SUMMER – 2015 EXAMINATION

MODEL ANSWER

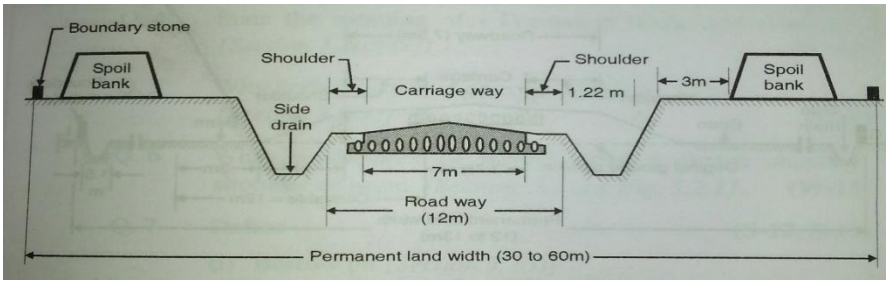
Important Instructions to examiners:

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 the candidate and those in the 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 the model answer.
6) In case of some questions credit may be given by judgment 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.

Model Answer

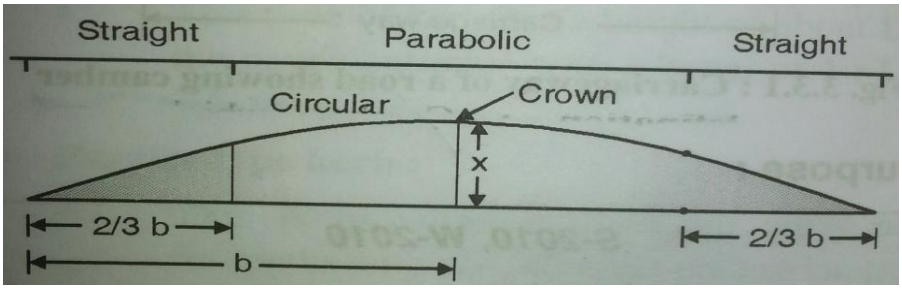
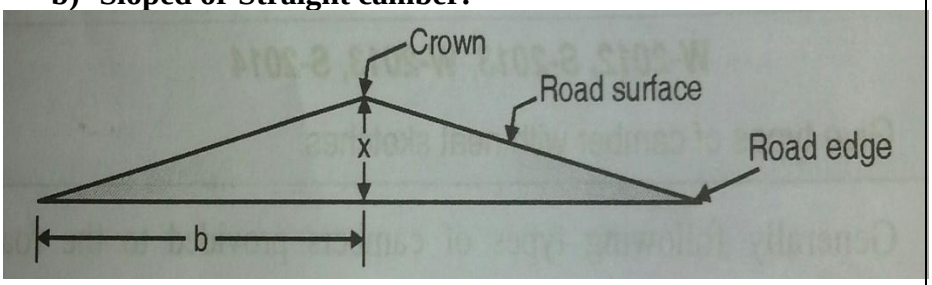
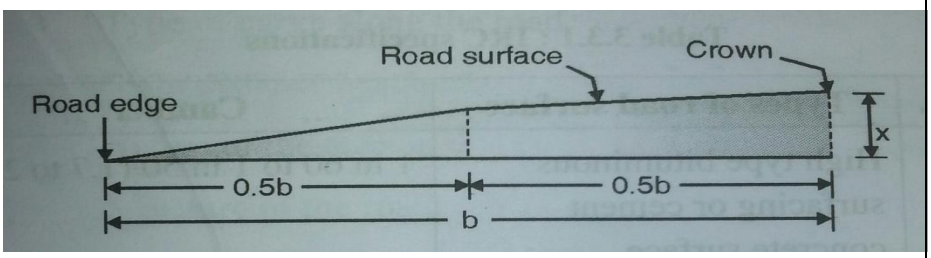
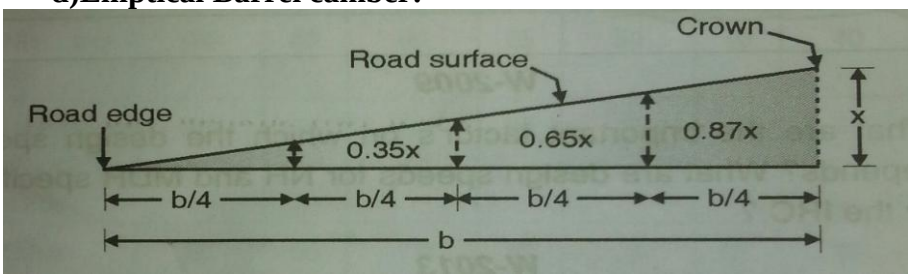
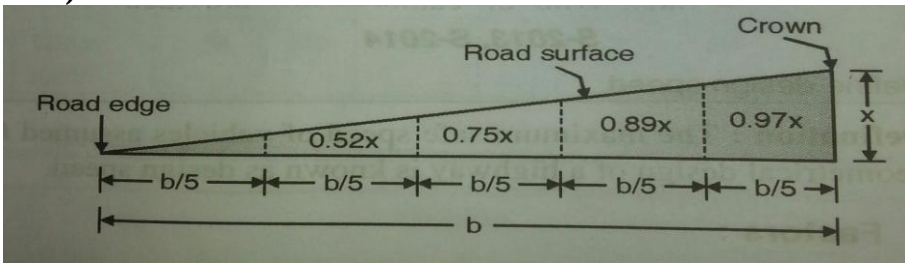
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a) i)**	**State four characteristics of road transport.**		
	Ans.	1. It helps in development of natural resources of the area. 2. It helps in development of agriculture of the area. 3. The improvement of highway system of a region increases the land value. 4. It helps in development of the commerce of the area. 5. It helps in better fire and police protections. 6. It helps in medical and education facilities. 7. It serves as feeders for airways, waterways and railways. 8. Easy and quick transportation of men, machines, animals, materials and goods can be made. 9. Remote areas and rural areas become accessible and communicable.	***1 mark each (any four)***	**4**
	ii)	**State classification of urban roads.**		
	Ans:	Urban roads are classified as follows: a) **Arterial roads:** The streets primarily for through traffic on a continuous route, but with high level of traffic mobility are known as arterial roads.		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		b) **Sub-arterial roads:** The streets primarily for through traffic on a continuous route but have a lower level of traffic mobility than the arterials are known as sub-arterial roads. c) **Collector streets:** The streets which provide access to arterial streets and they collect and distribute traffic from and to local streets is known as collector streets. d) **Local streets:** The streets which provides access to abutting streets are known as local streets.	***1 mark each***	**4**
	iii)	**State four purposes of reconnaissance survey.**		
	Ans.	a) To collect the details of obstruction along the route which are not available in the map. b) To collect geological features of field. c) To collect information regarding the availability of local construction material, water and labour. d) To determine the approximate values of gradient, length of gradients and radius of curves of alternate alignments. e) To locate the obligatory points along the alternative routes. f) To determine approximate estimate of the total cost of construction of the road along each route. g) To determine two or three best possible routes.	***1 mark each (any four)***	**4**
	iv)	**Define road alignment. Write four factors affecting it.**	**2**	
	Ans.	**Definition:** The position occupied by center line of a road in plan is called road alignment. **Factors affecting alignment of roads:** 1. Need of traffic 2. Purpose and class of road 3. Obligatory points 4. Curve 5. Gradient 6. Sight distance 7. Number of CD works 8. Obstruction 9. Earthwork 10. Availability of labour and material	***1/2 mark each (any four)***	**4**
