valve mechanism is simple and easy to lubricate.
2. Detachable head easy to remove for cleaning and decarburizing without disturbing either the valve gear or main pipe work.
3. Valves of larger sizes can be provided.

Disadvantages:

1. Lack of turbulence as the air had to take two right angle turns to enter the cylinder and in doing so much initial velocity is lost.
2. Extremely prone to detonation due to large flame length and slow combustion due to lack of turbulence.
3. More surface-to-volume ratio and therefore more heat loss.
4. Valve size restricted.
6. Thermal failure in cylinder block also.



3 — **Attempt any FOUR of the following:** — **16**

a. **List four types of sensors used in MPFI system, state their locations and functions.** — **4**

Answer: *(Any four 1 marks each)* — **4**

Sr.	Name	Function	Location
1	Oxygen Sensor	Measuring the quantity of oxygen in exhaust	Located at inlet and outlet side of catalytic converter
2	Mass air flow(MAF) Sensor	It is used to tell the ECU the mass of air entering the engine.	Mounted between air filter and turbocharger.
3	Coolant temperature sensor	Measures the temperature of the coolant in the System and sends signal to ECU.	There are two sensors fitted on water box.
4	Throttle position sensor	It supplies information to the ECU about the position the throttle is in inlet manifold.	The sensor is usually located on the butterfly spindle/shaft so that it can directly monitor the position of the throttle.
5	Crank position sensor	It supplies information to the ECU about the position and rotation of the crank shaft.	This sensor is mounted on the cylinder block behind the flywheel.
6	Vehicle speed sensor	Sends electrical pulses to the ECU about the speed of vehicle.	This sensor is mounted on gear box on speed output location.
7	Cam Sensor	It senses cam position and corresponding signal is sent to the ECU.	This sensor is fitted on cylinder head cover.
8	Knock sensor	It detects the vibrations generated during the combustion process and supplies signal to the ECU.	This sensor is fitted on cylinder block.

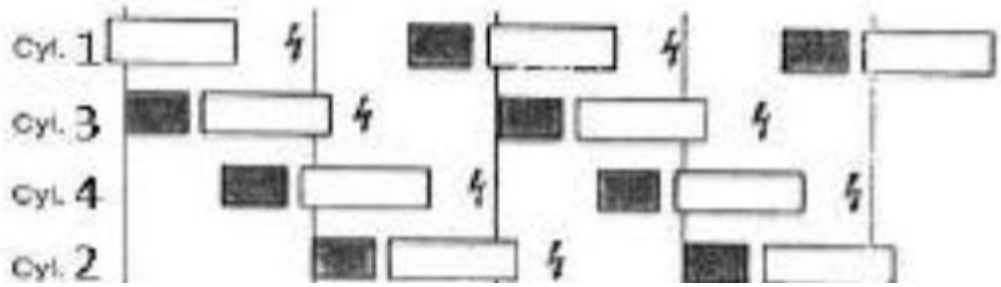
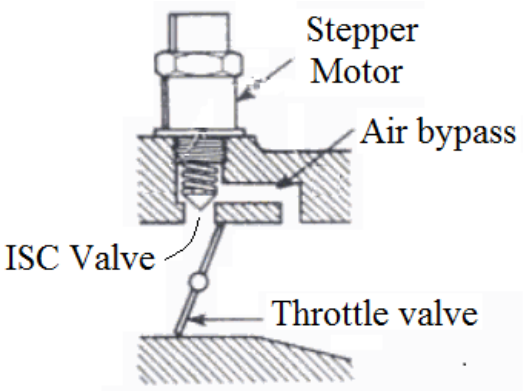
b. **List three methods of fuel injection. Describe sequential method with suitable sketch.** — **4**

Answer: *(Listing any 3 Methods : 1 marks, Description 1 Mark & sketch 2 Marks)*

Methods of petrol injection — **1**

1. Sequential fuel injection. (SFI)
2. Grouped fuel injection.
3. Simultaneous fuel injection
4. Continuous injection.

Sequential Injection: Each injector is controlled separately. Injection timing, both with reference to crank/ camshaft position and pulse width, can be optimized for each individual cylinder. — **1**

			**2**
	c.	**Illustrate idle speed control as an output control function of ECM.**	**4**
		Answer: (*Description 2 Marks & sketch 2 Marks)* **Idle Speed Control as Output function of a ECM:** While the engine is being started, or operated, the logic module of Electronic Control Module (ECM) will signal the **Stepper motor of Idle Speed Control (ISC) valve** to provide the easy starting without the operator having to touch the accelerator pedal. 1. When the engine is cold, the logic module will position the AIS motor to provide the correct cold fast idle speed. The ISC valve motor allows more air to flow past the motor plunger into the intake manifold to increase the idle speed. This air flow bypasses the throttle. 2. The ISC valve motor will provide the correct idle speed when the air conditioner is on and required air: fuel mixture when the engine is decelerating. 3. The injection time is extended to provide additional fuel for cold start and during the post-start and warm up phases. The idle speed is controlled by a stepper motor, which is signaled by ECM as a function of engine speed, load and engine temperature. 4. The stepper motor controls the idle passage size to change the amount of air entering the intake manifold. Thus it controls the effective air: fuel ratio. 5. Stepper Motor: It rotates a valve shaft either in or out. This in turn increases or decreases the clearance between the ISC (Idle Speed Control) valve and its seat, thereby regulating the amount of air allowed to pass through. The Idle speed control valve stepper motor allows 125 possible valve opening positions.  Figure: Idle Speed Control	**2** **2**

