



**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) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1		<b>Attempt any <u>FIVE</u> of the following :</b>		<b>(10)</b>
	<b>a)</b>	<b>List out any four zones of Indian Railway.</b>		
	<b>Ans.</b>	<ol style="list-style-type: none"><li>i. Eastern Railway.</li><li>ii. South Eastern Railway.</li><li>iii. Northern Railway.</li><li>iv. North Eastern Railway.</li><li>v. Southern Railway.</li><li>vi. Central Railway.</li><li>vii. Western Railway.</li><li>viii. South Central Railway.</li></ol>	$\frac{1}{2}$ <b>each (any four)</b>	<b>2</b>
	<b>b)</b>	<b>Define rail gauge.</b>		
	<b>Ans.</b>	<b>Rail Gauge:</b> The clear horizontal distance between the inner (running) faces of the two rails forming a track is known as rail gauge.	<b>2</b>	<b>2</b>
	<b>c)</b>	<b>Define points and crossings.</b>		
	<b>Ans.</b>	Points and crossing are the special arrangement provided on rail way track to facilitate trains to be diverted from one track to another.	<b>2</b>	<b>2</b>



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	d)	<b>List out the tools required for the track maintenance.</b>		
	Ans.	<ul style="list-style-type: none"><li>i. Cant board.</li><li>ii. Wire claw.</li><li>iii. Powarah.</li><li>iv. Hammer.</li><li>v. Rail bender.</li><li>vi. Jacks.</li><li>vii. Rail Gauge.</li><li>viii. Sleeper tongs.</li><li>ix. Auger.</li><li>x. Shovels.</li><li>xi. Rail tong.</li><li>xii. Claw bar.</li><li>xiii. Sledge hammer.</li><li>xiv. Chisel.</li><li>xv. Beater cum pickaxe.</li><li>xvi. Spanner.</li><li>xvii. Spirit level along with straight edge.</li></ul>	$\frac{1}{2}$ each (any four)	2
	e)	<b>List the types of Culvert.</b>		
	Ans.	<b>Following are the types of culverts:</b> <ul style="list-style-type: none"><li>i. Arch culvert.</li><li>ii. Box culvert.</li><li>iii. Slab culvert.</li><li>iv. Pipe culvert.</li></ul>	$\frac{1}{2}$ each	2
	f)	<b>Define equilibrium cant.</b>		
	Ans.	<b>Equilibrium cant:</b> For a constant speed of a running train the amount of required cant to achieve the balance is called equilibrium cant.	2	2
	g)	<b>Define lining of tunnel.</b>		
	Ans.	<b>Lining of tunnel:</b> A layer of timber, iron, masonry or concrete provided on the inside of a tunnel is known as lining of tunnel.	2	2



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	a)	<b>Attempt any <u>THREE</u> of the following:</b> <b>State the role of transportation in the development of nation.</b>		(12)
	Ans.	<b>Transportation plays a very important role in the development of Nation in the following ways:</b> i. Easy and quick transportation of men, machines, animals, material and goods can be made. ii. Transportation system increases the social awareness among people. iii. Transportation is essential for strategic movement in emergency for defense of the country and to maintain better law and order. iv. Transportation Network creates job opportunities for millions of people. v. Transportation through air ways plays an important role of communication to the people staying in remote area and also helps the people in difficulties during floods. vi. Areas which are connected by proper means of transport can developed fast.	<b>1 each (any four)</b>	<b>4</b>
	b)	<b>Explain any two causes of creep of Rail with a neat sketch.</b>		
	Ans.	<b>The following are the principle causes of creep:</b> i. <b>Wave action or Wave Theory:</b> Wave motion is set-up in a resilient track by the moving wheel loads. The train wheels causes depression under themselves forming lifts or crests. With movement of wheels, the lifts on front of the moving wheels are carried forward whereas the lifts at the rear of the moving wheels get back to their normal position. Thus, the rails are pushed forward which causes creep in the forward direction.	<b>1</b>	<b>4</b>