	v)	**Define design speed. Write four factors affecting it.**		
	Ans.	**Definition:** The maximum safe speed of vehicles assumed for geometrical design of a highway is known as design speed.	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		Factors affecting design speed: 1. Class and condition of road surface. 2. Nature, intensity and type of traffic. 3. Type of curve along the road. 4. Sight distance required. 5. Nature of terrain. 6. Structure of the road.	***1/2 mark each (any four)***	**4**
Q.1	**b) i)**	**Calculate the stopping sight distance for two way traffic in a single lane road. The design speed of the road is 60 kmph. Assume reaction time of the driver as 2.5 seconds and coefficient of friction as 0.6.**		
	Ans.	**Given:** Design speed = 60 kmph Total reaction time = 2.5 seconds Coefficient of friction = 0.6	**2**	
		Length of SSD = $\frac{V^2}{254\ f}$ + 0.278 Vt	**1**	
		= $\frac{(60)^2}{254 \times 0.6}$ + 0.278 x 60 x 2.5	**1**	
		= **65.32 m**	**1**	
		In case of two way traffic in a single lane road, length of SSD = 65.32 x 2	**1**	**6**
		= **130.64 m.**		
	ii)	**Draw a neat cross section of state highway in cutting and show all components.**		
	Ans.	 **(*Note: For neat sketch = 2 marks, labeling =2 marks, and dimensions =2 marks)**		**6**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**a)**	**List out the various drawings prepared for a highway project and explain the importance of any one drawing in brief.**		
	Ans:	**The various drawings prepared for a highway project are as follows:** 1. Key map 2. Index map 3. Preliminary survey plan 4. Detail location survey plan and longitudinal section 5. Detail cross section of road 6. Land acquisition plans 7. Drawings of cross drainage and masonry structures	***1/2 mark each (any four)***	
		1) **Key map:** The map which shows the proposed road, existing roads and important places to be connected is known as key map. The size of map generally should exceed 240 x 330mm (A4). The size of this map is chosen depending on the area to be covered. 2) **Index map:** The locality map also called key map drawn to a scale 1:250,000. It shows the location of the road with respect to important towns, industrial centers, etc. In short it provides bird eye view of the project. 3) **Preliminary survey plan:** These plans show the details of the various alternate alignments and other information collected during preliminary survey. The size of these plans varies from 240x330mm to 880x1230mm and their scale may also be varied from 10cm=1km to 20cm=1km. 4) **Detail location survey plan and longitudinal section:** The plan should be drawn at the top and longitudinal section at the bottom. The general scale for horizontal length is 1:2500 and for vertical distances 1:250 naturally for hilly stretches this scale could be changed. 5) **Detail cross section of road:** The cross section should be drawn serially along the continuous chainage. This cross section should show existing road level/ground level, and the proposed road level, area of cut and fill involved and type and thickness of different pavement courses.		

