MODEL ANSWER
WINTER– 17 EXAMINATION

Subject Title: Automobile Engineering   **Subject Code:** | 17526 |

_____

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.
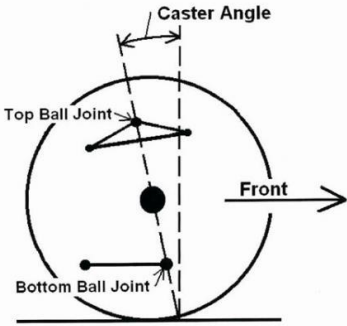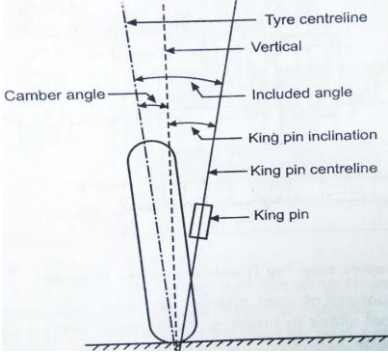7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(A)	**Attempt any THREE.**	12
	a)	**State the necessity of transmission system in automobile.**	4
		Answer: (1 mark for each) **Necessity of transmission system:** 1. To disconnect the engine from the driving wheels when starting the engine. 2. To connect the driving wheels smoothly & without shock to the engine, when the engine is running. 3. To reduce the speed of the engine at the driving wheels in the ratio of about 4:1 in the passenger cars & in greater ratio in heavy vehicles up to 10:1. 4. To vary vehicles speed and torque according to driving conditions. 5. To transmit the power from engine to rear axle at varied angle and speed. 6. To drive the driven wheel on either side of the vehicle at different speeds while the vehicle is negotiating a turn.	
	b)	**State the various requirements of automobile body.**	4
		Answer: (any four, 1 marks for each). **Requirements of automobile body:** 1. The body should be light. 2. It should have minimum number of components. 3. It should provide sufficient space for passengers and luggage. 4. It should withstand vibrations while in motion. 5. It should offer minimum resistance to air. 6. It should be cheap and easy in manufacturing. 7. It should be attractive in shape. 8. It should have uniformly distributed load. 9. It should have long fatigue life 10. It should provide good vision and ventilation	

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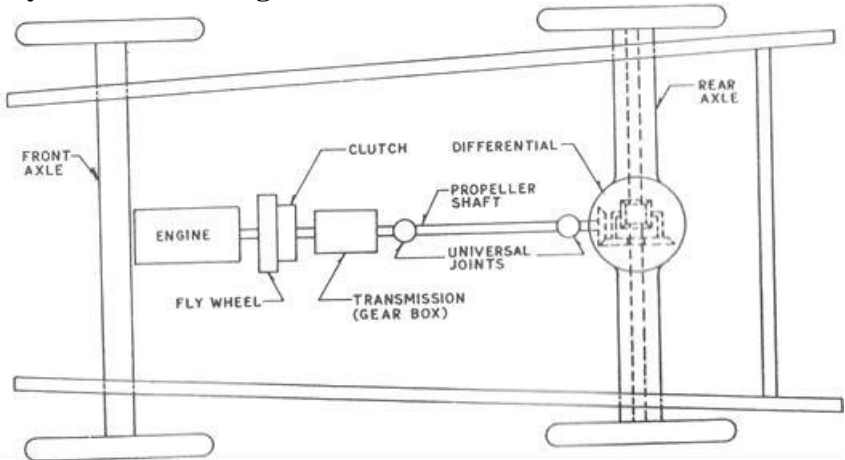
	c)	**Define the following and state general range of angles used:**
		    (i) Castor ,
		    (ii) Camber.
			4

		Answer: **(i)Castor:** It is the angle between king pin Centre line and the vertical, in plane of wheel **OR** It is forward or backward tilt of the wheel from true vertical when viewed from the side of wheel. **Range (Amount):** About 3 degree of castor gives good results. **(ii)Camber:** It is the tilt of car wheels from the vertical when viewed from the front of vehicle. **Range (Amount):** Camber should not exceed 2 degree.	**01** **01** **01** **01**
	(d)	**State the classification of brakes and braking system.**	**4**

		Answer:
		 Classification of brakes :
		 1. Drum brakes
		   I) Internal expanding shoe brakes
		   II) External expanding shoe brakes.
		 2. Disc brakes
		 The operating system for such brakes can be of any of the following type:
		 (Any 3 systems - 3 marks)
		 I) Mechanical braking system.
		 II) Hydraulic braking system.
		 III) Pneumatic braking system.
		 IV) Vacuum braking system.
		 V) Electrical braking system.
		 VI) Combined vacuum and electrical braking system.
			01
			