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2		<div data-bbox="422 369 1212 784" data-label="Image"> </div> <p data-bbox="630 795 1005 840" style="text-align: center;"><b>Fig. Wave Theory of Creep</b></p> <p data-bbox="359 851 702 896"><b>ii. Percussion Theory:</b></p> <p data-bbox="383 907 1252 1164">The rail creep is due to impact of wheels at the end of facing rail at each fish plate joint as shown in figure. When the wheel pass over such a rail joint the trailing rail depresses down and the wheel give impact to the end of facing rail, which results creep in forward direction.</p> <div data-bbox="478 1187 1197 1545" data-label="Image"> </div> <p data-bbox="614 1590 1069 1635" style="text-align: center;"><b>Fig. Percussion Theory of Creep.</b></p> <p data-bbox="223 1646 1181 1691"><b>c) State the various factors affecting selection of site of a bridge.</b></p> <p data-bbox="223 1691 1117 1736"><b>Ans. Following factors affect the selection of site for a bridge:</b></p> <p data-bbox="367 1758 646 1803"><b>i. Width of river:</b></p> <p data-bbox="430 1814 1252 2072">The width of river indicates length of bridge. It is desirable to have well defined and a narrow channel at bridge site as far as possible which will help in providing least possible length of bridge. The smaller the width of river, the cheaper will be the bridge in its initial cost as well as maintenance cost.</p>	<p data-bbox="1308 548 1340 593" style="text-align: center;">1</p> <p data-bbox="1308 996 1340 1041" style="text-align: center;">1</p> <p data-bbox="1308 1355 1340 1400" style="text-align: center;">1</p> <p data-bbox="1284 1836 1364 1982" style="text-align: center;">1 each (any four)</p>	<p data-bbox="1436 1836 1468 1881" style="text-align: center;">4</p>



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	c) Ans.	<p><b>ii. A straight reach :</b></p> <p>The river should have straight reach over a reasonable long distance on upstream side and downstream side of the bridge site so that the utility of bridge can be maintained for the design period. On the other hand the curved reach of river is not desirable as it creates problems during construction and maintenance of bridge.</p> <p><b>iii. Foundations :</b></p> <p>The nature of soil at bridge site should be such that good sound foundations should be available at reasonable depth. Such type of bridge site will save expense, labour and time required.</p> <p><b>iv. Connections with roads :</b></p> <p>The bridge is constructed to connect the road on either side of a river. The bridge site should therefore form a proper link between the roads on either side of a river. The approaches at the bridge site should be such that they do not involve heavy expenditure.</p> <p><b>v. Firm embankments :</b></p> <p>The embankment at bridge site should be high, permanent, straight, solid and firm. Such embankments will not get disturbed at the time of heavy floods and they do not allow the course of stream to alter.</p> <p><b>vi. Materials and labour :</b></p> <p>The site of the proposed bridge should be such that labour, construction material should be easily available nearby site. The transportation charges for material and labour at the bridge site should be minimum. This type of bridge site will provide economy in the overall cost of construction.</p> <p><b>vii. Right angle crossing :</b></p> <p>At bridge site, the direction of flow of water should be nearly perpendicular to the centre-line of bridge. Such crossing is known as right angle crossing. This type of site will help in</p>		



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	c)	providing square alignment of bridge which will result in easy and economy in bridge construction.		
	Ans.	<p><b>viii. Velocity of flow :</b></p> <p>The velocity of flow at bridge site should be between the range of non - silting and non-scouring. This type of site will result in minimum maintenance cost.</p> <p><b>ix. Scouring and silting :</b></p> <p>There should be no scouring and silting at bridge site, which will result in minimum maintenance cost.</p> <p><b>x. Minimum obstruction to water way :</b></p> <p>There should be minimum obstruction to natural waterway at the site of bridge.</p> <p><b>xi. Sound, economical and straight approaches :</b></p> <p>The bridge site should provide sound, economical and straight approaches. In case of curved alignment, the bridge should be on the tangent and not on the curve, since it is difficult to construct and maintain a curved bridge.</p> <p><b>xii. Free board :</b></p> <p>Sufficient free board should be available for the passage of boats, ships under the bridge superstructure if the river is used for navigation.</p>		
	d)	<b>Define ballast and mention any three functions of ballast.</b>		
	Ans.	<p><b>Ballast:</b></p> <p>The granular material spread on the formation of a railway track for the sleepers to rest upon is known as ballast.</p> <p><b>Functions of ballast:</b></p> <p>i. To distribute uniformly the load from the sleepers over a large area of formation or sub grade.</p> <p>ii. To hold the sleepers in their correct position and preventing their lateral movements.</p> <p>iii. To prevent the growth of weeds inside the track.</p> <p>iv. To drain off the rain water from the track quickly and to</p>	1	4
			1 each (any three)	