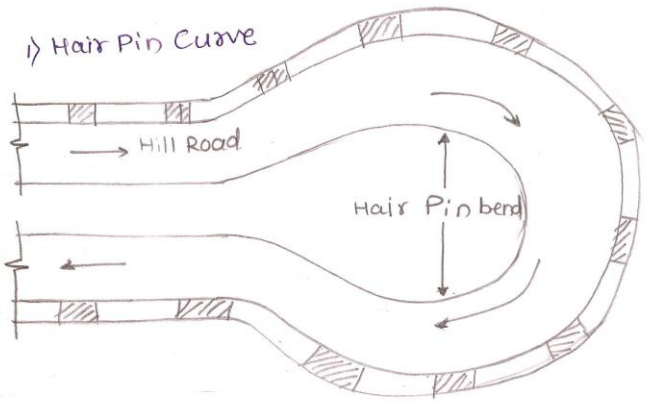
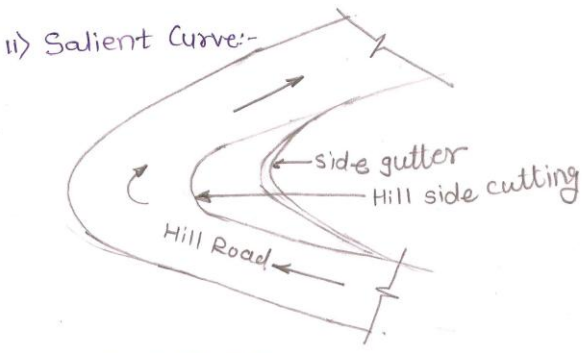
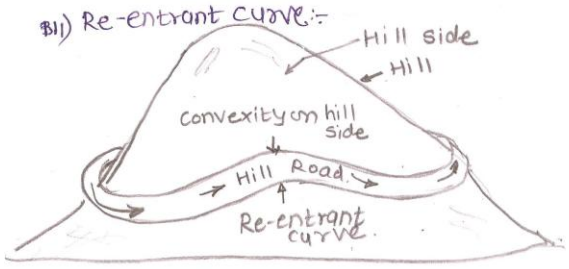
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		6) **Land acquisition plans:** These maps are required for land acquisition proceedings. Generally they are prepared on existing village maps, or settlement maps giving the details of property and their survey number so that the land acquisition proceedings could be smooth. 7) **Drawings of cross drainage and masonry structures:** A separate drawing is given when there is typical and different design for the cross drainage structure. For small cross drainage work, standard designs are adopted.	***2 mark each (any one)***	**4**
Q.2	**b)**	**What is cross drainage work? Write necessity of cross drainage work.**		
	Ans:	**Cross drainage work:** An efficient drainage system for disposing off the surface water collected in side drains or that of the natural streams across a road or railway track or across a hill road is called cross drainage.	**1**	
		Necessity of CD work: 1. Helps to maintain the continuity of a road or a railway track while going across the river, streams, nala, depressions and valleys. 2. Maintain the gradient in undulating area in case of railway. 3. Provides continuous access to the surrounding villages and towns even at the time of flood and heavy rain. 4. Maintains continuous communications.	***1 mark each (any three)***	**4**
	c)	**State any four factors on which super elevation depends.**		
	Ans:	1. **Road width:** If width of road increases super elevation decreases and vice versa. 2. **Radius of curve:** If radius of curve increases super elevation decreases and vice versa. 3. **Design speed:** For higher design speed higher degree of super elevation is required. 4. **Friction between road surface and tyres:** If friction between road surface and tyres increases super elevation decreases.	***1 mark each (any four)***	

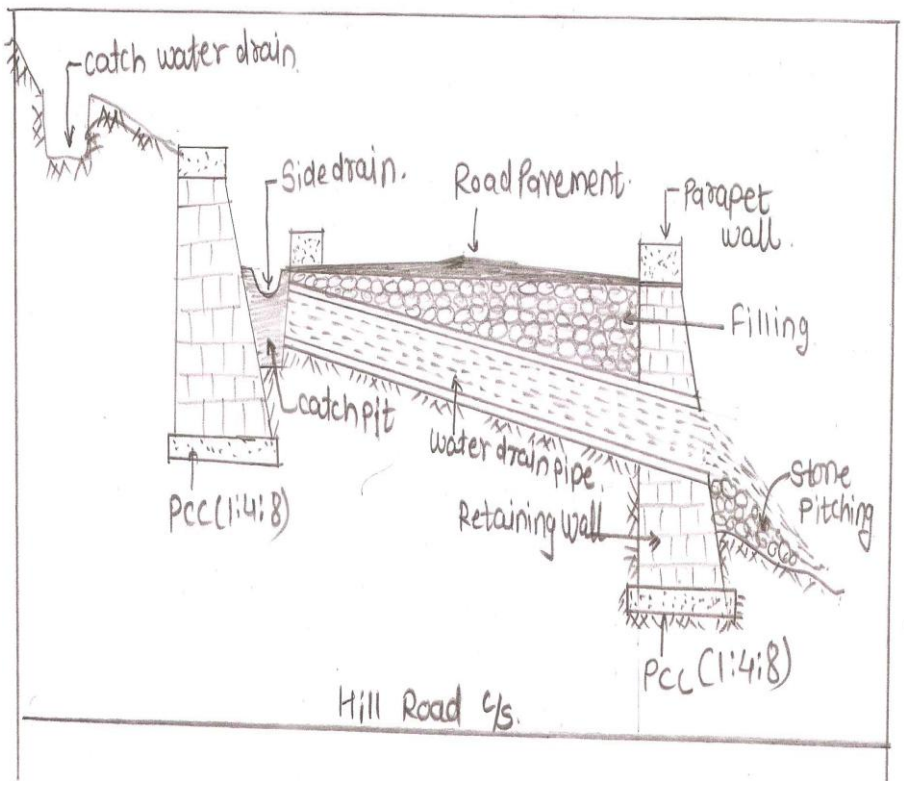
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		5. **Type of traffic:** Depending upon type of traffic i.e. regular or mixed the super elevation changes.		**4**
Q.2	**d)**	**Give types of camber with neat sketches.**		
	Ans:	**a) Composite camber:** 	***1 marks each (any four)***	
		b) Sloped or Straight camber: 		
		c) Two straight line camber: 		
		d)Elliptical Barrel camber: 		
		e)Parabolic Barrel camber: 		**4**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.2</td><td>e)

Ans:</td><td>State different types of Tar used in construction of road with its suitability.