OR

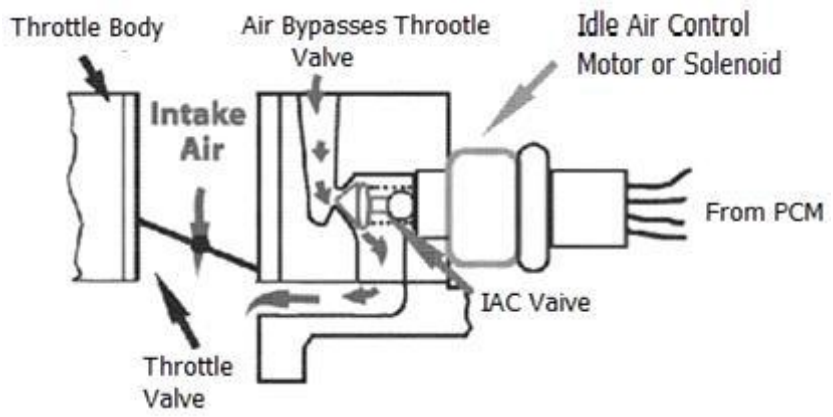


Figure: Idle Speed Control

d. Write function of glow plug. Why and where it is used? List it's types. **4**

Answer: (*Function 2 Marks ,Use 1 mark & Types1 Mark)*

Function of Glow plug: The colder the diesel engine, the more difficult it is to start. So, as a starting aid, glow plug is used in diesel engine. The self-ignition temperature of diesel is 250°C. For compression ignition, the charge (air + diesel) should reach a temperature of about 550°C. Cold weather conditions make it difficult to happen. The glow plug heats to starting temperature (approx. 850°C) as rapidly as possible. **2**

Purpose of using a Glow Plug: Cold weather conditions make it difficult to start the engine, so as a starting aid a glow plug is used in C.I. Engines. The glow plug heats to starting temperature (approx. 850°C) as rapidly as possible. **1**