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	d) Ans.	<p>provide well drained foundation bed immediately below the sleepers.</p> <p>v. To provide cushion effect to the track since it acts as an elastic medium between the sleepers and the formation.</p> <p>vii. To provide a firm bed for the sleepers to rest upon.</p> <p>viii. To protect the top surface of formation.</p> <p>ix. To provide an easy method for track adjustment and gradients without any disturbance to formation.</p>		



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	a)	<p><b>Attempt any <u>THREE</u> of the following:</b></p> <p><b>State the requirements of good pier.</b></p> <p><b>Ans. Requirements of good pier:</b></p> <ol style="list-style-type: none"><li>It should be easily and cheaply constructed.</li><li>It should be constructed of durable material.</li><li>It should have sufficient bearing area at its top to receive the bearings supporting the bridge girder.</li><li>It should be stable against lateral and longitudinal thrust of water.</li><li>It should be strong enough to take loads.</li><li>It should involve less maintenance cost.</li></ol>	1 each (any four)	4
	b)	<p><b>Discuss any two types of foundation provided for R.C.C. bridges.</b></p> <p><b>Ans. Following are the types of foundation provided for R.C.C. bridges:</b></p> <ol style="list-style-type: none"><li><b>Spread foundation:</b> This type of foundation in shape is similar as provided for walls. It is best suited in situations where the scouring of the river bed is minimum and good hard soil is available within 2m to 3 m below river bed level. This type of foundation can be provided even if the bed contains erodible material as sand, but the scouring is prevented by driving sheet piles on upstream and downstream side and floor pitching.</li></ol>	2 each (any two)	4