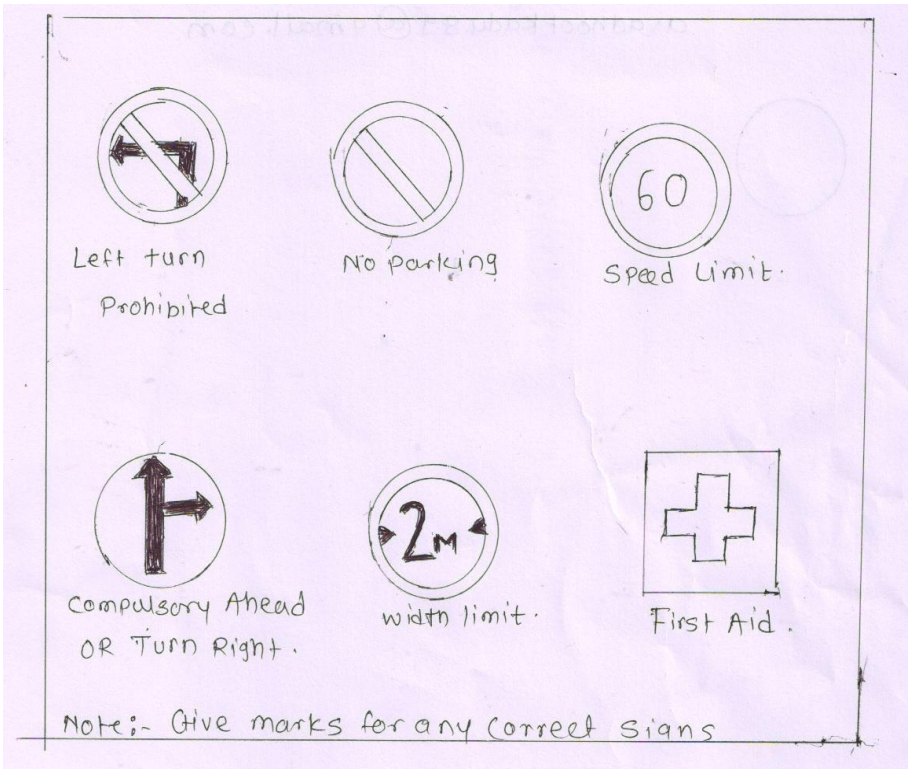
<table>
<tr><th>Sr . No.</th><th>Grade</th><th>Suitability</th></tr>
<tr><td>1</td><td>RT1</td><td>It is recommended for painting road pavements under exceptionally cold weather.</td></tr>
<tr><td>2</td><td>RT2</td><td>It is recommended for painting road pavements under normal conditions.</td></tr>
<tr><td>3</td><td>RT3</td><td>It is recommended for surface painting and renewal coats, premixed top course and light carpets.</td></tr>
<tr><td>4</td><td>RT4</td><td>It is recommended for premixed macadam in base course.</td></tr>
<tr><td>5</td><td>RT5</td><td>It is recommended for grouted macadam.</td></tr>
</table></td><td>1 mark each (any four)</td><td>4</td></tr>
<tr><td></td><td>f)
Ans:</td><td>State and explain functions of pavement components.
1) Wearing surface:
a) To resist wear and tear
b) To provide adequate foot hold and avoid slipping or skidding of vehicles.
2) Base: This layer distribute the concentrated loads from the upper layer to the lower layers and withstand high shearing stress.
3) Sub-base: This layer supports wearing surface and base.
4) Sub-grade: Sub-grade is the last layer forming the foundation for the road pavement.</td><td>1 mark each</td><td>4</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q. 3	**c)**	**What are various types of curves provided on hill road? Draw neat sketch of any one of them.**		
	Ans:-	Following are three types of curves provided in hill roads:-		
		i) Hair pin curves- The curve which terns in 180^0 is called Hair pin curves	***½ mark each***	
		ii) Salient curves- The curves having their convexity on the outer edge of hill road is called Salient curves		
		iii) Re-entrant curves- The curves having their convexity on the inner edge of hill road is called Salient curves		
		Hill road curves:-		
			***2 mark diagram***	
			***½ mark labeling***	
			***(any one diagram)***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q. 3	**a)**	**Calculate the design speed of a vehicle on a horizontal curve having radius of 100m with permissible super elevation of 7%. Consider coefficient of friction 0.18**.		
	Ans:-	Given Data, Radius (r) = 100m Super elevation (e) = 7% Coefficient of friction(f) = 0.18 Design speed(v) = ? We know that $e + f = V^2/127R$ $0.07 + 0.18 = V^2 / (127 \times 100)$ So, V = 56.43kmph.	**2** **1** **1**	**4**
	b)	**Draw the cross section of a typical hill road and label any four component parts.**		
	Ans:-		***3 marks for diagram*** ***1 marks for labelling***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
	d)	**State the requirements of good quality material which plays the major role in highway construction.**		
	Ans:-	The following materials are used for highway construction:-		
		1) Soil:		
		i) It should provide good stability	**1**	
		ii) It should be good in compressibility		
		iii) It should provide good drainability.		
		2) Aggregates:-		
		i)It should have proper grain size as per requirement	**1**	
		ii)It should provide significant crushing strength		
		iii) It should provide strength against abrasion and impact.		
		3) Bitumen:		
		i) It should have high softening point.		
		ii) It should have sufficient penetration resistance.	**1**	
		iii) It should have high ductility value.		
		4) Cement:-		
		i) It should have high compressive strength.		
		ii) It should possess good binding properties.		
		iii) It should have minimum soundness.	**1**	**4**
		(Note- Any two requirements each)		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q. 3	e)	**What is pavement? State requirements of good pavements.**		
	Ans:-	**Pavement:** It is a structure having several layers which are bound together with the help of binding material. These layers are placed one by one on the soil sub grade to provide surface for vehicle.	**1**	
		Requirements of good pavement:- i) It should be easy in construction ii) It should be strong and durable iii) It should be smooth iv) It should provide visibility at night v) It should be suitable for all types of traffic vi) It should have low maintenance cost vii) It should have long life viii) It should provide safe and comfortable riding.	***½ mark for each (any six)***	**4**
Q.4	**a) i)**	**Define:-** **1) Borrow pit** **2) Lead & lift**		
	Ans:-	**1) Borrow pit:-** Earthen roads are generally constructed by utilizing locally available materials. These materials are obtained by digging pits along one side or both sides of road alignment (which are parallel to the road alignment). These pits are known as borrow pits.	***2***	
		2) Lead and lift:- **Lead**- It is the horizontal distance through which the material is conveyed to disposed off, for which contractor need not to pay extra payment	***1***	
		Lift:- It is the vertical distance through which materials are raised after excavation, for which contractor need not to pay extra payment	***1***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**ii)**	**Define PCU and Traffic Density.**		
	Ans-	**PCU:- Passenger Car Unit**		
		Practically, the passenger car is considered as standard vehicle to convert the other vehicle classes is known as "Passenger Car Unit".	**2**	
		Traffic Density:-		
		It is the number of vehicles occupying a unit length of a road way at a given instant, usually expressed as vehicles per kilometer.	**2**	**4**
	iii)	**Define traffic sign. Draw six types of traffic signs.**		
		Traffic sign: It is a standard device which indicates the information or gives guidelines to the road users for providing safety, to control and to guide the traffic.	**1**	
		Types of Traffic signs		
			***½ marks each***	
		(Note- Give marks for signs drawn out of 3 types of traffic signs. Above signs are just given for illustration)	***(any six)***	**4**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.4</td><td>iv)