			 03

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1	(B)	**Attempt any ONE:**	**06**
	a)	**Sketch and explain chassis layout of front engine rear wheel drive.**	**06**
		Answer: layout of Front Engine Rear Wheel Drive Vehicle: **Figure: layout of Front Engine Rear Wheel drive** The layout of car is shown in the figure. It shows the position of the main parts of an automobile. It consists of engine located at the front of vehicle, followed by a clutch, gear box, propeller shaft, universal joint, differential, rear axle etc. The drive from the gear box is conveyed through a short shaft to the front universal joint of the propeller shaft. From the propeller shaft it is conveyed to the rear wheel through a sliding slip joint and universal joint. The bevel gear of the short shaft is driven by rear universal joint. This bevel gear meshes with a larger bevel gear which drives the two rear axle shafts through a differential gear.	**03** **03**
	b)	**(i) State the function of clutch.** **(ii) Explain with neat sketch, the working of Diaphragm type clutch.**	**02** **04**
		Answer: **i) Function of clutch:** 1. To permit engagement or disengagement of gears when the vehicle is stationary (the engine is running) and when the vehicle is in motion without damaging the gear wheels. 2. To transmit the engine power to the road wheels smoothly without shock to the transmission system while setting the vehicle in motion. 3. To allow the engine to take up load gradually without shock or jerk. **ii) Diaphragm clutch:** In diaphragm clutch, instead of helical springs diaphragm type spring is used, which apply the pressure on the pressure plate for engaging the clutch. The spring is either tapered finger type or crown type and is mounted on the pressure plate. In the conical position of the spring, the clutch plate remains gripped between the flywheel and the pressure plate. When the clutch pedal is depressed, the throw-out bearing moves towards the flywheel pressing centre portion of the spring which causes the rim to move backward. This removes the pressure on the pressure plate and the clutch is disengaged.	**02** **04**

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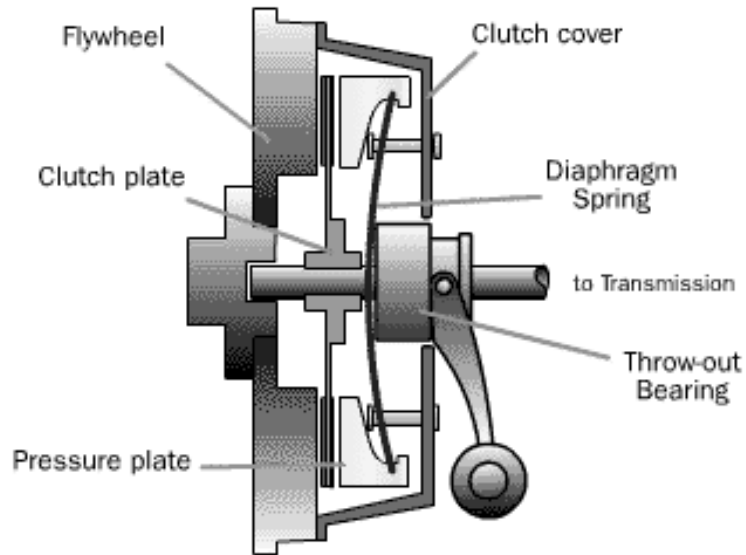
Figure: Diaphragm Clutch (Disengaged)
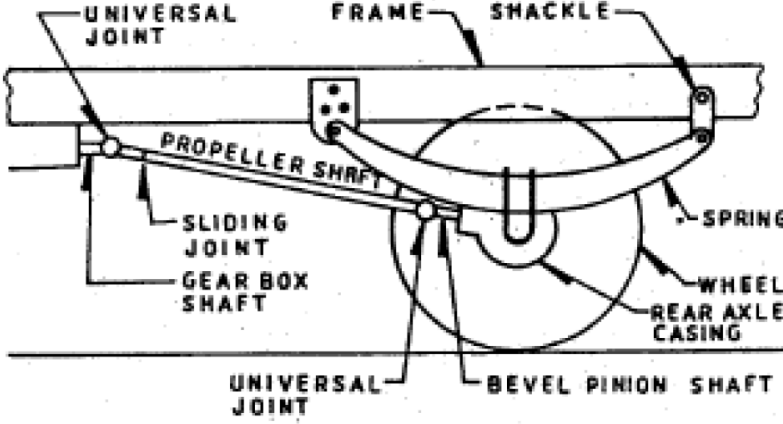
2.		**Attempt any FOUR :**	**16**
	(a)	**State the various types of automobile bodies.**	**04**

Answer: (1 mark for 1 type)
Types of automobile bodies:
i) Closed Cars
   a) Saloon
   b) Hatchback
   c) Coupe
   d) Limousine
ii) Open cars
   a) Sports
   b) Convertible
iii) Special Style
   a) Estate Cars
   b) Station Wagon
iv) Transport Vehicles
   a) Van
   b) Truck
   c) Articulated Vehicle
   d) Bus
   e) Coach

Other types of bodies are
1. Tractor with articulated trailer
2. Half body Truck
3. Dump truck
4. Tanker
5. Delivery truck