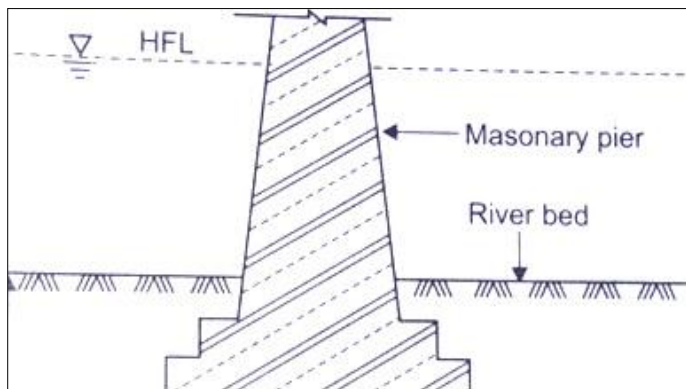
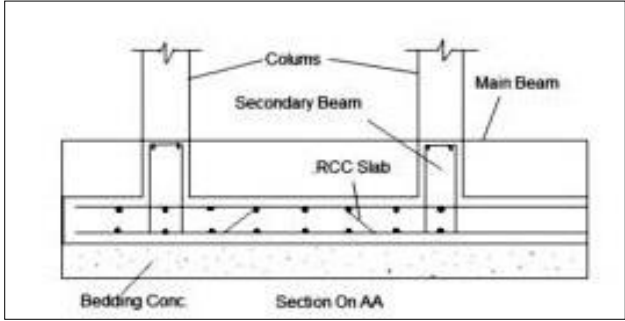
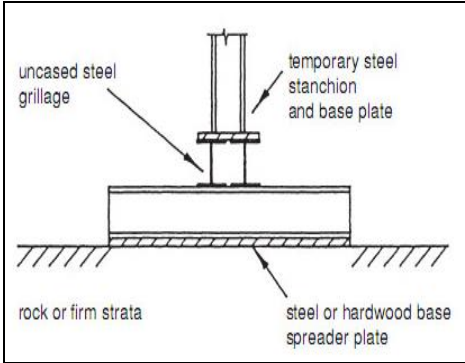
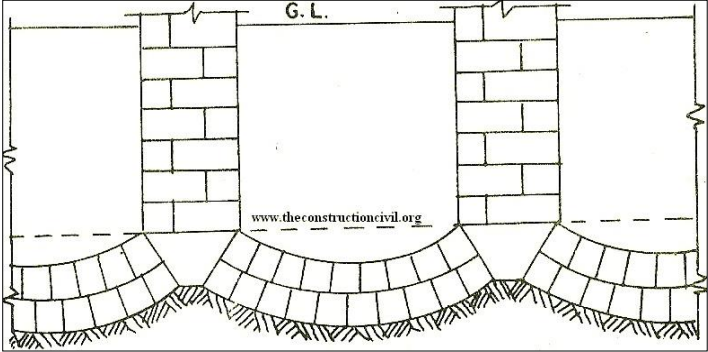
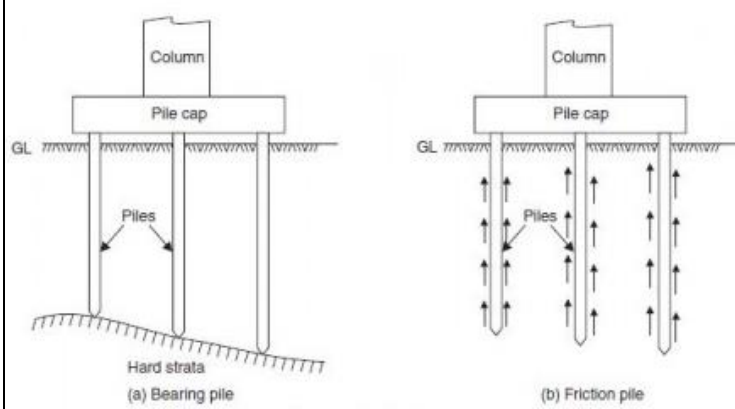
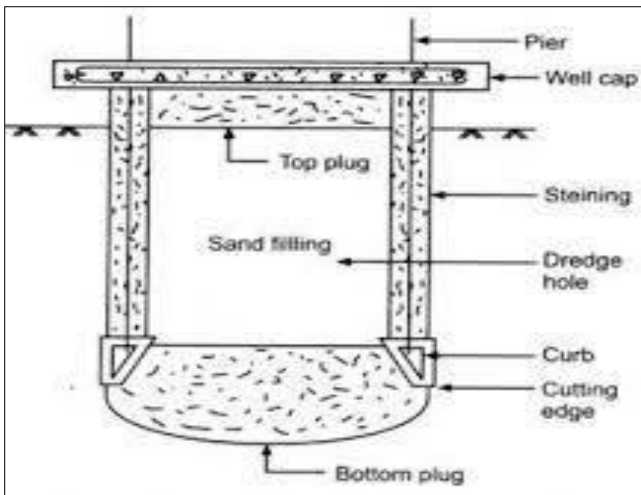


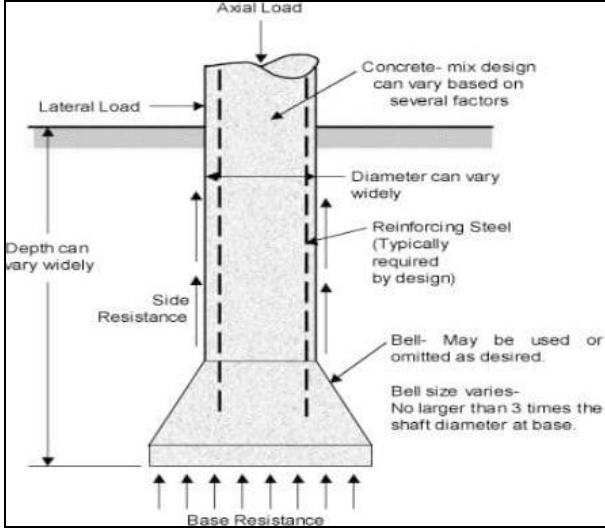
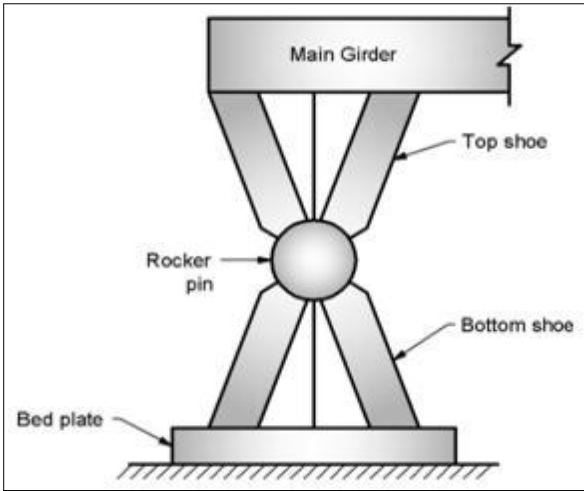
Fig. Spread Foundation.