Ans.</td><td>Differentiate between surface and sub surface drainage.

<table>
<tr><th>Surface drainage</th><th>Sub surface drainage</th></tr>
<tr><td>1) The type of drainage in which surface water is collected and disposed off is known as surface drainage

2)It is useful to carry rainwater away from carriage way

3)Catch water drain and side drains are required to construct surface drainage

4) It is applicable in heavy rainfall areas.

5) It helps to surface in dry condition by avoiding rainwater entry.</td><td>1) The type of drainage in which sub-surface water is collected and disposed off is known as surface drainage
2) It is useful to carry groundwater away from subgrade soil.
3) Longitudinal and cross water drains are required to construct sub-surface drainage.

4) It is feasible in water-logging areas
5) It helps to keep pavement layers in dry condition by avoiding rise of ground water table.</td></tr>
</table></td><td>1mark each (any four)</td><td>4</td></tr>
<tr><td></td><td>b) i)

Ans.</td><td>What is soil stabilized road? Explain one method of soil stabilization.

Soil stabilized road : The soil stabilized roads can be constructed by adding different admixtures like aggregate, cement, lime fly ash, bitumen etc. These admixtures binds and holds soil particles together.

1.Mechanical soil stabilization:-

i. Excavation of subgrade soil should be done by JCB.

ii. Pulverization should be done to form fine particles.

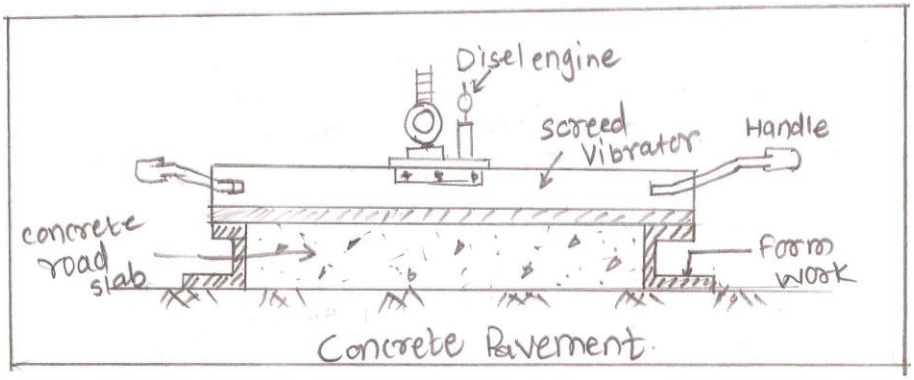
iii. A specific size of aggregate as per IRC are added in soil to improve soil particles.