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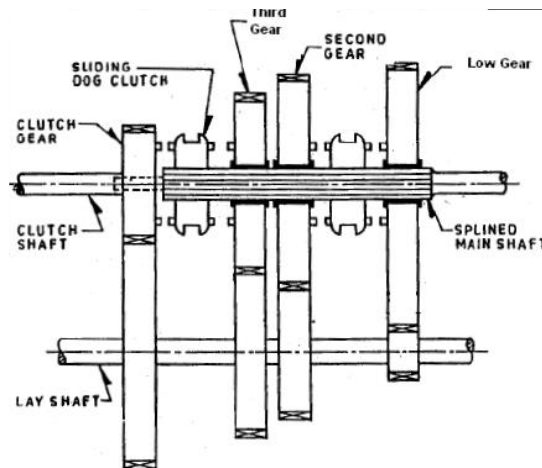|			
	(b)	**Explain with neat sketch, Hotchkiss drive.**	**04**
		Answer: (Explanation -2marks , sketch- 2marks) **Hotchkiss Drive-** This is the simplest & most widely used. The springs be sides taking weight of the body also take the torque reaction, driving thrust & side thrust. The propeller shaft is provided with two universal joints & also sliding joint. The spring is fixed rigidly in the middle to the rear axle. The front end of the spring is fixed is fixed to the frame by the front half of the springs. Due to torque reaction, the spring deflects as shown in fig. & is taken up by the springs. Similarly to take up the braking torque, the springs would deflect in the opposite direction. When the rear axle moves up & down due to the road condition, it has to move in a circle with the front spring support at the frame as centre. But for the propeller shaft motion, the centre is at the front of the universal joint. This means that during this movement of the rear axle, the length of propeller shaft has to vary. This is provided for by means of a sliding joint in propeller shaft. Hotchkiss drive	**02** **02**
	(c)	**(i) State function of slip joint provided on propeller shaft.** **(ii) State the necessity of universal joints used in propeller shaft.**	**02** **02**
		Answer: i) **Function of Slip Joint:** When the rear wheel comes across a bump, the spring compresses or expands as the differential with the rear axle housing and the wheel moves up and down. This not only changes the angle but also varies the length of propeller shaft. So the slip joint **permits the effective length of propeller shaft depending upon the road conditions**. If there is no slip joint, the propeller shaft will buckle or brake. ii) **Necessity of universal joint:** A universal joint is used where two shafts are connected at an angle to transmit the torque. Universal joint is used to transmit motion at varying angles.	**02** **02**
	(d)	**Explain with neat sketch working of consent mesh gear box.**	**04**
		Answer: working 2 marks, sketch 2 marks) **Working of constant mesh gear box:** A simplified diagram of constant mesh gear box has been shown in Figure. In this	

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		gear box, all gears on the main transmission shaft are constantly connected to corresponding gears on countershaft or lay shaft. In addition, two dog clutches are provided on the main shaft. One dog clutch is between the third gear and clutch gear and another is between the first (Low) gear and second gear. Top or 4th speed gear is obtained when the left dog clutch is shifted to left to mesh with clutch gear by using the gear shift lever. In this case, main shaft rotates at the same speed as that of clutch gear or engine crankshaft speed which is the maximum speed. Third gear is obtained when dog cutch (left side) meshes with third gear on main shaft. In this way by sliding the second dog clutch, second and first gears are obtained. *(Note: Equivalent shall be given to any other suitable sketch and relevant description)*	**02** **02**
	(e)	**Compare hydraulic braking system and pneumatic braking system (any four point)**	**04**
		Answer: (1mark for each, any 4) **Difference between Hydraulic and Pneumatic Braking System:** table below	

Sr. No.	Hydraulic Braking System	Pneumatic Braking System
1	Braking Fluid used as a working medium	Compressed air is used as a working medium
2	Simple in construction & less expensive.	Complicated in construction and expensive.
3	Occupied less space as compared to Air brake	Occupied more space as compared to Hydraulic brake
4	System is self lubricating	Need to lubricate mechanical parts
5	Bleeding is necessary	No need of bleeding
6	Increased braking effort, but less powerful than air brakes.	Most powerful than Hydraulic brake
7	Low maintenance cost	Maintenance cost is more
8	Mostly used in passenger cars, LMVs	Mostly used in heavy vehicles like buses and trucks.

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3		**Attempt any <u>TWO</u>**	**12**
	a)	**State the need of differential. Explain with neat sketch construction and working of differential.**	**08**

Answer:
Need- 2marks, sketch- 2marks, construction 2 marks, working-2 marks
Need of differential:
1. When vehicle is taking turn outer wheel will have to travel greater distance as compared to inner wheel.
2. The vehicle has a solid rear axle only and no other device, there will be tendency to skid
3. Hence wheel skidding is avoided by incorporating so mechanism i.e. differential.
4. Differential reduces the speed of inner wheel and increases the speed of outer wheel when vehicle is taking turn, at the same time keep the speed of rear wheel same when going straight ahead.

    (02)

Construction: The arrangement differential gear is as shown in figure. The crown wheel is fixed to casing. The inner ends of the half shafts pass through the boss of the differential case in which they are rotate. Inside the differential case the shaft carry the bevel sun gear with which bevel pinion mesh. The bevel pinions are free to turn on the pin fixed in the differential case. The differential provides an equal drive to each half shaft, although they may be rotating at different speeds, therefore it allows the outer wheel to rotate faster than inner wheel.

    (02)

    (02)

Working:
1. When vehicle moves in a straight line:
The power comes from propeller shaft to the bevel pinion which drives the crown wheel. Then it is carried to the differential cage in which a set of planet pinions and sun gears are located. From the sun gear it is transmitted to the road wheels through axle half shafts. In this case, the crown wheel, differential cage, planet pinions and sun gears all turn as a single unit and there is no any relative motion between the sun gear and planet pinion. The planet pinions do not rotate about their own axis.
The road wheels, half shafts and sun wheels offer the same resistance to being turned and the differential gearing does not therefore operate. Both the road wheels turn at the same speed i.e. "N" rpm.

