WINTER – 19 EXAMINATION

Subject Name: Advance Auto. Engg. **Model Answer** Subject Code: 22440

Important Instructions to examiners:

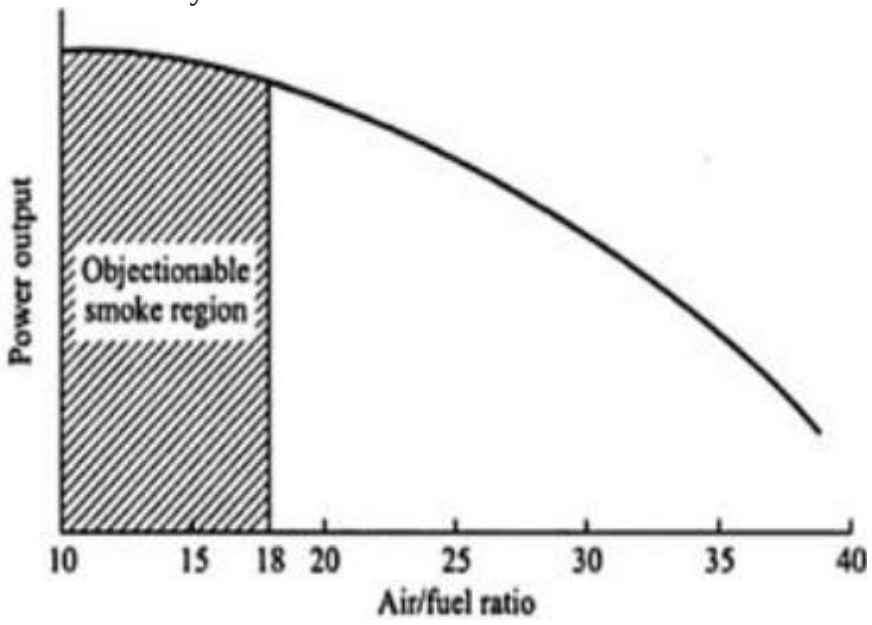
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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

8)

Q. N	SUB Q. N.	ANSWER	MARKING SCHEME
1		**Attempt any FIVE of the following.**	**10**
	a	**State the general conditions necessary for combustion.**	**02**
	Ans.	Three things are required in proper combination before ignition and combustion can take place Heat, Oxygen and Fuel. There must be Fuel to burn. There must be Air to supply oxygen. There must be Heat (ignition temperature) to start and continue the combustion process.	***Correct Answer 01 Mark***
	b	**State the effect of detonation.**	**02**
	Ans.	**Effects of Detonation:** 1. 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. 2. Mechanical damage: Due to rapid pressure waves, rate of wear is increased and piston head, cylinder head and valves may be pitted. 3. Carbon deposits: Detonation results in increased carbon deposits. 4. 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. 5. Decrease in power output and efficiency: Due to increase in the rate of heat transfer the power output is decreased. 6. 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.	***Any Two 01 Mark each***
	c	**State the function and location of oxygen sensor and mass air flow sensor.**	**02**
	Ans.		***Correct Ans. 01 Mark Each***

S. N.	Name	Function	Location
1	**Oxygen Sensor**	Measuring quantity of oxygen in exhaust	Located at inlet and outlet side of catalytic convertor
2	**Mass Air**	It is used to tell ECU the mass of	Mounted between air filter

		Flow Sensor | air entering the engine. | and turbocharger.	
	d	**List four drawback of carbureted SI Engine.**	**02**
	Ans.	**Drawback of Carbureted SI Engine:** **1) Air-Fuel Ratio:** As in SI engine Air-fuel ratio varies from 8:1 to 18.5:1 i.e. from 8 kg of air/kg of fuel to 18.5 kg of air/kg of fuel. Richer or leaner air-fuel ratio limit causes the engine to misfire, or simply refuse to run at all. 2) **Fuel consumption:** As atomization rate deepened upon velocity of air in venture also As in SI engine Air-fuel ratio varies from 8:1 to 18.5:1 so Fuel consumption is more in SI engine. **3) Power output:** Power output varies due to variation of Air-fuel ratio. **4) Emission:** As in SI engine Air-fuel ratio varies from 8:1 to 18.5:1 i.e. from 8 kg of air/kg of fuel to 18.5 kg of air/kg of fuel. So emission is more in SI engine. **** (any suitable answer can be considered***)	***1/2 Mark Each***
	e	**List two dis advantages and advantages of CNG.**	**02**
	Ans.	**Dis - advantages:** 1. Low engine performance. 2. Low engine volumetric efficiency. 3. Need of large pressurized fuel storage tank. 4. Refuelling is a slow process 5. Inconsistent fuel properties. **Advantages:** 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	***Any two advantages and disadvantages 1/2 Mark Each***
	f	**Enlists various pollutants from the gasoline engine. State their effect on environment.**	**02**
	Ans.	**Pollutants from Gasoline Engine & their effect on Environment:** **Pollutant** | **Environmental Effect of Pollutants** 1. Hydrocarbons | They play an important role in forming NO2 and O3 which are health and environmental hazards. 2. Carbon Monoxide | CO is a highly poisonous gas that can cause dizziness, headaches, impaired thinking, and death by O2 starvation. It can affect the central nervous system, impairing physical coordination, vision and judgment, creating nausea and headaches, reducing worker productivity and increasing personal discomfort. 3. Carbon dioxide | CO2 is a greenhouse gas and may be the major cause of global warming. 4. Oxides of Nitrogen | NO is unhealthy and contributes to the greenhouse effect. NO2 is a very toxic gas and contributes to the formation of smog, ozone, and acid rain.	***Lists of Pollutants 01 Mark & Their effect on environment. 01 Mark***