Glow plug is used in1) Diesel Engines 2) Air craft engine

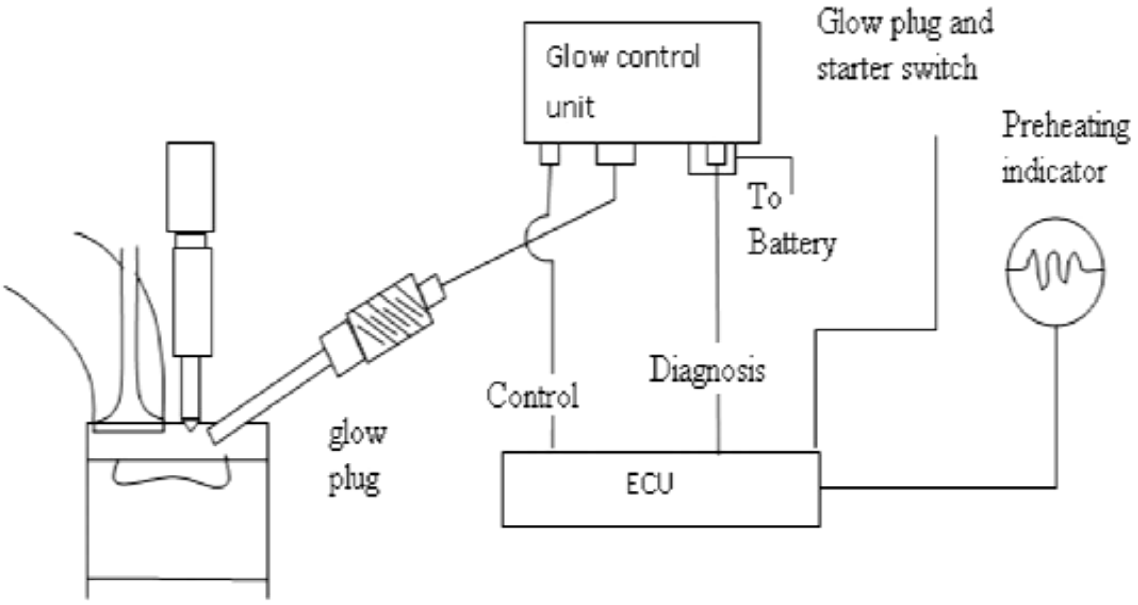
Types of glow plugs

1.Conventional type **1**

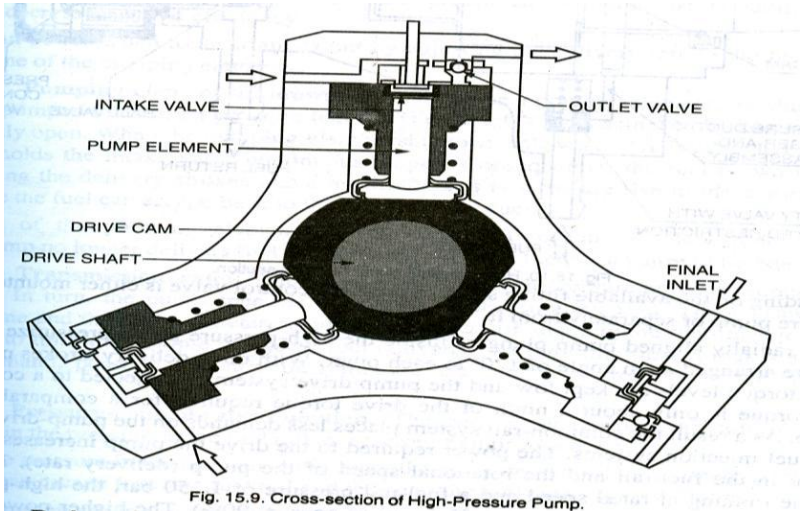
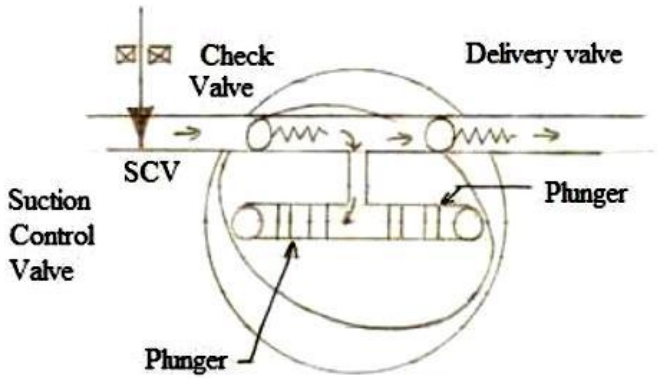
2. Self-temperature controlling type.