2. When Vehicle takes a turn:
When the vehicle is taking a turn assume that the cage is stationary then, turning one sun gear will cause the other to rotate "n" times in a particular time, the right sun gear wheel also rotate "n" times in the same period but in opposite direction. The rotation is super-imposed on the normal wheel speed when the vehicle is taking a

    (02)

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|			
		turn. While wheel speed "N" rpm going straight and when it takes a turn towards right at this time there will be a resistance to the motion to the right wheel and as a result of differential action the right wheel rotates back at "n" rpm then the left wheel rotate forward at "n" rpm. This gives the resultant speed of the left wheel as (N+n) and that of the right wheel as (N-n) rpm.	
	b)	**Explain the working of rack and pinion type steering gearbox with neat sketch also state its advantages**	**08**

Answer:
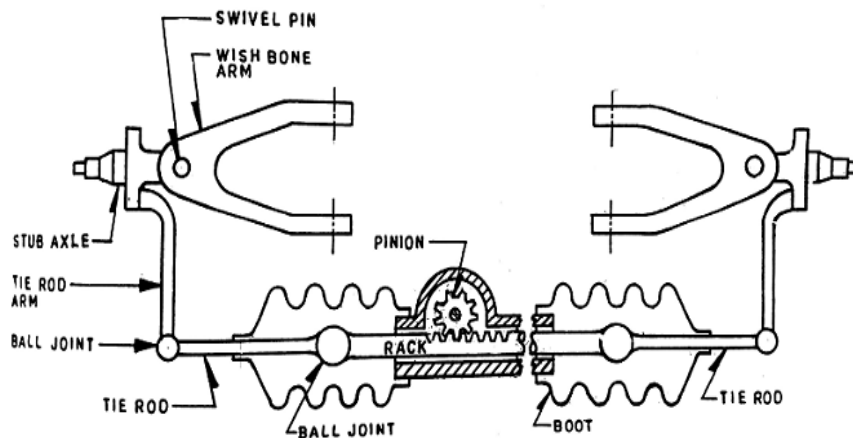
Figure: Rack and Pinion steering gear

Construction: In this type of steering gear box, a pinion is mounted at the end of the steering shaft. The pinion engages the with rack which is provided with ball joint at its each end in order to allow for the rise and fall of wheel. The rotary motion of the steering wheel is transmitted to the pinion. The circular motion of pinion is converted into the linear rack movement, which further transmitted to tie rods to the stub axle through ball joint.

This type of steering gear box provides sufficiently low gear reduction for car and it is quiet suitable even for heavier motor vehicle if assisted with power. It occupies very less space and less number of linkages.

Working: The rack-and-pinion steering box has a pinion, connected to the steering column. This pinion runs in mesh with a rack that is connected to the steering tie rods. Both the pinion and the rack teeth are helical gears. Helical gearing gives smoother and quieter operation for the driver.

Turning the steering wheel rotates the pinion, and moves the rack from side to side. Ball joints at the end of the rack locate the tie-rods and allow movement in the steering and suspension. Mechanical advantage is gained by the reduction ratio. The value of this ratio depends on the size of the pinion. A small pinion gives light steering, but it requires many turns of the steering wheel to travel from lock, to lock. A large pinion means the number of turns of the steering column is reduced, but the steering is heavier to turn.

Uses: All most all small cars like Maruti 800, Alto, Wagon R, Swift Dezire, i10 etc houses this type of steering gearbox.

(marks shown in right margin: 03, 03)

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		Advantages of rack and pinion type steering gearbox 1) Rack & pinion steering gear box is simple in construction 2) Economical & easy to manufacture. 3) It is easy to operate with accuracy. 4) Contact between steering rack & pinion is free from play 5) Internal damping is maintained. 6) Minimal steering elasticity, compact so mostly used in front engine Front wheel drive. 7) The idler arm & intermediate rod is not needed 8) Easy to limit steering rack travel and so steering angle	02
	(C)	**Describe Pneumatic braking system with neat sketch & state its advantages**	**08**
		Answer: (sketch – 03 marks, Description –03 marks, advantages – 2 marks ,) **Pneumatic braking system:-** Compressor takes air from the atmosphere to the filter and the compressed air is sent to the reservoir through the unloader valve , which gets lifted at a predetermined reservoir pressure (900KPa) & relieves the compressor of load. From the reservoir the air goes to various accessories & also to the brake chambers located at each wheel. The control of brake valve is with driver who can control the intensity of braking according to the requirements. When pressure drops to 700 KPa, the governor again cuts in the compressor to raise system pressure. When air system pressure falls to 400 KPa, a warning in the form of a buzzer is sounded. **Advantages: (any two, 1 mark for each)** (1) More powerful than mechanical or hydraulic brakes, are exclusively used in heavy vehicles. (2) Simplifies the chassis design. (3) Its location & working is easy & simple. (4) Available compressed air also used for tyre inflation, windscreen wipers, horns & many other accessories. Layout of Air Brake System	03 03 02

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4	(A)	**Attempt any THREE of the following:**	12
	(a)	**Differentiate between radial and cross ply tyres**	04
		Answer: (any four, 1 mark for each)	

Sr.No	Radial ply tyre	Cross ply tyre
1	Plies are running radially straight from bead to bead	Plies are running diagonally opposite from bead to bead
2	Stiffness of tyre is less	Stiffness of tyre is more
3	It gives ultimate comfort for speed more than 55 Km/hr.	Because of more stiffness tyre is less comfortable.
4	Steering is harder	Steering is easy
5	Tyre has firm grip with road	Tyre has lesser grip with road.
6	Radial ply tyre has more breaking grip	Cross ply tyre has less breaking grip
7	Parking of vehicle is difficult	Parking of vehicle is easy
8	It is costlier	It is cheaper than radial
9	Tread life is more	Tread life is less

	(b)	**State the function of helper spring and shackle in leaf spring.**	**04**

Answer:
Helper spring

    1) Helper spring is just like a semi elliptical spring but without eyes at the end
    Its end toches the bracket to take heavy load in addition to the main leaf spring
    2) Its function is to cushion the vehicle and passengers
    3) It store energy while travelling from road irregularities and road bumps and
       release energy to come back its original position
    4) Cost of implementation is lower and not complicated.
    5) It provides more rigidity to frame, avoiding distortion.