	g	**State four method to control diesel smoke.**	**02**
	Ans.	**Methods to Control Diesel Smoke:** **1. De-rating:-** At lower loads, the air: fuel ratio obtained will be leaner & hence the smoke developed will be less. However this means a loss of output. **2. Maintenance:** - Maintaining the injection system of engine properly results in a significantly reduced smoke, best engine performance, and clean exhaust system. Other methods are changes in Combustion chamber geometry. **3. Smoke suppressant additives:-** Some barium compound, if used in fuel, reduce the temp of combustion, thus avoiding the soot formation, & if formed- they break it into the fine particles, thus appreciably reducing smoke. **4. Fumigation**: - Fumigation consists of introducing a small amount of fuel into the intake manifold. This shortens the delay period- curbs thermal cracking which is responsible for soot format	***Four Method 1/2 Mark Each.***
2		**Attempt any THREE of the following:**	**12**
	a	**Describe the Air Fuel Ratio in CI Engine.**	**04**
	Ans.	**Air Fuel Ratio in CI Engine:** Thermodynamic analysis of the engine cycles has clearly established that operating an engine with a leaner air-fuel ratio always gives a better thermal efficiency but the mean effective pressure and the power output reduce. The CI engine is always designed to operate with an excess air, of 15 to 40% depending upon the application. The power output curve for a typical CI engine operating at constant speed is shown in Fig. given below. The approximate region of A/F ratios in which visible black smoke occurs is indicated by the shaded area.  **Figure: CI Engine- A/F Ratio Vs Power Output** **OR** Irrespective of load at any given speed, an approximately constant supply of air enters the cylinder. With change in load, the quantity of fuel injected is changed varying the air fuel ratio. The overall air fuel ratio thus varies from about 18:1 at full load to about 80:1 at no load. The diesel engine always designed to operate with an excess air of 15 to 40% depending upon the application.	***Correct Answer 04 Mark Each***

b **Select a combustion chamber for petrol engine with justification.** **04**

Ans. **Selection of a Combustion Chamber for Petrol Engine with Justification:**

Combustion Chamber	Justification
1) T Head Type Combustion Chambers 2) L Head Type & Side Head Combustion Chambers	1. Easy to manufacture flat cylinder head, 2. Lower height of engine and front hood for better frontal visibility of vehicle 1. Neat and compact layout 2. Easy to lubricate valves, easy to decarbonize engine.
3) F- Head Combustion Chamber	1. High volumetric efficiency 2. Maximum compression ratio for fuel of given octane rating 3. High thermal efficiency 4. It can operate on leaner air-fuel ratios without misfiring.
4) Over Head Valve or I Head, (Bathtub and Wedge Shaped) Combustion Chamber	1. Lower pumping losses and higher volumetric efficiency. 2. Lesser distance of flame travel. Therefore low octane requirement. 3. More uniform cooling of cylinder and piston. 4. Lower surface to volume ratio and therefore less heat loss. 5. Easier to cast and hence lower casting cost.
5) Ricardo Turbulent head side valve Combustion chamber	1. Faster flame speed, 2. Reduced detonation 3. Homogeneous air: fuel mixture formation.

List Of Combustion Chamber 02 Marks & Justification of Any Two 01 Mark Each

c **Illustrate with example of fuel injection as an output control function of ECM.** **04**

Ans. **Fuel Injection as an Output Control Function of ECM:**

ECM controls fuel injection by calculating A: F ratio needed for engine. Engine requires different air fuel ratios while cranking, warm- up, idle, normal running, sudden acceleration and during deceleration. As ECM receives inputs from various sensors such as TPS, CKP, CMP, MAP, CTS and O_2 and other sensors, it calculates the injector pulse width that precisely meets the engine requirement. ECM refers Look-up tables and maps stored in memories (ROM/RAM/KAM).

Description 02 marks

Illustration:

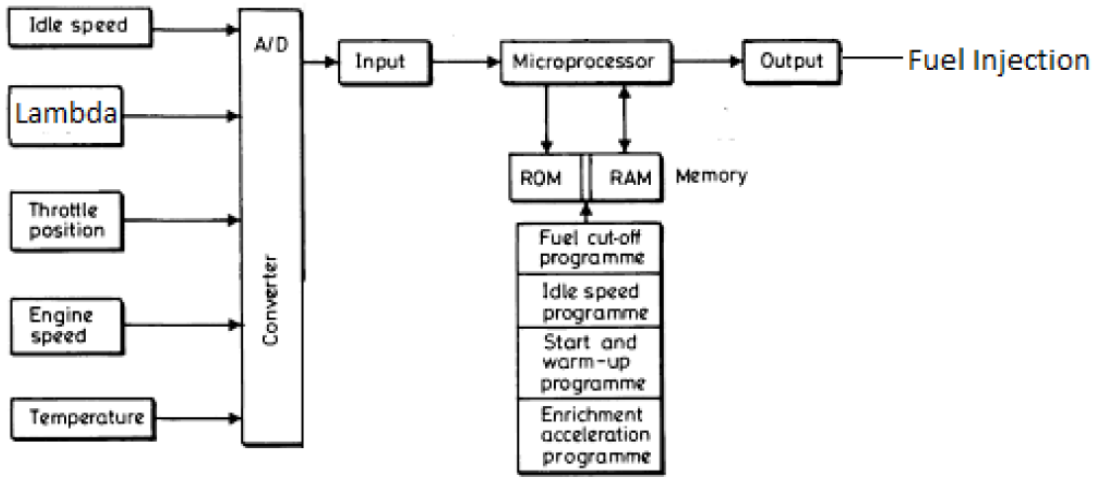
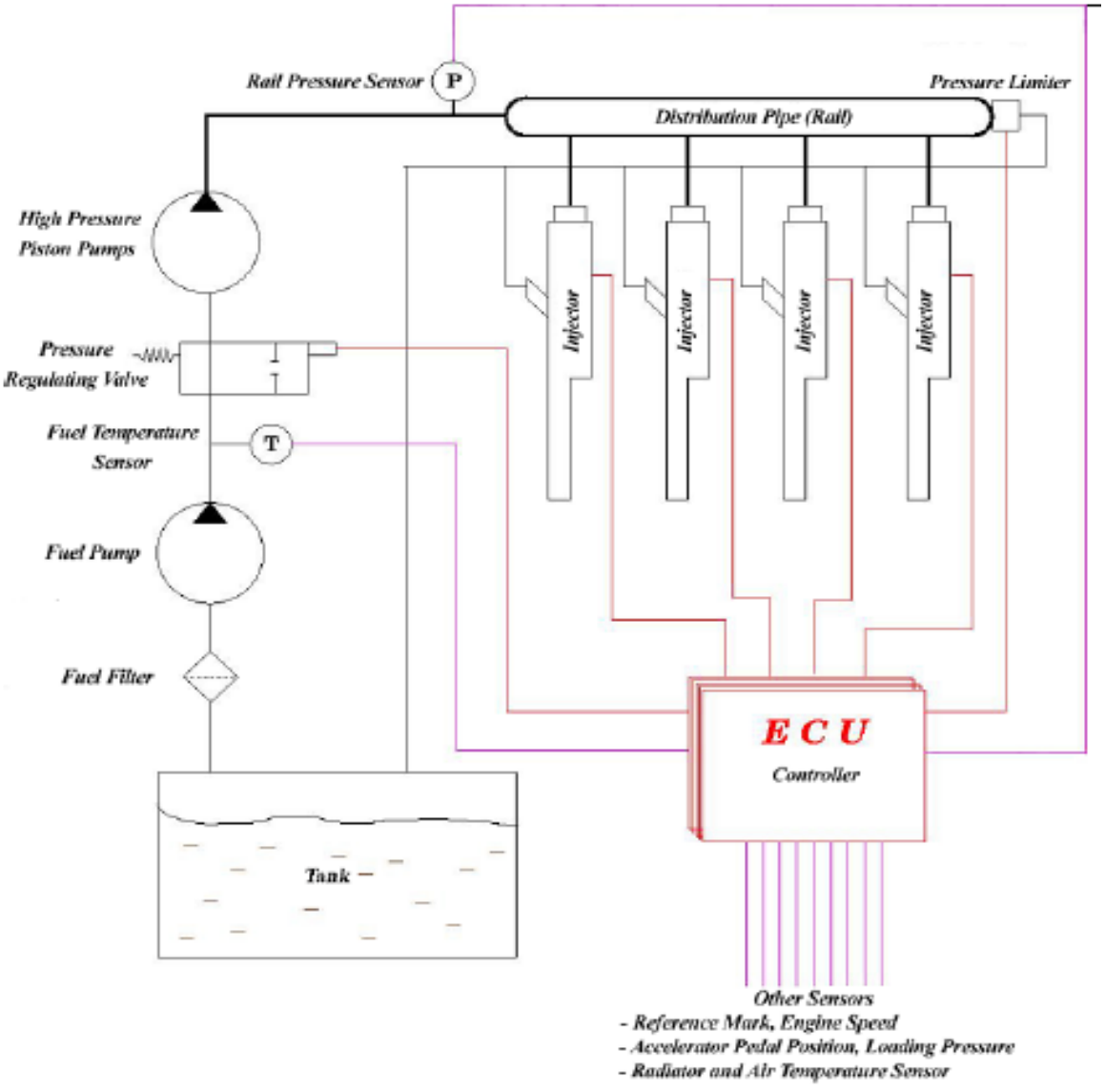