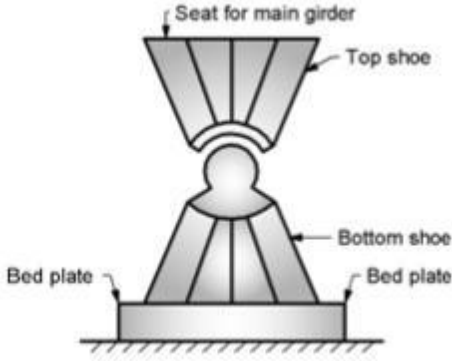


Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 3	b) Ans.	<p><b>ii. Raft foundation:</b></p> <p>A footing is a concrete support under a foundation that rests in solid ground and is wider than the structure supported. Footings distribute the weight of the structure over the ground. Raft foundation is a thick concrete slab reinforced with steel which covers the entire contact area of the structure like a thick floor. Sometimes area covered by raft may be greater than the contact area depending on the bearing capacity of the soil underneath. The reinforcing bars runs normal to each other in both top and bottom layers of steel reinforcement.</p> <div data-bbox="528 925 1155 1245" data-label="Image">  <p>The diagram shows a cross-section of a raft foundation. It features two vertical columns supported by a horizontal secondary beam. A main beam runs parallel to the secondary beam. Below these, a thick RCC slab is shown, resting on a layer of bedding concrete. The section is labeled 'Section On AA'.</p> </div> <p style="text-align: center;"><b>Fig. Raft Foundation.</b></p> <p><b>iii. Grillage foundation:</b></p> <p>Grillage foundation is used when heavy structural loads from columns, piers or stanchions are required to be transferred to a soil of low bearing capacity. Grillage foundation is often found to be lighter and more economical. This avoids deep excavation and provides necessary area at the base to reduce the intensity of pressure within safe bearing capacity of soil.</p> <div data-bbox="609 1704 1075 2065" data-label="Image">  <p>The diagram illustrates a grillage foundation. It shows a vertical column (temporary steel stanchion) with a base plate resting on a horizontal steel grillage. The grillage is supported by a steel or hardwood base spreader plate, which in turn rests on a layer of rock or firm strata.</p> </div> <p style="text-align: center;"><b>Fig. Grillage Foundation.</b></p>		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	b) Ans.	<p><b>iv. Inverted Arch foundation:</b></p> <p>Inverted Arch Footing/Foundation is used to be provided for multi-storied buildings in olden times. However, with the advent of reinforced cement concrete construction practice, inverted arch footing is rarely done these days. One of the drawbacks in this type of construction is that the end piles have to be specially strengthened by buttresses to avoid the arch thrust tending to rapture the pier junction. However, the advantage of inverted arch construction is that in soft soils the depth of foundation is greatly reduced. Inverted arch footing has been illustrated below.</p>  <p><b>Fig. Inverted Arch Foundation.</b></p> <p><b>v. Pile foundation:</b></p> <p>A pile is basically a long cylinder of a strong material such as concrete that is pushed into the ground to act as a steady support for structures built on top of it.</p>  <p><b>Fig. Pile Foundation.</b></p>		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	b) Ans.	<p>Pile foundations are used in the following situations:</p> <ol style="list-style-type: none"> <li>When there is a layer of weak soil at the surface. This layer cannot support the weight of the building, so the loads of the building have to bypass this layer and be transferred to the layer of stronger soil or rock that is below the weak layer.</li> <li>When a building has very heavy, concentrated loads, such as in a high rise structure, bridge, or water tank.</li> </ol> <p><b>vi. Well foundation:</b></p> <p>The foundation constructed by sinking a single large well, a twin well or a number of small well close together, under each abutment or pier is known as well foundation. This is the most common type of foundation used for bridges in our country. The wells are generally made of concrete or masonry. They may also be consisting of iron and steel, in which case, the foundation is known as tubular foundation. Deep well foundation and shallow well foundation are the two types of well foundation.</p>  <p><b>Fig. Well Foundation.</b></p> <p><b>vii. Caisson foundation:</b></p> <p>A caisson foundation also called as pier foundation is a watertight retaining structure used as a bridge pier, in the construction of a concrete dam, or for the repair of ships. It is a</p>		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	b) Ans.	<p>prefabricated hollow box or cylinder sunk into the ground to some desired depth and then filled with concrete thus forming a foundation.</p>  <p style="text-align: center;"><b>Fig. Caisson Foundation.</b></p> <p>c) Draw the sketches of Rocker bearing and Knuckle bearings used in bridges.</p> <p>Ans. i. <b>Rocker Bearing:</b></p>  <p style="text-align: center;"><b>Fig. Rocker Bearing.</b></p> <p style="text-align: center;"><i>(Note: One mark for sketch and one mark for labeling.)</i></p>	2	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	c) Ans.	<p><b>ii. Knuckle Bearing:</b></p>  <p style="text-align: center;"><b>Fig. Knuckle Bearing.</b></p> <p style="text-align: center;"><i>(Note: One mark for sketch and one mark for labeling.)</i></p>	2	
	d) Ans.	<p><b>Define the terms:</b></p> <ol style="list-style-type: none"> <li><b>i. Effective span</b></li> <li><b>ii. Clear span</b></li> <li><b>iii. Economic span</b></li> <li><b>iv. Afflux</b></li> </ol> <p><b>i. Effective span:</b> The center to center distance between any two adjacent supports of the bridge superstructure is called span or effective span of bridge.</p> <p><b>ii. Clear span:</b> The clear distance between any two adjacent supports of the bridge superstructure is called clear span.</p> <p><b>iii. Economic span</b> The span for which the total cost of the bridge is minimum is known as economical span of a bridge.</p> <p><b>iv. Afflux</b> It is the rise in water surface of water – course, caused due to the obstruction by the bridge in the flow of water.</p> <p style="text-align: center;"><b>OR</b></p> <p>The heading up of the water above its normal level while passing under the bridge is called afflux.</p>	1  1  1  1	4