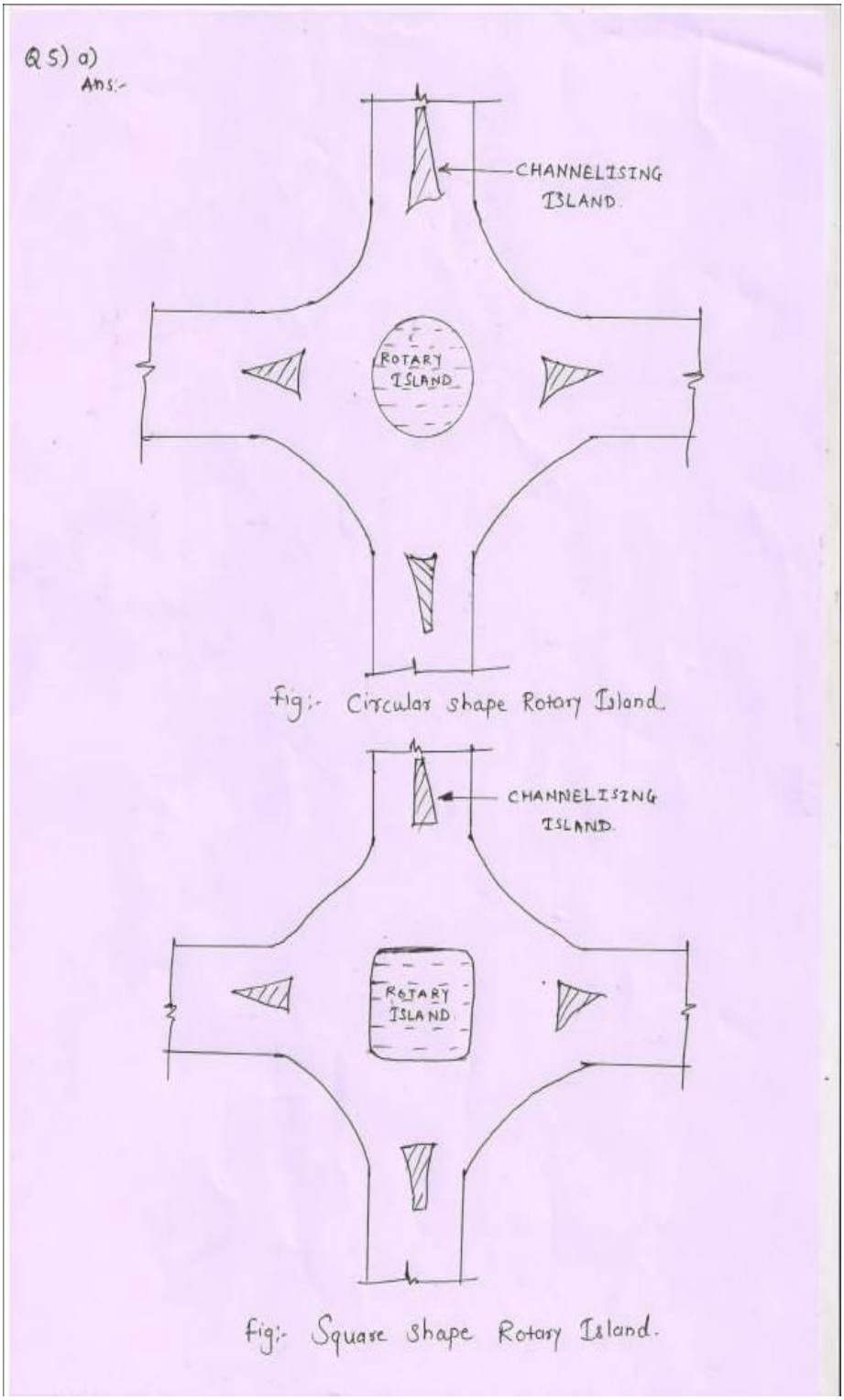
iv. Then suitable compaction should be done using heavy compaction roller followed by curing.

v. After alternate curing and compaction for minimum 7 days, The road is said to be stabilized

(Note- Any other relevant method could be considered)</td><td>2

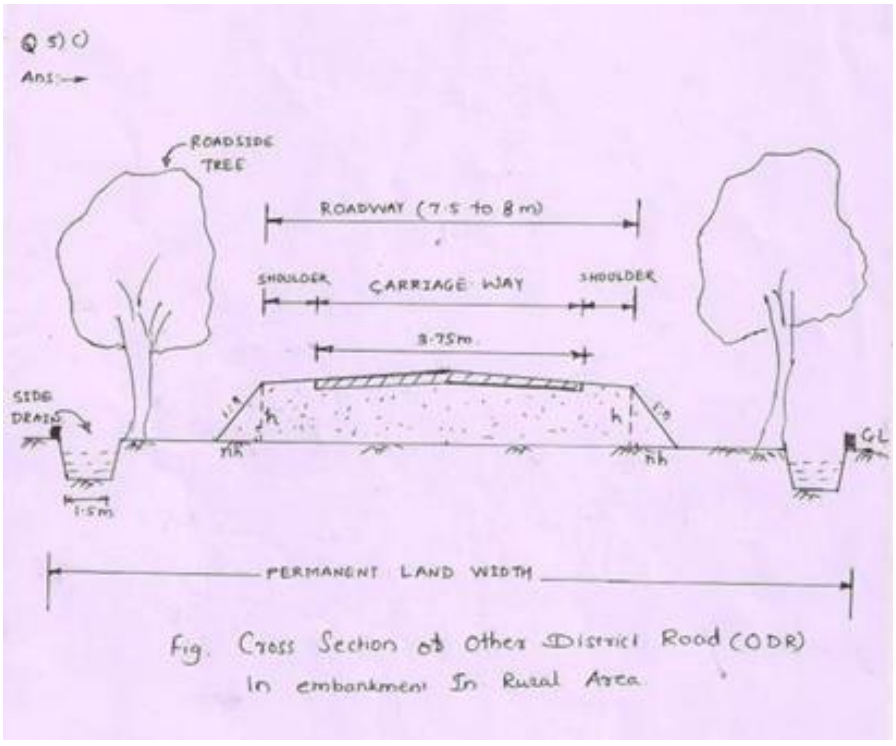
4</td><td>6</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
	ii)	**Describe the procedure of construction of cement concrete pavement showing its components.**		
	Ans:-	i) The subgrade soil should be compacted first by rollers, ii) The fine aggregate (sand) should be spread evenly on prepared subgrade to increase B.C. Of subgrade. iii) Fixing of formwork is done to exact width and grade. Adjacent channel must be joined iv) Batching of materials and mixing is done in a proper manner v) placing of concrete by RMC vehicles. vi) Compaction is done for achieving maximum strength vii) Floating is done from edge to the crown of the road viii) Brooming is done to ensure an adequate foot hold. ix) Edging is done to strengthened the edges of roads x) Curing is done by ponding method for proper hardening of the surface. xi) Filling of joints and edging is done.	**4**	
		Diagram:  Concrete Pavement.	**2**	**6**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**a)** **Ans**:-	**Draw labeled sketch of circular shape and square shape rotary island.**  	***1 mark diagram*** ***1 mark labeling*** ***1 mark diagram*** ***1 mark labeling***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**	**State the difference between alignment of hill roads and alignment of plain roads.**		
	Ans:-			