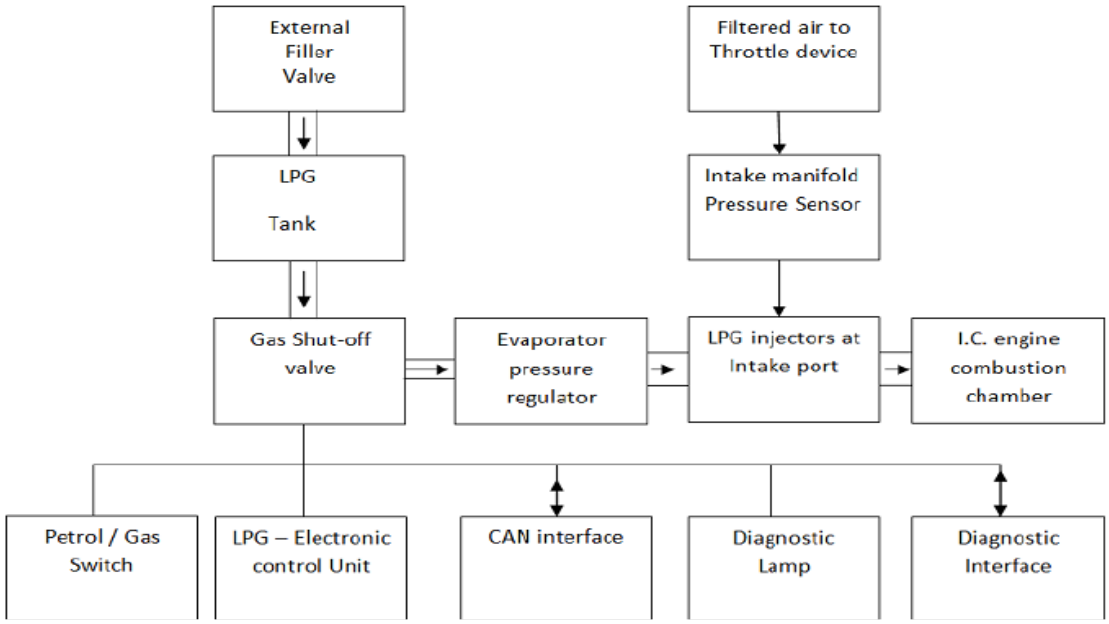
Figure: ECM Block Diagram and Fuel Injection Control Function

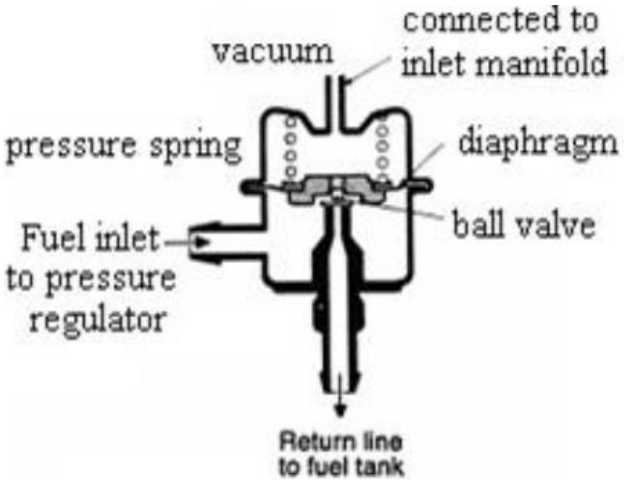
&

Illustration 02 marks

When the engine is being cranked by the starter, and when the engine is colder than operating temperature, the ECM sees the low RPM, and quickly goes to the Cranking fuel Table, increasing the Injector pulse width, allowing more fuel to get the engine started. At the same time, the ECU tells the IAC to open, allowing enough air into the engine for start and idle (Throttle body valve is closed).

	d	Describe operation of CRDI system.	04
	Ans.	**Operation of CRDI System:** High pressure pump provides high pressure fuel to the common rail. The common rail stores the fuel and maintains a constant pressure in the common rail line (approximately 1500 bars.). This pressure is continuously available at injectors. The injection pressure is independent of engine speed. The quantity of fuel injected in the combustion chamber is controlled by actuating solenoid valve in the injector. As solenoid is energized, injection begins. Injector pulse width, multiple injections and duration of injection – all are controlled by EDC of CRDI system. The system pressure is controlled by means of a pressure sensor. Pilot injection and possibly a second, third injection is achieved by repeatedly activating solenoid valve, whereas the injection rate can be modified by controlling the nozzle needle movement.  **Figure: Layout of Common Rail Fuel System for Diesel Engine**	***Description 02 Marks*** ***&*** ***Sketch 02 Marks***