e. Draw a neat labeled circuit diagram of glow plug. **4**

Answer: (*Circuit diagram 3 Marks ,Labeling 1 Marks)*

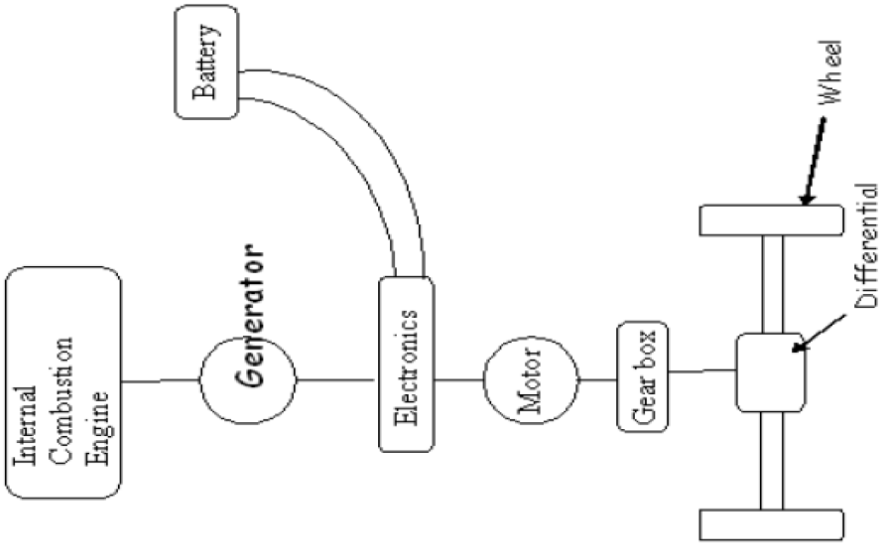


4

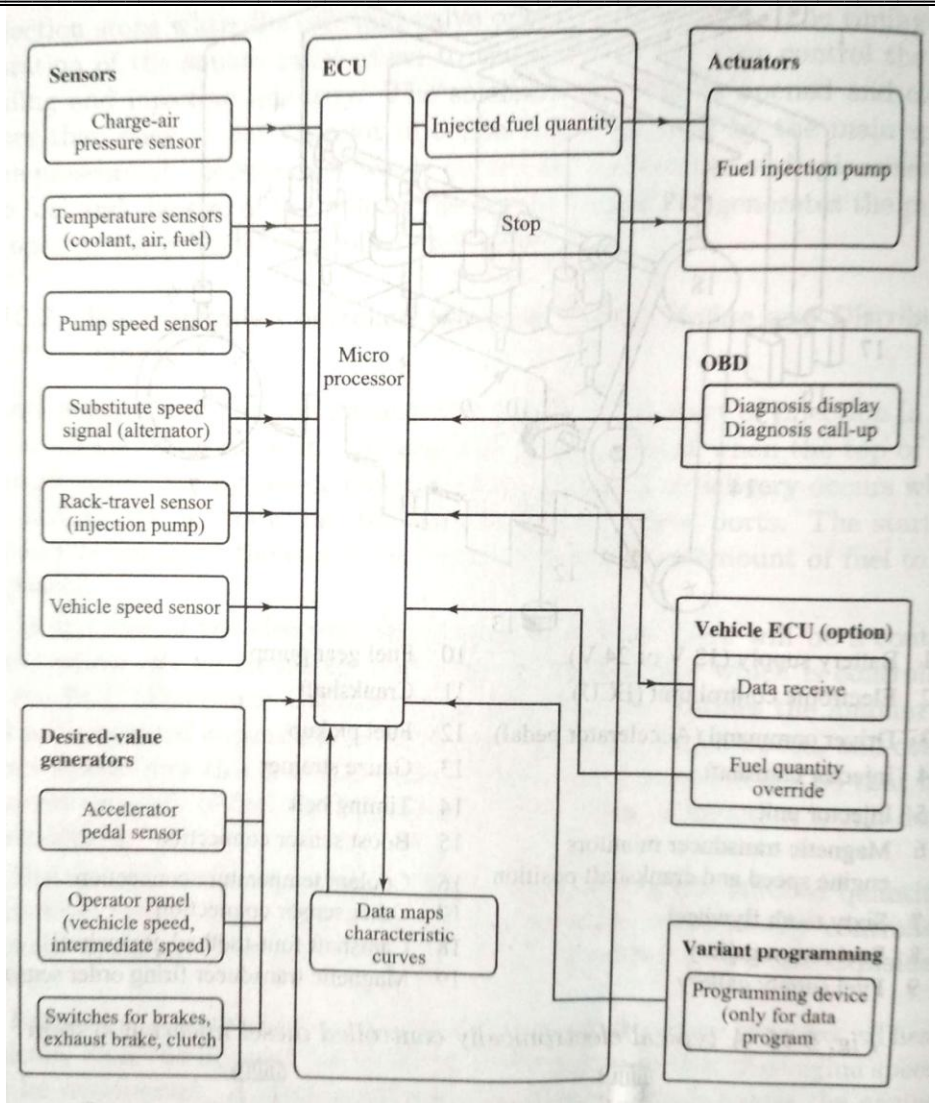
	f.	**Describe the working of high pressure fuel pump.**	**4**
		Answer: *(working 2 marks, sketch 2 marks)* **Working:** **Downward motion of plunger**: The safety valve at the inlet opens if the pre-supply pressure of fuel exceeds 1.5 bars and fuel comes and fills the chamber till the plunger moves up to BDC. **Upward motion of plunger: -** the upward motion of plunger closes the safety valve and increases the fuel pressure, this rise in pressure if it is more than the desired pressure then outlet (delivery) valve opens and pressurized fuel goes to common rail. Once the plunger reaches the TDC position then pressure falls and outlet valve closes. **Element shut-off valve –**The pump flow can be varied with engine load; individual pistons of the pump are able to be shut down by using a solenoid to hold the intake valve of that piston open. **Delivery rate –** The delivery rate of pressurized fuel during idling or part load condition is very high but this can be reduced with help of pressure control valve.	**2**
		 Fig. 15.9. Cross-section of High-Pressure Pump.	**2**
		OR The fuel inlet to the pump is controlled by the SCV (suction control valve) through the EDC • The rotation of the inner cam pushes the plunger inwards, so that it can pump the fuel. • Plunger outward movement is caused by the pressure of fuel feed pump. Fuel enters the pumping element chamber (intake stroke) • At BDC the check valve closes • The fuel in the chamber is pressurized by the plungers moving inward. • The delivery valve opens and the fuel passes to the common rail. • A constant pressure of about 1400 to 1600 bar is maintained in the common rail.	
		 Figure: Sectional view of High Pressure Fuel pump in CRDI system	

4	**A)**	**Attempt any Three of the following:**	**12**
	a.	Compare LPG and CNG fuels on the basis of i) Auto ignition temperature ii) Calorific value iii) Economy iv) Octane rating	**4**
		Answer: *(Comparison based on each point 1 Mark each)* **Comparison LPG and CNG**	**4**

Parameter	**LPG**	**CNG**
Auto Ignition Temperature	Approx 400^0c	540^0c
Calorific Value	46.1 MJ/Kg or 3.39MJ/ Cu. M	47.7 MJ/Kg
Economy	It is cheaper than CNG Approx. Rs 40.53per Litre in Mumbai	It is costlier than LPG Approx Rs 43.45 per Litre in Mumbai
Octane rating	104-112	120-130

	b.	**Draw a labeled block diagram of series type hybrid vehicle.**	**4**
		Answer: (*Block diagram* 3*Marks,Labeling 1mark)*  Block diagram of Series Hybrid vehicle.	**4**
	c.	**CNG is used as alternative fuel, justify with four merits and four demerits.**	**4**
		Answer: Merits: *(Any two merits and demerits -2 marks each)* 1. CNG reduces the harmful emission 2. Operating cost of the vehicle running on CNG is lower. 3. Reduced vehicle maintenance. 4. Fuel theft is not possible. Since NG cannot be siphoned off from a vehicle 5. CNG contains less carbon than any other fossil fuel. 6. CNG vehicle is as safe as petrol vehicle 7 CNG has a much higher Octane Number.—So, it is superior to petrol. And the anti- knock additives are not required. 8. Being a gaseous fuel, CNG mixes with air easily and evenly. 9. Almost any petrol / diesel vehicle can be converted to operate on CNG. 10. CNG is non-toxic. 11. CNG is lighter than air and so Dissipates into atmosphere implies less chance of fire	**2**