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks																																
Q.4	a)	<p>Attempt any <b>THREE</b> of the following:</p> <p>State any four advantages and disadvantages of prestressed bridges.</p>	1/2 each (any four)	(12)																																
	Ans.	<p><b>Advantages of prestressed bridges:</b></p> <ol style="list-style-type: none"> <li>Prestressed bridges have higher load carrying capacity.</li> <li>Fewer expansion joints.</li> <li>Reduced deflection of girders.</li> <li>Lighter construction.</li> <li>More aesthetic appearance.</li> <li>More effective use of precast members.</li> <li>Better resistance to fatigue due elimination of cracking of its members under severe traffic loads.</li> <li>Less cost of maintenance.</li> </ol> <p><b>Disadvantages of prestressed bridge:</b></p> <ol style="list-style-type: none"> <li>Use of high tensile steel results in high cost</li> <li>Skill supervision required.</li> <li>Special equipments are required.</li> <li>Precast concrete bridges are specially suitable as urban highway bridges having long span.</li> </ol>																																		
	b)	<p>Compare Temporary and Permanent bridges. Write any 4 points.</p>	1 each (any four)	4																																
	Ans.	<table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Points of Comparison</th> <th>Temporary Bridge</th> <th>Permanent Bridge</th> </tr> </thead> <tbody> <tr> <td>i.</td> <td>Initial cost</td> <td>Initial cost is low</td> <td>Initial cost is high</td> </tr> <tr> <td>ii.</td> <td>Structural forms</td> <td>These bridges are simple in their structural forms.</td> <td>These bridges are simple as well as complex in their structural forms.</td> </tr> <tr> <td>iii.</td> <td>Skill required on construction</td> <td>Less skill required for construction</td> <td>More skill required for construction</td> </tr> <tr> <td>iv.</td> <td>Time required in construction</td> <td>Require less time in construction</td> <td>Require more time in construction</td> </tr> <tr> <td>v.</td> <td>Load carrying capacity</td> <td>These bridge can take light loads</td> <td>These bridge can take heavy loads</td> </tr> <tr> <td>vi.</td> <td>Construction</td> <td>Easy in construction</td> <td>Difficult in construction</td> </tr> <tr> <td>vii.</td> <td>Suitability to traffic</td> <td>Suitable for light traffic</td> <td>Suitable for heavy traffic</td> </tr> </tbody> </table>			Sr. No.	Points of Comparison	Temporary Bridge	Permanent Bridge	i.	Initial cost	Initial cost is low	Initial cost is high	ii.	Structural forms	These bridges are simple in their structural forms.	These bridges are simple as well as complex in their structural forms.	iii.	Skill required on construction	Less skill required for construction	More skill required for construction	iv.	Time required in construction	Require less time in construction	Require more time in construction	v.	Load carrying capacity	These bridge can take light loads	These bridge can take heavy loads	vi.	Construction	Easy in construction	Difficult in construction	vii.	Suitability to traffic	Suitable for light traffic	Suitable for heavy traffic
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Que. No.	Sub. Que.	Model Answer				Marks	Total Marks	
Q.4		viii.	Maintenance cost	Low	High			
	c)	<b>Explain the following:</b>						
		i.	Drills.					
		ii.	Drills carrying equipment					
	Ans.	i.	Drills:					
			The mechanical devices used for drilling holes in the tunnel are known as drills. The drills are usually made of high carbon steel.					
			The following different types of drills are commonly used.					
			1. Jack Hammers.			1		
			2. Drifters.					
			3. Wagon Drills					
			4. Churn Drills.				4	
		1.	Jack Hammers:					
		i.	These are light weight, hard held air operated percussion type drills. These are primarily used for drilling down holes. For this reason they are frequently called sinkers. They are classified according to their weight as 20 kg or 25 kg jack hammer. A complete drilling consists of a hammer, drill steel and a bit.			1 (any one)		
		ii.	The compressed air is passed through the hammer, which causes the piston to reciprocate at a speed of up to 2200 blows per minute, which produce the hammer effect. The energy of this piston is transmitted to the bit through the drill steel. Some of the air is passed through a hole in the drill steel and the bit to remove the cuttings from the hole and to cool the bit.					
		iii.	Jack hammers are used usually for drilling holes of size 4 to 4.5 cm in diameter and 3.0 m depth. The maximum diameter of the hole which can be drilled by a jack hammer is 6.25 cm and 6.0 m depth, but normally they are not used for such holes.					