3		**Attempt any THREE of the following:**	**12**
	a	**Sketch and describe LPG fuel supply system layout.**	**04**
	Ans.	 **Figure: LPG Fuel Supply System Layout for SI Engine.** The system works by pumping LPG at high pressure from the LPG vehicle tank to the engine inlet manifold via a set of liquid LPG injectors. The injectors spray the liquid LPG into the intake manifold. The fuel vaporizing in the intake manifold cools and increases the density of the intake air.	***Sketch 03 Marks,*** ***&*** ***Description 01 marks***
	b	**LPG is used as a fuel for petrol engine. Justify your answer.**	**04**
	Ans.	**LPG is used as a fuel for petrol engine, because of its following advantages** **1.** It is cheaper than petrol **2.** It is highly detonation resistant and does not pre-ignite easily. **3.** It gives better manifold distribution and mixes easily with air. **4.** Residue and oil contamination is small as it burns cleanly: implies longer lubricating oil change period. **5.** LPG is lead free – implies- less exhaust emission. **6.** Life of spark plug is increased. **7.** LPG has a higher octane rating than petrol. **8.** It meets emission norms **9.** It can be transported easily to remote places by road and also by rail. **10.** It results in increased engine life and smoother engine performance. **11.** Crankcase oil dilution is small. So, oil replacement frequency is reduced. **12.** Low engine deposits reduce the cost of maintenance. **13.** Engine need not be modified. LPG kits are readily available (even for MPFI engines) and the kit cost is mostly affordable. ***(NOTE: Credit Should be given to any other Appropriate Answer)***	***Any 08 Justification 1/2 Mark Each***
	c	**Describe features of Variable Valve Timing Mechanism (VVT)**	**04**
	Ans.	**Features of VVT:** Variable valve timing (VVT) is a system for varying the valve opening of an internal combustion engine. This allows the engine to deliver high power, but also to work tractably and efficiently at low power. There are many systems for VVT, which involve changing either the relative timing, duration or opening of the engine's inlet and exhaust valves.	***Description 01 Marks***

		Cam Changing VVT: **Stage 1 (Low Speed):** The 3 pieces of rocker arms moves independently. Therefore the left rocker arm, which actuates the left inlet valve, is driven by the low-lift left cam. The right rocker arm, which actuates the right inlet valve, is driven by the medium-lift right cam. Both cams' timing is relatively slow compare with the middle cam, which actuates no valve now. **Stage 2 (Medium Speed):** Hydraulic pressure (painted orange in the picture) connects the left and right rocker arms together, leaving the middle rocker arm and cam to run on their own. Since the right cam is larger than the left cam, those connected rocker arms are actually driven by the right cam. As a result, both inlet valves obtain slow timing but medium lift. **Stage 3 (High Speed):** Hydraulic pressure connects all 3 rocker arms together. Since the middle cam is the largest, both inlet valves are actually driven by that fast cam. Therefore, fast timing and high lift are obtained in both valves	***&*** ***Three Features 01 Mark Each***
	d	**Describe any four methods to improve fuel economy.**	**04**
	Ans.	**Methods to Improve Fuel Economy:** 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).	***Any Four 01 Mark Each***
4		**Attempt any THREE of the following:**	**12**
	a	**Describe the working of pressure regulation in PFI system with the help of schematic diagram.**	**04**
	Ans.	**Working of Pressure Regulator in PFI System:** 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.  **Figure: Fuel Pressure Regulator Operation**	***Description 02 marks*** ***&*** ***Diagram 02 marks***
	b	**Describe the procedure to locate leakage in Compressed Natural Gas Fuel supply system of a car. State relevant precaution.**	**04**
	Ans.	**Procedure to locate Leakage in Compressed Natural Gas Fuel Supply System of a Car:** 1. The first indicator is the foul smelling agent present in CNG.. 2. The second level of test you can do is to take a soap solution and apply the same in all	***Procedure 02 Marks***

possible areas of leak.
3. There is one more way you can install a gas leak detector .They detect gas leaks as soon as the CNG reaches 20% of the explosive limit.

Precautions to be taken During Leakage Identification:

1. When a gas leak is suspected, extinguish all flames, incense sticks, etc.
2. Close the CNG regulator and
3. Put the safety cap on the cylinder.

and Precautions 02 Marks

c **Sketch and describe the layout of series hybrid vehicles.** **04**

Ans.

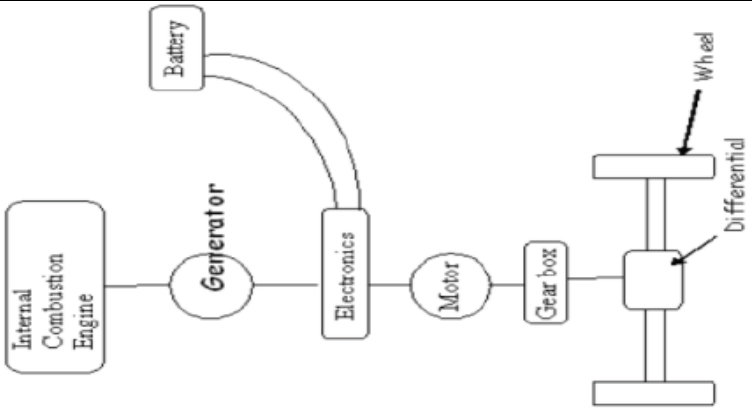


Figure: Block Diagram of Series type Hybrid Car

Sketch 02 Marks

And

Series-Hybrid vehicle

In Series Hybrid vehicles, the Internal Combustion Engine (ICE) drives a generator, which charges the battery and supplies current to the electronically controlled motor. The electric motor propels the car. In this system, Internal Combustion Engine operates at constant speed with maximum efficiency, It causes low exhaust emissions. The vehicle is controlled electronically. The electric control simplifies the mechanical gears and the differential. Both Internal combustion engine and electric drive have to be rated to the maximum power. It has low overall system efficiency.