		Hazard. **Demerits:** 1. Low engine performance. 2. Low engine volumetric efficiency. 3. Need of large pressurized fuel storage tank. 4. Refueling is a slow process 5. Inconsistent fuel properties. So above merits and demerits suggest that CNG is used as alternative fuel.	**2**
	d.	Enlist drawbacks of carbureted (SI) Engine on the basis of emission fuel Consumption, Air fuel ratio and fuel distribution.	**4**
		Answer: Drawbacks of carbureted (SI) Engine. *(1 marks for each point)* **Parameter** / **Drawbacks** **Emission** — Does not meet emission Norms **Fuel consumption** — Due to absence of throttling specific fuel consumption is more **Air fuel ratio** — Variation in Air /fuel ratio **Fuel distribution** — Mal-distribution of charge. Fuel distribution for each cylinder is not equal for multi cylinder engine.	**4**
	B)	**Attempt any ONE of the following:**	**6**
	a.	**With the help of neat sketch, describe block diagram of Electronic Diesel Control Unit (EDC).**	**6**
		Answer: *(Description 3Marks, Block diagram 3Marks)* **EDC:** The ECU determines the correct quantity of the fuel to be injected based on the inputs and the data in the look up table. The fuel input depends on the rack position and thus ECU controls the rack position using a solenoid. The position of the rack is measured and used for feedback. The accelerator pedal position is the input from the driver and a potentiometer is used to sense it. The system can maintain the vehicle speed at any set value. The ECU can also regulate the fuel quantity depending on other conditions like braking. The ECU can also protect the engine against overheating by regulating the maximum quantity of fuel delivered**.**	**3**