02

Functions of shackle in leaf spring
 1) A shackle is an integral component of the suspension system that attaches
   between the leaf spring and the vehicle frame. It allows for the leaf spring to
   accommodate the change in length of leaf spring during suspension articulation.
 2) The axle will rotate downwards at the shackle side, so pinion angle will be
   increased
 3) The shackle mount will provide increased leverage
 4) Suspension down travel will be increased, but up travel could be limited slightly.
 5) Shackle improves vehicle function by providing more room for larger wheels
   and tires as well as increased ground clearance for off road use.

02

	(c)	**Describe wire harness, state any four colour codes used in wiring system of automobiles?**	**04**

Answer: Describe wire harness 02 Marks, Any four colour codes 02 Marks

[1] In order to quickly identify and also to simplify the wiring system, the cables are colored. For quick identification, insulations of various wires in a circuit are assigned different colors. The seven color code system is the general one and

02

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involves brown, yellow, red, white, green, blue and black colors.

[2] In motor vehicle wiring system there are number of wires for different systems such as head lamp, fog, side indicator, horn etc. As the wires are more for each circuit, we have limited space for making of suitable arrangement of wiring.

[3] Thus following seven color code system mentioned below, used in an automobile

Colour codes: (any four, ½ marks for each)

S.N.	Colour	Circuit	Example with tracer
1.	Brown	Battery and generator circuit.	Starter switch to control box – brown with blue tracer.
2.	Yellow	Overdrive circuit.	Overdrive switch or column to overdrive relay - yellow with green tracer.
3.	White	Ignition circuit and all other requirements when ignition circuit is switched or without fuse protection.	Starter switch to solenoid switch - white with red tracer.
4.	Green and light green	Auxiliary circuits fed through ignition switch as well as protected by ignition auxiliary fuse.	Stop lamp switch to stop lamp - green with purple tracer.
5.	Purple	Circuits protected by fuse and normally not controlled by the ignition switch.	Horn push to horn - purple with black tracer.
6.	Blue	Head lamp circuit.	Lighting switch to head lamp - blue with white tracer.
7.	Red	Side and tail lamp circuit including fog lamp, panel lights etc.	Penal lamp switch to panel lamp - red with white tracer.
8.	Black	Earth (ground) circuits.	

02

(d)	**Explain Battery ignition system with neat sketch**	04

Answer: Battery ignition system for four cylinder engine

☐ When the ignition switch is in the ON Position, current flows from the battery to the primary winding of ignition coil.

☐ The current in the primary circuit goes on increasing exponentially during the period that the contact breaker points are connected.

☐ The laminated core of the ignition coil stores the electromagnetic energy generated on account of this current built up in the primary circuit.

☐ When the contact breaker points open, the electromagnetic field built up in the primary circuit collapses and the energy is projected in the secondary circuit.

☐ As the break period of contact breaker is very short, the EMF voltage induced in secondary circuit is very high and is proportional to the rate of change of flux in winding.

☐ This sudden high voltage generated is directed to specific spark plug as per the firing order with the help of distributor.

☐ The condenser stores energy during this break period of contact breaker and releases it during the make period, thereby avoiding acting at contact breaker point.

☐ The voltage multiplication is dependent on the number of turns of primary and
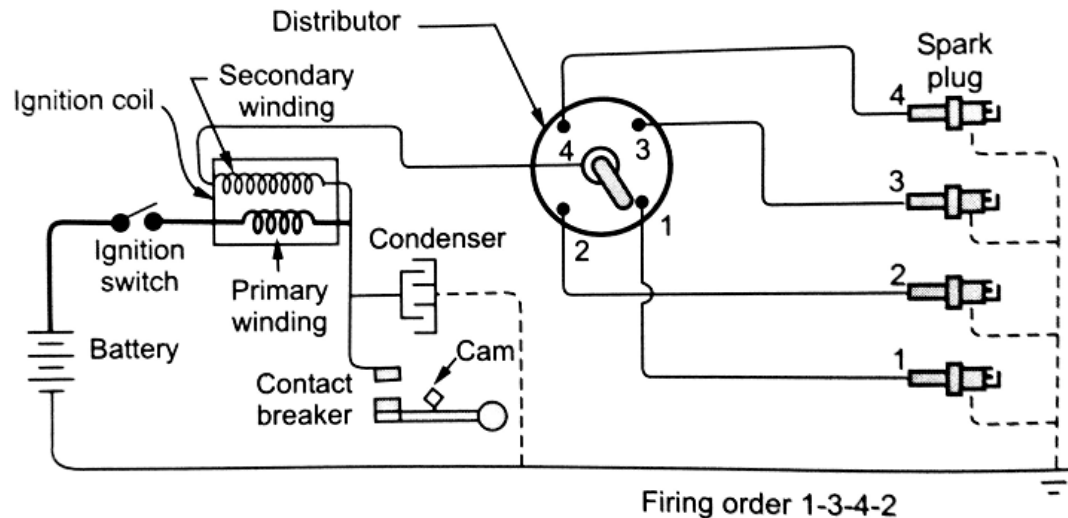
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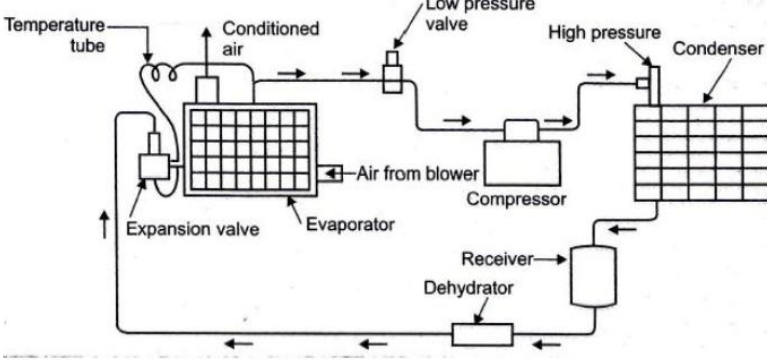|		secondary winding of ignition coil.	
		Figure: Battery ignition system for four cylinder engine. (Note:- battery ignition system for single cylinder may also be given full credit)	02
4	**B**	**Attempt any ONE of the following**	**06**
	(a)	**Draw a layout of air conditioning system of car & explain its working?**	**06**