Description 02 Marks

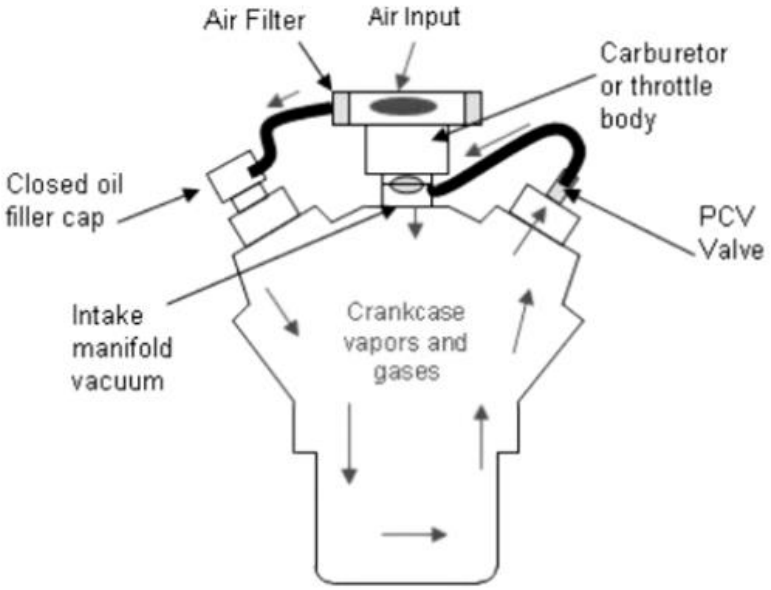
d **Prepare a chart of euro norms for a petrol engine of car.** **04**

Ans. **Chart of Euro Norms for a Petrol Engine of Car:**

Any Four Norms 01 Mark Each

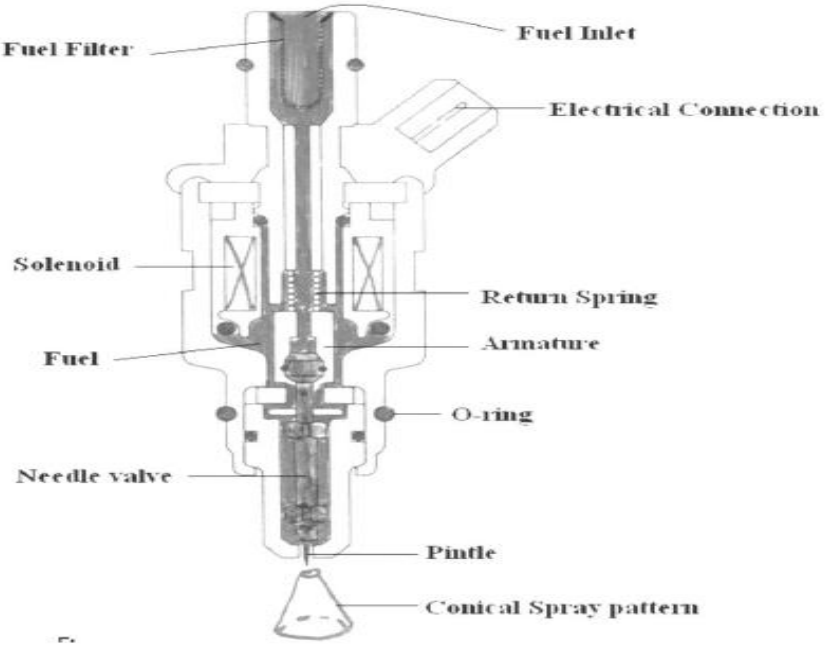
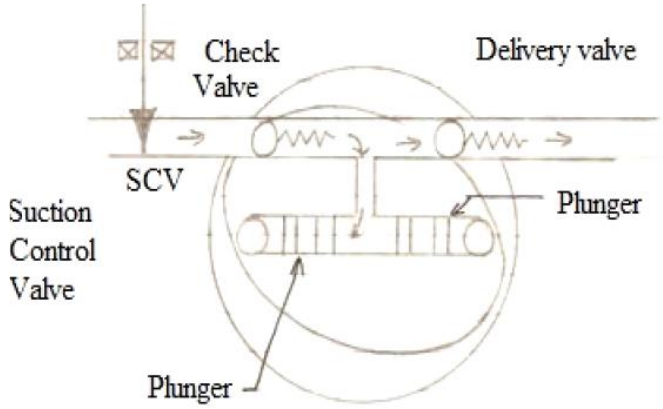
Petrol (Gasoline)									
Tier	**Date (Type Approval)**	**Date (First Registration)**	**CO**	**THC**	**NMHC**	**NO_x**	**HC + NO_x**	**PM**	**PN[#/km]**
Euro 1 +	July 1992	January 1993	2.72 (3.16)	--	--	--	0.97 (1..13)	--	--
Euro 2	Jan. 1996	January 1997	2.2	--	--	--	0.5	--	--
Euro 3	Jan.2000	January 2001	2.3	0.20	--	0.15	--	--	--
Euro 4	Jan. 2005	January 2006	1.0	0.10	--	0.08	--	--	--
Euro 5a	Sept. 2009	January 2011	1.0	0.10	0.068	0.060	--	0.005**	--
Euro 5b	Sept. 2011	January 2013	1.0	0.10	0.068	0.060		0.0045**	
Euro 6b	Sept. 2014	Sept. 15	1.0	0.10	0.068	0.060		0.0045**	6 X 10^{11***}
Euro 6c	---	Sept. 18	1.0	0.10	0.068	0.060		0.0045**	6 X 10^{11}
Euro 6d - Temp	Sept. 2017	Sept. 19	1.0	0.10	0.068	0.060		0.0045**	6 X 10^{11}
Euro 6d	Jan. 2020	Jan. 2021	1.0	0.10	0.068	0.060		0.0045**	6 X 10^{11}