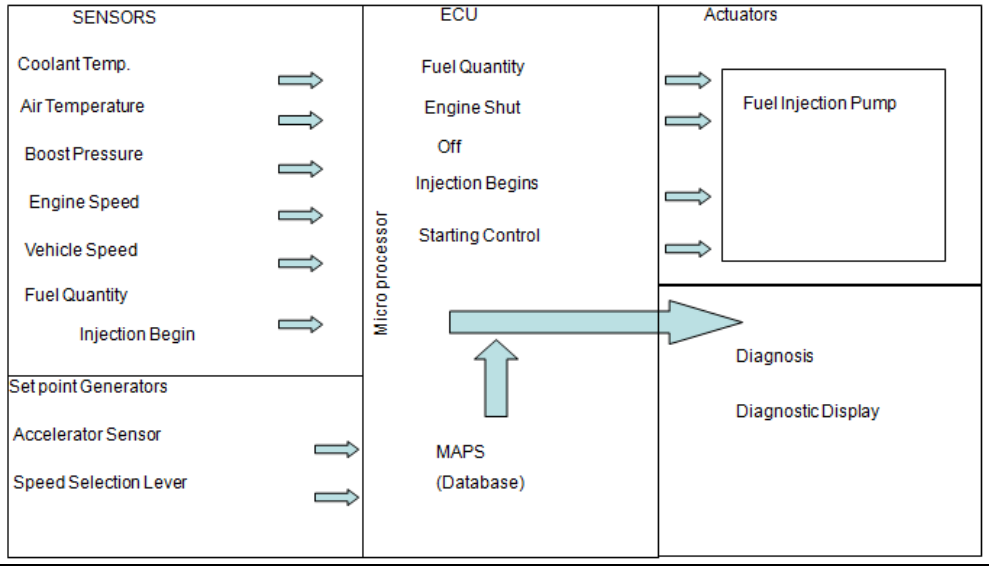


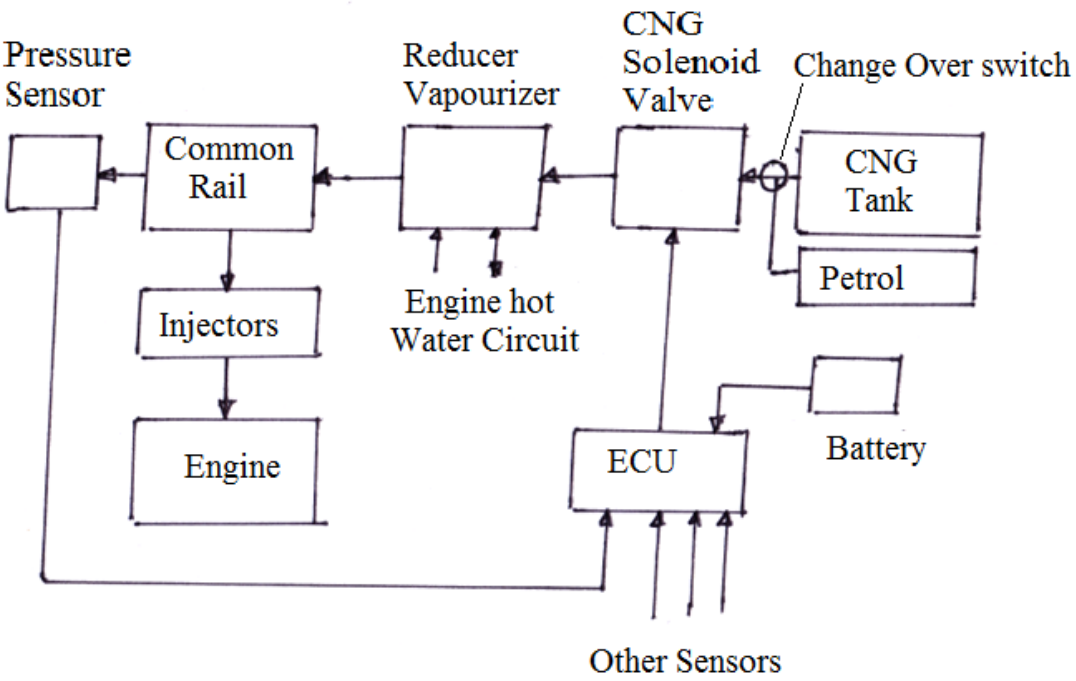
Block diagram of EDC

3

OR

ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM



	b.	**Draw a labeled block diagram of CNG conversion Kit. Describe it's working**	**6**
		Answer: *(Description 3Marks, Figure 3 Marks)* **Working of CNG Kit:** The Sequential Injection system still has a high pressure tank, filler, filter and regulator, the regulator is different in that it puts out a steady pressure as opposed to variable pressure. The Natural Gas is then injected by natural gas injectors which are controlled by the gasoline injector pulse. This system also uses its own MAP (manifold absolute pressure) sensor, natural gas pressure sensor, natural gas temperature sensor and coolant temperature sensor to operate and control the system.  Figure: CNG Kit	**3** **3**
5		**Attempt any TWO of the following:**	**16**
	a.	**Compare detonation and diesel knock on the basis of (i) Fuel Ignition Temperature (ii) Compression Ratio (iii) Speed (iv) inlet temperature (v) inlet pressure (vi) cylinder wall temperature (vii) cylinder size**	**8**
		Answer: Comparison between detonation and diesel knock *(1 mark each)*	**8**

Parameter	To avoid Detonation in SI Engine	To avoid Diesel knock
i) Fuel Ignition Temperature	High	Low
ii) Compression Ratio	Low	High
iii) Speed	High	Low
iv) Inlet temperature	Low	High

v) Inlet pressure	Low	High
vi) Ignition delay	Long	Short
vii) Cylinder wall temperature	Low	High
viii) Cylinder size	Small	Large

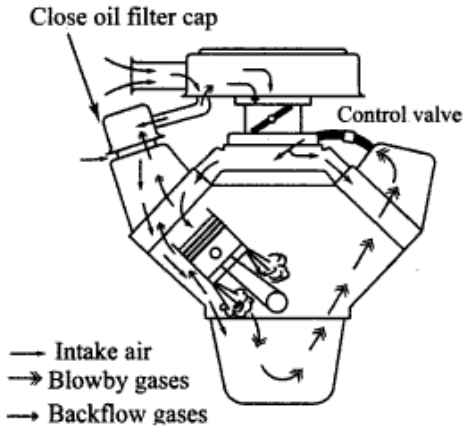
b. **List eight ways of reducing pollution. Explain PCV and evaporative emission system with suitable sketch.** **8**

Answer: Eight ways of reducing pollution:- (*Any Eight method)*

1) Optimize Ignition Advance 2) Use unleaded gasoline & Low sulphur diesel 3) Use leaner air fuel ratio 4) Use exhaust gas treatment devices ex Catalytic converter, EGR valve PCV system etc. 5) Use smoke suppressant additives 6) Fumigation 7) Do periodic Maintenance 8) De-rating 9) Use Alternative fuel CNG,LPG, Bio-diesel, Hybrid Vehicle, Electric vehicle, Solar vehicle etc. 10) Use Computer control engines with advance technology such as CRDI, VVT, VTEC, DTSi etc. **2**

PCV system: The purpose of PCV system is to remove these harmful gases from the crankcase before damage occurs and combine them with the engine's normal incoming air: fuel mixture. **1**

PCV system uses a variable flow PCV valve accurately matches ventilation flow with blow-by production characteristics. By accurately matching these two factors, crankcase ventilation performance is optimized, while engine performance and drivability remains unaffected



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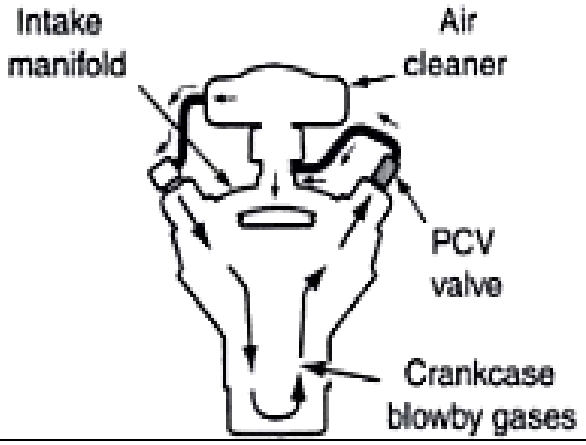
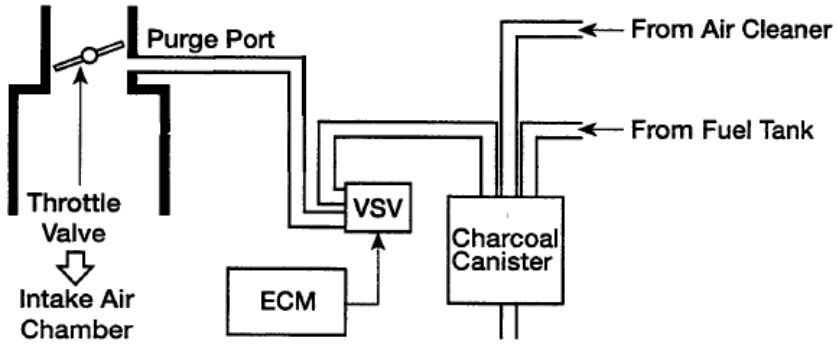
OR



Evaporative emissions control System:



VSV: Vacuum Switching Valve ECM: Electronic Control Module

Figure: Evaporative Emission Control system

2

As fuel is drawn from the tank, a vacuum may be created in the tank. This is prevented by allowing atmospheric pressure to enter the tank through the check valve in the charcoal canister or fuel tank cap check valve. The EVAP system is designed to limit maximum vacuum and pressure in the fuel tank.