		Answer:- (Layout- 4 marks, working 2 marks)
		Working of car air conditioning system.
		The layout of car air conditioning system is shown in figure.
		The main components of the system are compressor, condenser, receiver/dryer, Expansion valve and evaporator. In this system the heat is absorbed and transferred in the following steps
		   i. Refrigerant leaves the compressor as high pressure vapour.
		   ii. By removing heat via condenser, the vapour becomes low temperature liquid.
		  iii. Moisture and contaminants are removed by the receiver dryer, where the clean refrigerant is stored until it is needed
		  iv. The expansion valve controls the flow of refrigerant into the evaporator.
		   v. Heat is absorbed from the air inside the passenger compartment by the low pressure refrigerant, causing the liquid to vaporize and greatly decreased passenger compartment temperature.
		The refrigerant returns to the compressor as a low pressure, low temperature vapours and a cycle completed.
			03

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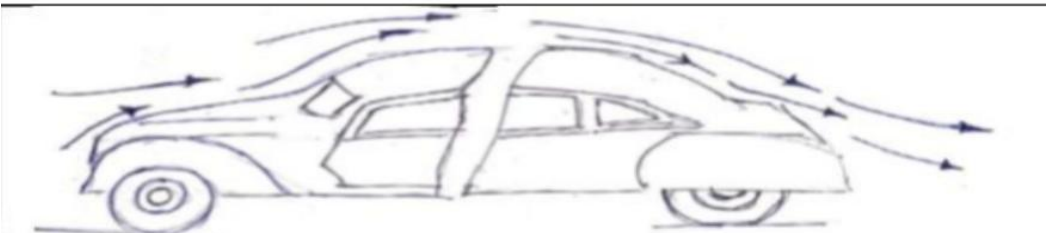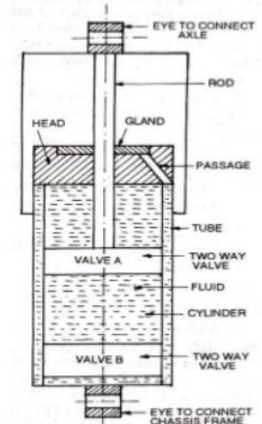
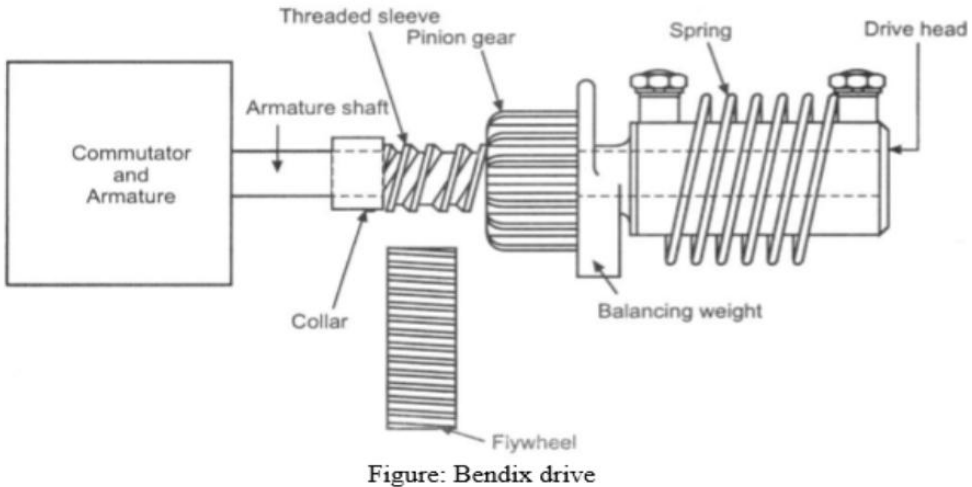|			
		 Fig. Car Air Conditioning	03
	(b)	**(i) State the important precautions to be taken while using air conditioning system of vehicle (Any Four)**	04