*Before Euro 5, Passenger Vehicles >2500kg. were type approved as Light Commercial Vehicles N_1 Class I.
** Applies only to vehicles with direct injection engine.
***6 X 10^{11}/ km within first three years from Euro 6b effective dates.
+ Values in parameters are conformity of production(COP) limit

	e	**Describe the working of PCV System.**	04
	Ans.	**Working of PCV system:** During normal compression stroke, a small amount of gases in the combustion chamber escapes past the piston. Approximately 70 % of these 'blow-by' gases are unburned fuel (HC) that can dilute and contaminate the engine oil, cause corrosion to critical parts, and contribute to sludge build up. At higher engine speeds, blow-by gases increase crankcase pressure that can cause oil leakage from sealed engine surfaces. 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. 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.  **Figure: PCV System**	***Explanation 02 Marks*** ***&*** ***Sketch 02 Marks***
5		**Attempt any TWO of the following:**	**12**
	a	**Compare the SI and CI engine on the basis of: (i) Compression Ratio (ii) Operating Speed (iii) Power O/P per weight.**	**06**
	Ans.		***Each Correct Point 02 Marks Each***

Parameter	SI Engine	CI Engine
(i) Compression Ratio	Compression ratio is low, about 10:1 limited by detonation	Compression ratio is higher, about 18:1 to 22:1
(ii) Operating Speed	To avoid Detonation in SI Engine operating speed is High	To avoid Diesel knock operating speed is Low
(iii) Power O/P per weight.	Power output is Less than CI engine due to lower compression ratio.	Power output is more than SI engine due to higher compression ratio.

	b	**Describe the working of electronic fuel injector with the help of suitable sketch.**	**06**
	Ans.	**Working of Electronic Fuel Injector:** In MPFI system, Top feed fuel Injector is used. These injectors are solenoid-operated valves that are opened and closed by means of electric pulses from the ECU. The injectors are mounted in the intake manifold and spray onto the back of the intake valves. In general, one injector is used for each cylinder. The injected fuel mass is determined by the injector opening time (for a given pressure drop across the injector). In MPFI systems, each engine cylinder is assigned an electromagnetic fuel injector, which is activated individually for each cylinder. In this way, both the fuel mass	***Description 03 Marks***

		appropriate to each cylinder and the correct start of injection are calculated by the control unit (ECU) The amount of fuel sprayed from the injectors is controlled by cycling the injectors open and close. More fuel will be sprayed out when the injector pulse is longer. In order to operate properly, the fuel must spray as a liquid throughout the injection. Injection pressure is approximately 2 bar to 3.5 bar. Pressure helps to keep the fuel as a liquid throughout the system. When the solenoid coil is energized, the Pintle is pulled up. System pressure then forces fuel between the Pintle and discharge opening to form a fine spray pattern that has a cone shape.  **Figure: Electronic Fuel Injector.**	***&*** ***Sketch*** ***03*** ***Marks***
	c	**Describe the working of high pressure pump used in CRDI system.**	**06**
	Ans.	**Working of High Pressure Fuel Pump Used In CRDI System**: • 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 Pump used in CRDI System**	

6 **Attempt any TWO of the following:** **12**

a **Compare Throttle Body Injection and Port Fuel Injection of Petrol Engine.** **06**

Ans.

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 1 bar)	PFI is comparatively high pressure injection (differential pressure = 2 to 3.5bar)
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.

Any Six Points, Each Correct Point 01 Mark

b **Describe the idle speed control function of an electronic control module with neat sketch.** **06**

Ans.

Idle Speed Control System as Output Function of 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.

Description 04 Marks

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 signalled 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.