Alignment of hill roads	Alignment of plain roads
1) Sharp curves are to be provided.	1) Sharp curves are not to be provided.
2) The minimum radii of such sharp curve should be required to take into consideration while fixing alignment of hill roads.	2) As curves are not to be provided, radii of curve should not require to be taken into account.
3) Cost per kilometer length is much higher in case of hill roads.	3) Cost per kilometer length is less in case of plain roads as compared to hill roads.
4) Proper care is required to be taken for drainage.	4) In case of plain roads drainage does no causes that much problem.
5) Stability is very important factor in case of hill roads due to problem of land slide.	5) Stability is not that much important in case of plain roads as there is no land slide.
6) Curves and bends are not easy for all types of vehicle to negotiate the route.	6) In spite of curves and bends the gradient should be easy for all types of vehicle.
7) Not economical as compared to plain roads.	7) Economical as compared to hill roads.

			1 mark each (any four)	**4**
	c)	**Draw a neat cross section of other district road in embankment in Rural area.**		
	Ans:-	 Fig. Cross Section of Other District Road (ODR) In embankment In Rural Area	***2 mark diagram*** ***1 mark labeling*** ***1 mark dimension***	**4**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.5</td><td>d)

Ans:-</td><td>Prepare the schedule of maintenance operation required for bituminous concrete road in the period from October to march in Maharashtra.
The schedule of maintenance operation shows the months along with maintenance operations which includes the following points:

<table>
<tr><th>Sr. No.</th><th>Months</th><th>Maintenance operations</th></tr>
<tr><td rowspan="9">1</td><td rowspan="9">October to March</td><td>a) Pot hole repairs</td></tr>
<tr><td>b) Renewal of coats that is surface treatment, resurfacing, sealing etc.</td></tr>
<tr><td>c) Repairs of damages caused by rains.</td></tr>
<tr><td>d) Repair of scour in culverts and bridges, also clearing of silt etc.</td></tr>
<tr><td>e) Attending kilometer stones, Road signs, Direction boards etc.</td></tr>
<tr><td>f) Maintenance of side drains.</td></tr>
<tr><td>g) Renewal and improvement works.</td></tr>
<tr><td>h)Repairs and inspection of bungalows and gang hunt</td></tr>
<tr><td>i)Renewal and improvement works</td></tr>
</table>

State the use of following equipment during construction of highway.
i.JCB ii. Grader iii. Plain Roller iv. Bulldozer

i) JCB
1. To excavate the earthwork for construction of foundations.
2. To collect and dispose of excavated material.

ii) Grader
1.To construct earth road quickly.
2.To give proper shape to the road subgrade.
3.To spread the loose soil materials evenly.

iii).Plain roller
1. For compaction of earth.
2 For compacting bituminous layers in roads.
3.For compacting thick layers of road in W.B.M. road construction.

iv) Bulldozer
1. For clearance of shrubs and small trees.
2. Backfilling of trenches and spreading of earth fill.

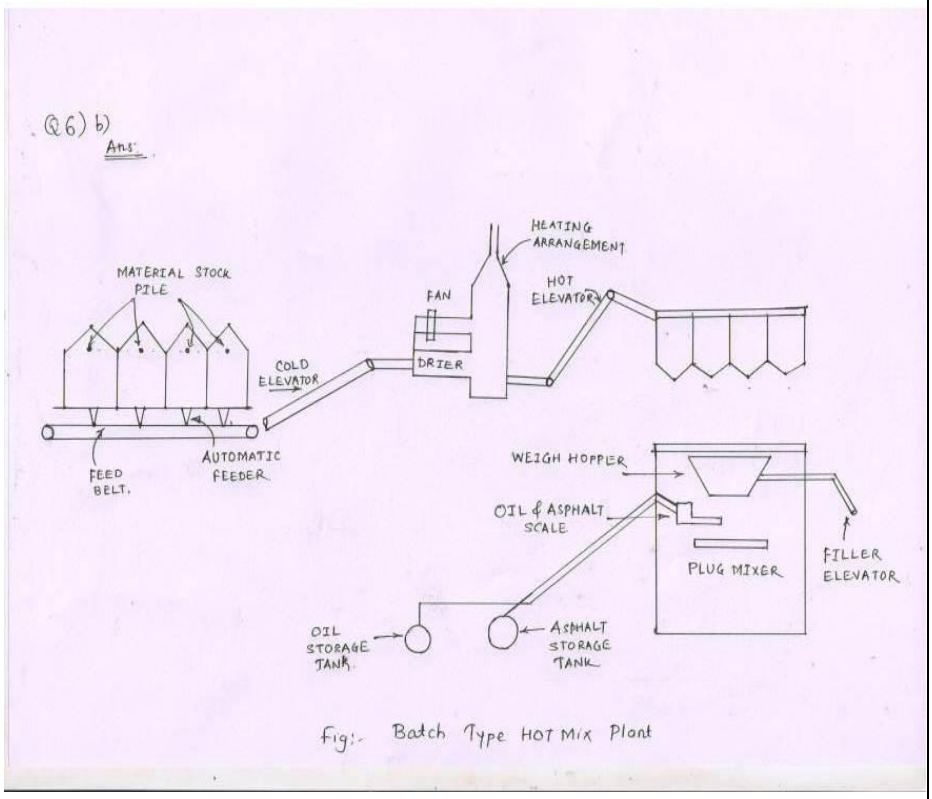
(Note: Minimum two uses each)</td><td>½ mark each