		Answer: 1 mark for each, any four
		Important precautions to be taken while using air conditioning system of vehicle:
		  i. Operate the air conditioner periodically or at least once a week to keep the internal parts lubricated as well as prevent the hoses from hardening.
		  ii. Do not switch ON the A.C. at high speeds which may result in the ceasing of compressor.
		  iii. Do not stick anything into the air outlet or the air inlet. As it dangerous and it can cause injury or damage.
		  iv. Avoid exposing a body directly to a continuous cool air flow for long periods- It is not good for health.
		  v. Avoid placing any obstacles near the inlet or outlet- if inlet or outlet is blocked it may causes damage to the unit.
		  vi. Do not run or stop the unit frequently. If run or stop the unit more than 4-5 times an hour, it may cause damage to the unit.
		  vii. The air filter should be cleared at least once every two weeks
		  viii. When the unit is cleaned, set the selector switch at off position
		  ix. Never operate A.C. with heater on.
		  x. Do not charge the refrigerant in the A.C. system before flushing.	

		(ii) Modern car uses R134 a refrigerant instead of R12. State reasons thereof	**02**
		Answer: (i) Refrigerant R134a is a hydro fluorocarbon (HFC) that has zero potential to cause the depletion of the ozone layer and very little greenhouse effect. (ii) R134a is the non-flammable and non-explosive, has toxicity within limits and good chemical stability. (iii) It has somewhat high affinity for the moisture. (iv) The overall physical and thermodynamic properties of refrigerant R134a closely resemble with that of refrigerant R12. (v) Due to all the above factors, R134a is considered to be an excellent replacement forR12 refrigerant	02

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Q5		Attempt any FOUR	16
	a)	**Explain the importance of aerodynamic shape of body.**	**04**
	Ans.	**Importance of aerodynamic body of car:** The body of vehicle is designed to protect the passenger as well as various components of the vehicle from the air. An aerodynamic shape of car body is the external shape of car body which will offer least resistance to air motion. Whenever car is moving there is an air resistance to motion of car. This air resistance depends on (i) Size of car (ii) frontal shape and area (iii) speed and (iv) wind velocity. This air resistance is given by $$Ra = Ca.A.V^2$$ Where, Ra - Air Resistance, Ca - coefficient of air resistance and V= Velocity of vehicle (speed) Now as frontal projected area of vehicle increases then vehicle air resistance increases & vice- versa. Figure shows the use of curved surfaces in modern vehicles instead of flat surfaces. Frontal area of car body is designed in such a way that front portion is made inclined & body is given smooth curves. This offers a least resistance to air and called as an aerodynamic shape. Thus, Aerodynamic shape of car body – 1. Reduces fuel consumption. 2. Air eddies are not formed behind the body. 3. Increases road traction. 4. Good on-road stability Figure: Streamlined car body	04
	b)	**Explain with neat sketch, working of telescopic shock absorber.**	**04**
	Ans.	**Working:** When the vehicle comes across a bump the lower eye moves up. Therefore the fluid passes from the lower side of the valve A to its upper side but since the volume of the space above valve A is less than the volume of the rod the fluid exerts pressure on the valve B. This pressure of the fluid through the valve opening provides the damping force. Similarly when the lower eye moves down the fluid passes from the upper side of the valve A to the lower side and also from the lower side of the valve B to its upper side. **(Note: Equivalent credit shall be given to any other suitable sketch if drawn)**	02 02

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	c)	**Explain with neat sketch, Bendix drive used in starting system.**	**04**
	Ans.	**Bendix drive used in starting system:** **(2 Marks for diagram, 2 Marks for Working)** Figure: Bendix drive	02
		(Note: Equivalent credit shall be given to any other suitable sketch if drawn) Bendix drive is an inertia based drive in which the pinion on the starter motor armature engages and disengages with the flywheel depending on the inertia of motor and flywheel. When the ignition switch is turned 'ON', the starter motor armature starts spinning. This causes the sleeve to rotate while the pinion is stationary due to the unbalanced weight. The pinion hence moves axially towards the collar until it engages with the flywheel ring gear. Since the pinion cannot move further axially, its starts to rotate along with the sleeve thereby also rotating the flywheel. When the flywheel starts rotating at above 100 rpm the engine gets starts. After the engine has started the pinion gear is turned by the engine much faster than rotated by starting motor. This causes, the pinion gear to turn back on the threaded sleeve, making it disengaged with the flywheel.	02
	d)	**State the necessity of wheel alignment and wheel balancing.**	**04**

	Ans.	The necessity of wheel alignment (Any two)
		    1) To eliminate tyre wear
		    2) To give vehicle proper handling
		    3) To eliminate pull, drift, wander, stiff steering and poor steering return ability
		    4) To improve driving stability
		    5) To improve riding characteristics
			02

		The necessity of wheel balancing (Any two)
		    1) Wheel imbalance causes wheel tramp, wheel hop, makes the tier vibrate up and down
		    2) Centrifugal forces try to throw heavy areas outward when the wheel is spinning
		    3) Weight must be evenly distributed around the axis of rotation
		    4) Wheel balancing is necessary to balance the wheel and distribute the weight of wheel evenly.
			02