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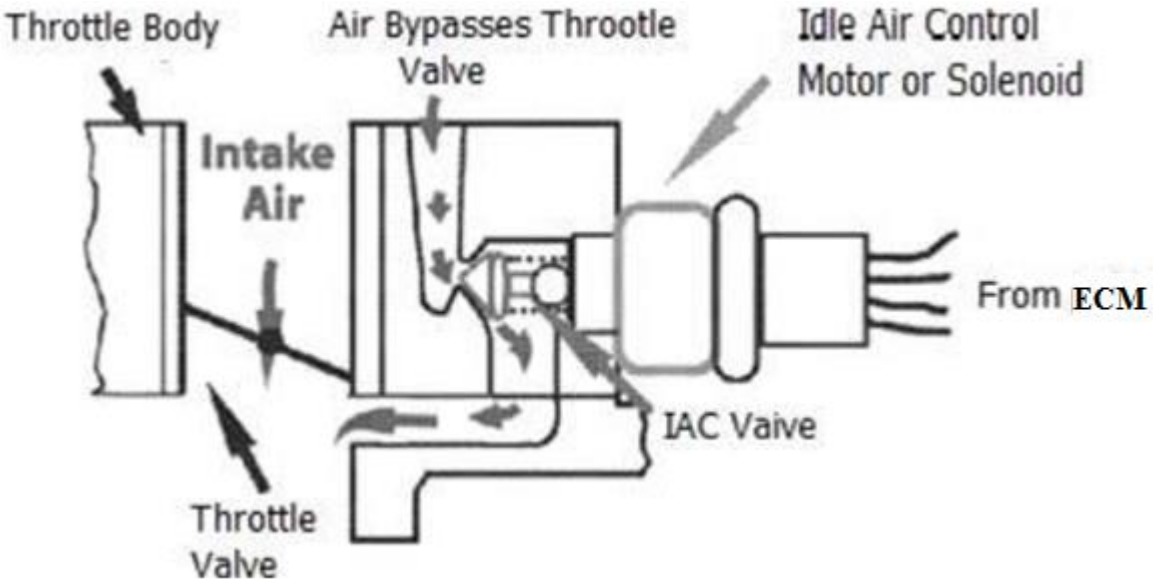

Figure: Idle Speed Control

Any One Neat Labeled Sketch 02 Marks

OR

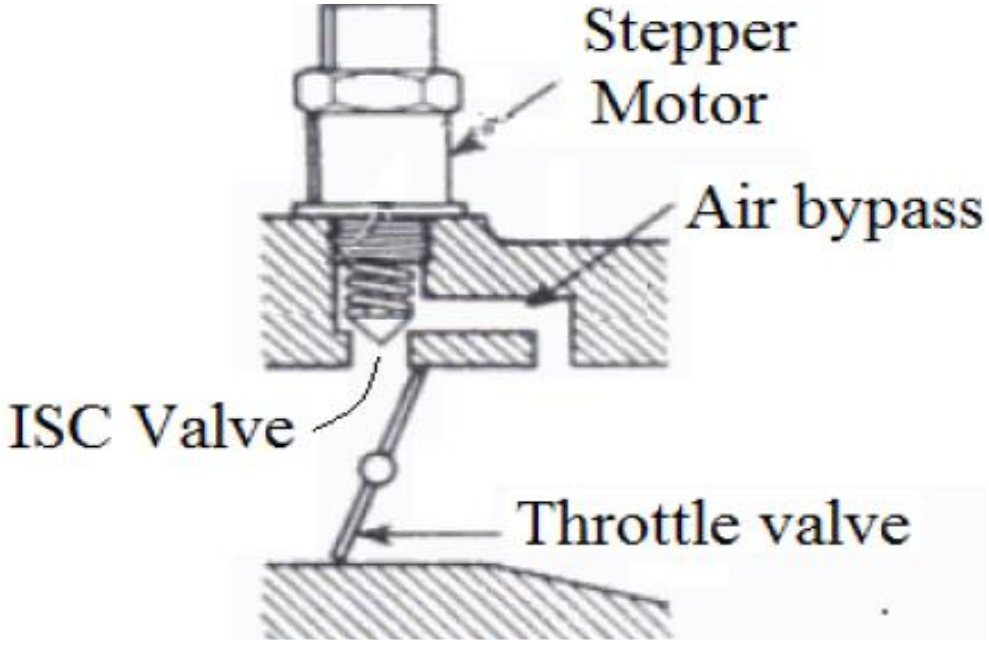

Figure: Idle Speed Control

	c	**Describe three engine modifications to be done to reduce SI engine Emission.**	**06**
	Ans.	**Engine Modifications to be Done to reduce SI Engine Emission are:** **1. Use of leaner air-fuel ratios:** The carburettor may be modified to provide relatively lean air fuel mixtures during idling and cruise operation. With this modification, idle speed needs to be increased to prevent stalling and rough idle. Fuel distribution is improved by better manifold design, Inlet air heating, raising of coolant temperature and use of electronic fuel injection system. **2. Retarding Ignition timing:** The controls are designed to retard the spark timing at idle and providing normal spark advance during acceleration and cruising. Retarding spark reduces NOX. Emission. It also reduces HC emission. **3. Modification of combustion chamber:** Modification in combustion chamber is attempted to avoid flame quenching zones, resulting in HC emission. This includes reducing surface to volume ratio, reduced squish area, reduced deal space around piston ring and reduced distance of the top piston ring from the top of the piston. **4. Lower compression ratio:** The lower compression ratio reduces the quenching effect by reducing quenching area reducing HC. It also reduces NOX. Emission. Reducing compression ratio results in some loss of power and fuel economy. **5. Reduced valve overlap:** Increased valve overlap allows some mixture to escape directly to increase emission level. This can be controlled by reducing valve overlap. **6. Alterations in induction system:** The supply of designed air fuel ratio to all cylinders under all operating conditions can be affected by alterations in induction. This includes inlet air heating, use of carburettor with closer tolerances and using special type of carburettors. This also includes fuel injection in manifold.	***Any Three Correct Methods 02 Mark Each***