(any eight)

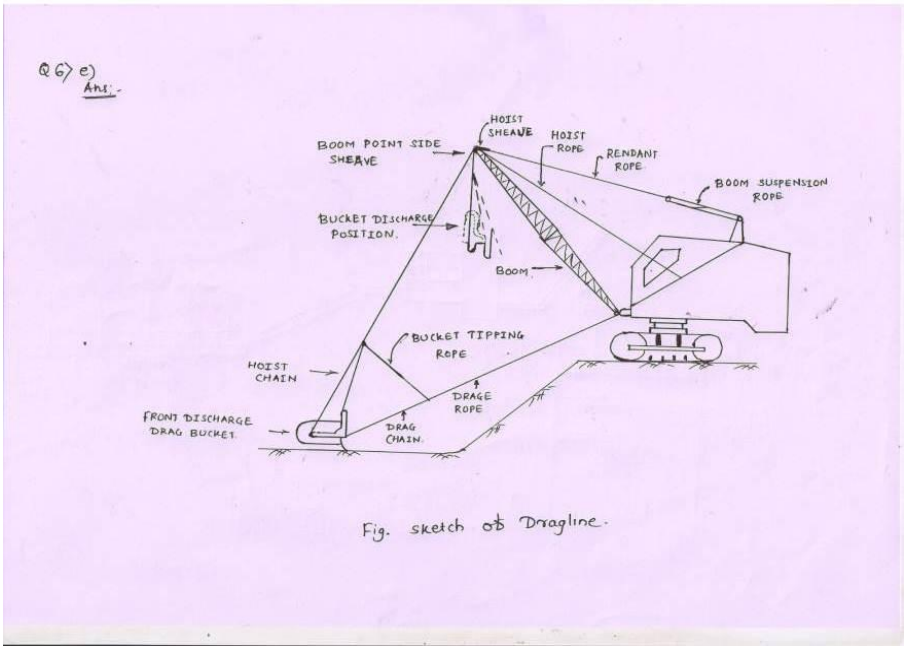
1 mark each equip ment</td><td>4

4</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**f)**	**Write the components parts of a hot mixed bitumen plant and their specific use for construction of highway.**		
	Ans:-	Following are the component parts of hot mixed bitumen plant 1. Cold bins 2. Dryer 3. Dust collector 4. Mixing unit 5. Storage tank 6. Screening unit 7. Cold feed gates 8. Cold elevator 9. Exhaust stock 10. Hot elevator 11. Hot bins 12. Weight box 13. Mineral filler storage.	**2**	
		1. Cold bins: - It is used for storing the cold aggregates and feeds to drier unit through belt conveyor. 2. Dryer: - in this part aggregates are heated and dried to the desired temperature. 3. Dust collector: - It collects the dust from the drier unit formed by heating the aggregates. 4. Mixing unit: - It is used for mixing aggregate and the binder at the binder at specified temperature and in specified quantities. 5. Storage tank: - it consist of insulated tanks with heating arrangements and is provided for storing bitumen. 6. Screening units: - it separates the aggregate in different fractions. **(*Note- Any four component parts 2 Marks, any four uses – 2 marks)***	**2**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**a)**	**Enlist equipment used for excavation in construction of road.**		
	Ans:-	Following are the various equipment used for the excavation purpose 1. JCB. 2. Power shovels. 3. Draglines. 4. Dredgers. 5. Rippers. 6. Scrapers. 7. Graders 8. Bulldozers	***½ mark each (any eight)***	**4**
	b)	**Draw flow chart for working process of batch type Hot Mix plant.**  Fig:- Batch Type HOT Mix Plant	***3 mark diagram*** ***1 mark for labeling***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**c)** **Ans:-**	**Explain various preventive measures that can be taken to avoid landslides.** The landslides can be prevented by taking the following measures. 1. Effective drainage system: - Landslides can be avoided by providing proper and effective drainage system that is by providing catch water drains, cross drains etc.to intercept and divert the water. 2. Slopes: - By providing proper slopes and their treatment to minimize the erosion due to which landslides may be avoided. 3. Support: - To support the earth fill by constructing retaining structure along with buttress at toe. 4. Soil stabilization: - Landslide may occur due to poor load bearing capacity of soil. By improving the stability conditions of soil by soil stabilization method the landslide may be avoided. 5. Angle of slope: - By reducing the angle of slope or by providing breast wall land slide which may occur due to increase in slope should be avoided. 6. Chemical treatment: - To enhance the properties of soil, chemical treatment may be adopted. It improves the load carrying capacity of soil and helps to avoid landslides. 7. Netting: - By providing jute netting or wire netting. It also help to avoid landslides in case of hilly areas. Net which is made up of fibres such as jute net are provided in hilly areas to prevent landslides. 8. Asphalt mulch treatment:- By asphalt mulch treatment of the slopes and growth of vegetation can also avoid the landslides.	***½ mark each (any eight)***	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**d)**	**Write the ideal requirements of Highway Drainage System.**		
	Ans:-	The drainage system of highway should fulfill the following requirements: 1. The ideal highway drainage system should be easy to construct and economical. 2. The drainage system should not give percolation and ultimately water logging in areas 3. The proper gradient should be provided for quick and efficient removal of water 4. The location of drains should be so determined for catching water from different sources. 5. The drain system should have sufficient capacity even in monsoon season. 6. It should keep road surface in dry condition for longer period 7. The drainage system should have lesser maintenance as far as possible . 8. In heavy rainfall areas, ground water table should be kept 1 to 2 m below subgrade.	***½ mark each***	**4**
	e)	**Draw a neat sketch of dragline and label it.**		
	Ans.		***2 mark diagram***	
			2 mark diagram	**4**