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	e)	**Name any four major components of automobile and state their function.**	**04**
	Ans.	Any four major components of automobile and their function 1. The basic structure: It consist of the frame, the suspension system, axles, wheels and tyres. Function: To support the weight of body and passenger, to cushion the shocks due to road irregularities. 2. The engine: Function: It provides the motive power for all various functions which the vehicle or any part of it, may be required to perform. 3. The Transmission system: It consist of a clutch, a gearbox, a propeller shaft and differential. Function: To engaged or disengaged the power from engine to transmission system, to transmit the torque and to distribute the final torque equally between the driving wheels. 4. The auxiliaries: It consist of electrical systems. Function: To provide spark for ignition of charge, to start the engine by providing initial motive force, to provide electrical energy for lighting system. 5. The controls: It consist of steering system and brakes Function: to control direction of moving vehicle, to steer the vehicle according to drivers will. 6. The body: Function: To provide space for passenger and luggage.	04
Q6		**Attempt any TWO**	**16**
	a)	**Describe construction of MacPherson suspension system. State the advantages.**	**08**
	Ans.	Mc-pherson strut type independent suspension: In this type, only lower wishbones are used as shown in fig. A strut containing shock absorber and the spring carries also the stub axle on which the wheel is mounted. The wishbone is hinged to the cross member and positions the wheel as well as resists accelerating, braking and side forces. This system is simple, lighter and keeping the unsprung weight lower. Further the camber also does not change when the wheels move up and down. This type of suspension provides the maximum area in the engine compartment and is, therefore, commonly used on front wheel drive cars. **Figure: Mc-pherson strut type independent suspension** **(Note: Equivalent credit shall be given to any other suitable sketch if drawn)**	03 03

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		The advantages of MacPherson suspension system (Any two) 1) System is light in weight, which reduces up-sprung weight. 2) Camber does not change when wheel moves up and down. 3) It provides maximum space for engine.	02
	b)	**Describe with neat sketch construction and working of lead acid battery.**	**08**
	Ans.	Battery Construction: Battery consists of – Container, Positive and negative plates, Separators, Cell cover, Electrolyte, Grids, Cell connectors, Taper terminals, sealing compounds etc. Positive and negative plates are arranged alternately and separated by separators. Negative plates are surrounded by spongy lead paste and positive plates are surrounded by lead peroxide. The entire container of battery is filled with an electrolyte. All positive plates are connected to positive terminal and all negative plates are connected to negative terminal.	. 02
		Working: In the charged state, each cell contains a lead peroxide (PbO2) on positive plate and spongy Lead (Pb) on negative plate. The chemical changes that takes place during discharging and charging processes are shown by the equation	02

$$PbO_2 + 2H_2SO_4 + Pb \rightleftharpoons PbSo_4 + 2H_2O + PbSO_4$$

| (Positive Plate) | (Electrolyte) | (Negative plate) | | (Positive Plate) | (Electrolyte) | (Negative plate) |

On discharging both PbO2 and Pb are converted to Lead Sulphate (PbSO4) and the electrolyte losses its dissolved Sulphuric acid and becomes primarily water. During recharging the electrodes are convertedback to lead peroxide on positive plate and spongy lead on negative plate. The chemical activity inside the battery depends on the temperature of electrolyte. At higher temperatures, the activities are faster while at lower temperature are slower.

Figure: Cut section of Lead acid battery

(Note: Equivalent credit shall be given to any other suitable sketch if drawn)

04

| | c) | **Explain construction and working of alternator with neat sketch.** | **08** |

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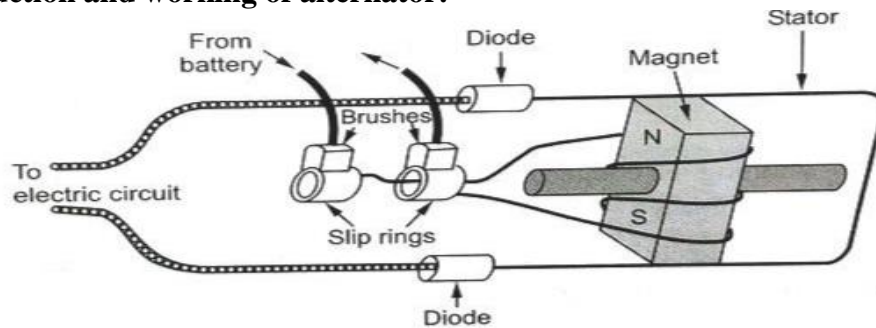|		
Ans.	**Construction and working of alternator:**	04

Figure: Alternator

(Note: Equivalent credit shall be given to any other suitable sketch if drawn) — 02

Construction: It consists of fan, rectifier, diode, spacer, stator, drive and housing, slip rings, rotors, drive and bearing, regulator, pulley etc. The operation of alternator is improved by placing the stator and rotor assembly inside the iron frame of housing which provide a conducting path for the magnetic line of force. Voltage increase by increasing stator winding in to number of coil. Alternators consist of rotor assembly, stator assembly and rectifier mounted in housing. Housing near of two piece of die cast aluminium which is light and weight. Stator is clamp in housing. — 02

Working: It consists of an electromagnetic rotor which is energized form the current of the battery through brush and slip ring assembly. Rotor is rotated by belt and pulley arrangement get power form engine stator winding is wound around the rotor. The rectifier circuit consisting of diodes is connected to the stator winding. Diodes are electronic device that allows current to flow only in one direction. When the electromagnetic rotor is turned its magnetic lines of force cut the stationary stator loop. This induces a current in the stator winding. Through the electromagnetic rotor reverses its polarity the alternating current produces in the stator winding is converted to direct current by the diodes.