1

c. Explain working of Variable Valve Timing and Electronic lift control (VTEC) system. Enlist its advantage and Drawbacks. **8**

Answer: Working of Variable Valve Timing and Electronic lift control (VTEC) system:-

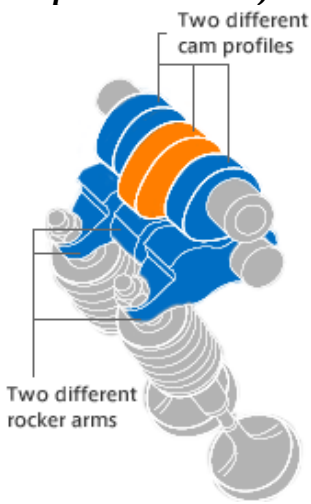
VTEC (which stands for Variable Valve Timing and Lift Electronic Control) is an electronic and mechanical system which effectively has multiple camshafts. As the engine moves into different rpm ranges, the engine's computer can activate alternate lobes on the camshaft and change the cam's timing. In this way, the engine gets the best features of low-speed and high-speed camshafts in the same engine **2**

An elegant, simple mechanism Switching between high and low valve lift using two cam profiles and two rocker arms per cylinder. The switch is made using hydraulic pressure to push/release the sliding pin, locking/unlocking the middle rocker arm and the other rocker arm.

At low engine speeds, the pin is retracted, disengaging the middle rocker arm. The valves are operated by the two outside, low-profile cams for a low valve lift.

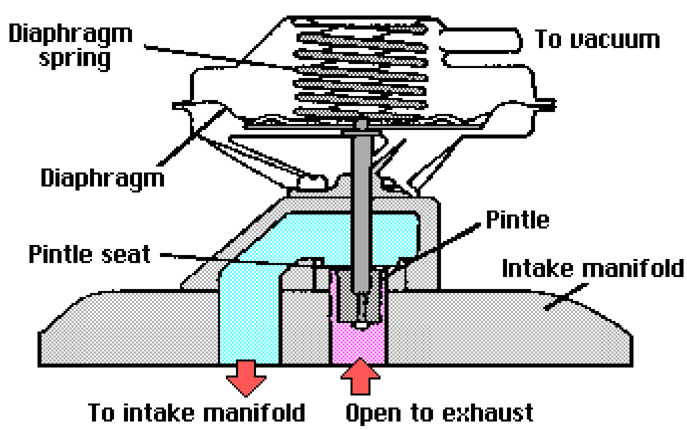
At higher engine speeds, increased hydraulic pressure pushes the pin, engaging the middle rocker arm. The valves are operated by the middle, high profile cam for high valve lift.

(Note: Credit should be given to an equivalent sketch)

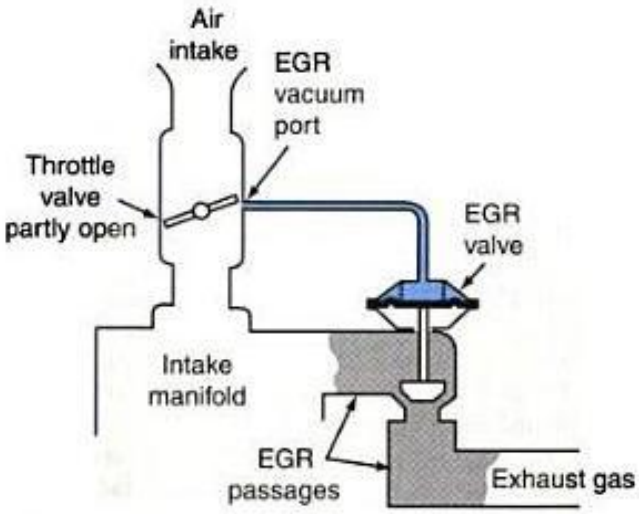


2

		Advantages: *(Any Two)* 1) Increased fuel efficiency and 2) High power output. 3) Emissions levels can also be more accurately controlled. 4) Improved Volumetric Efficiency 5) Improve drivability. **Drawbacks:** *(Any Two)* 1) High initial cost 2) Maintenance cost is high 3) Very complex structure required complicated control system.	**2** **2**
6		**Attempt any FOUR of the following:**	**16**
	a.	**How VGT is beneficial over conventional Turbocharger?**	**4**
		Answer: VGT is beneficial over conventional Turbocharger due to following reasons:- *(Any 4)* 1) Reduce Turbo Lag 2) Quick Responsive engine 3) Improved fuel efficiency by 20% 4) Accurate boost speed at low RPM 5) Boost pressure at high speed is not excessive. So waste gate boost control is not needed. 6) Higher power output at lower speed	**4**
	b.	**State four methods to improve fuel economy of a vehicle.**	**4**
		Answer: Methods of improving fuel economy. *(Any Four)* 1) Use of multi-functional fuel additives will provide 3 to 4% fuel economy. 2) Good driving habits. 3) Properly maintained fuel supply system. 4) Use of computer controlled fuel injection system. 5) Use of computer controlled ignition system. 6) Use of higher voltage automotive electrical system (42 volts system).	
	c.	**List three sources of pollutant from gasoline engine. Explain evaporative losses in detail.**	**4**
		Answer: Three sources of pollutant from gasoline engine:- 1) Carburettor losses 2) Crankcase blow-by 3) Engine exhaust emission **Evaporative losses:-** 1. Carburettor losses: occur due to air vent at float chamber. It also occurs due to hot soak losses which occur after the engine has been stopped, as a result of evaporation of petrol stored in the (float chamber) bowl, loss being through vent pipe or through air cleaner. 2. Crankcase blow-by: the blow-by is a phenomenon of leakage past the piston and piston rings from the cylinder to the crankcase. The blow-by HC emissions are about 20 % of the total HC emission from the engine. This is increased to about 30 % if the rings are worn.	

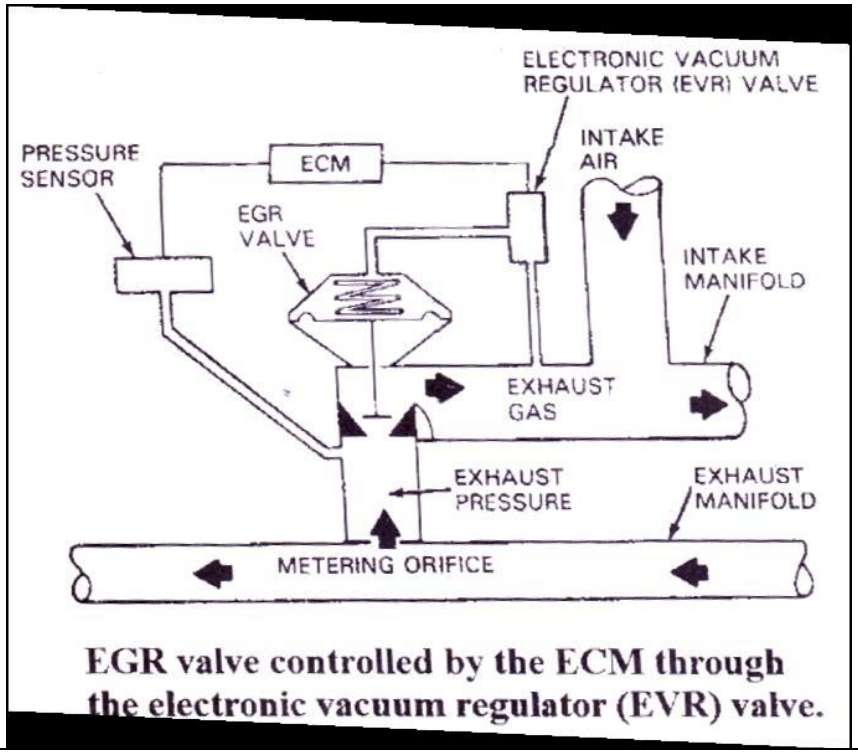
		3. <u>Engine exhaust emission</u>: complete combustion results carbon dioxide and water vapours. But due to incomplete combustion, the exhaust gas also contains carbon monoxide, unburnt hydrocarbons (UBHC).	
	d.	**List and Explain two type of diesel smoke. Explain four cause of diesel smoke.**	**4**
		Answer: **Two type of diesel smoke** 1) Blue-white smoke 2) Black smoke	**1**
		Four cause of diesel smoke:- 1) Blue smoke is due to burning the droplets of lubricating oil in combustion chamber because of worn piston rings & cylinder liners. 2) White smoke is due to water come in combustion chamber because cracked water jacket. 3) Black smoke will come due to rich air fuel mixture because of malfunctioning of Fuel injection system 4) Gray (Blue+ white) smoke will come because of both failure i.e lubricating oil in combustion chamber because of worn piston rings & cylinder liners & water come in combustion chamber because cracked water jacket.	**3**
	e.	**Describe operation of EGR Valve with suitable sketch.**	**4**
		Answer: Exhaust Gas Recirculation Valve *(Operation-2 marks, Sketch-2 marks)* When the engine is idling, the EGR valve is closed and there is no EGR flow into the manifold. The EGR valve remains closed until the engine is warm and is operating under load. As the load increases and combustion temperatures start to rise, the EGR valve opens and starts to leak exhaust back into the intake manifold. This has a quenching effect that lowers combustion temperatures and reduces the formation of NOx.	**2**
		 EGR valve (closed position)	**2**
		OR **Exhaust Gas Recirculation Valve** The EGR system is used to reduce the amount of NOx in the exhaust. Nox production increases as the temperature inside the combustion chamber rises due to acceleration or heavy engine loads, because high temperature encourages the nitrogen and oxygen in air to combine. Therefore, the best way to decrease the production of Nox is to hold down the temperature in the combustion chamber. The EGR system re-circulates exhaust gases through the intake manifold in order to reduce the temperature at which combustion takes place. When the air: fuel mixture & exhaust gases are mixed together, the proportion of fuel in the air: fuel mixture naturally falls (mixture	

becomes leaner), & in addition, some of the heat produced by combustion of this mixture is carried away by the exhaust gas. The maximum temperature attained in the combustion chamber therefore falls, reducing the amount of Nox produced.
The EGR system allows a small amount of exhaust gas (less than 10% of total) to be supplied into the incoming air: fuel mixture



OR

Exhaust Gas Recirculation Valve: Figure shows the EGR system controlled by the ECM. A pressure sensor monitors the exhaust system pressure. The sensor signals this information to the ECM. The ECM then signals the electronic vacuum regulator (EVR) valve how much vacuum to the apply EGR valve. This system accurately controls the amount of exhaust gas re-circulated.



EGR valve controlled by the ECM through the electronic vacuum regulator (EVR) valve.