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	c) Ans.	<p><b>2. Drifters:</b></p> <ol style="list-style-type: none"><li>In operation, drifters are similar to jack hammers but they are larger and are used as mounted tools for drilling down, horizontal or up holes. Their weights vary from 34 to 118 kg. They are capable of drilling holes up to 11.25 cm in diameter. They are extensively used for mining and tunneling. For removing the cuttings air or water can be used.</li><li>Drift means making a hole into the rock for construction of tunnel. This is just like drill into the rock. The instrument used for this purpose is Jack hammers and drifters. Drifters are useful to make a hole into the rock up to a depth of 6 m.</li></ol> <p><b>3. Wagon Drills:</b></p> <ol style="list-style-type: none"><li>These are heavy drifters mounted on masts which are mounted on wheels to provide probability or movability to the machine.</li><li>They are used to drill holes up to 11.25 cm in diameter and 10.0 m or more in depth. Wagon drills give better performance than jack hammers.</li><li>These can be used to drill holes at any angle from down to slightly above horizontal.</li></ol> <p><b>4. Churn Drills:</b></p> <ol style="list-style-type: none"><li>A churn drill may be used to drill holes varying from 15 to 30 cm in L diameter in rocks having any degree of hardness. It consists of a steel bit, attached to a heavy steel drill stem, which is lifted by a wire rope and dropped repeatedly in the hole being drilled.</li><li>The bit of this drills are very heavy of the order of 2270 kg. The hole is filled with water upto the desired depth and the bit is lifted few meters and dropped. . This process is repeated till a heavy slurry is formed the cuttings</li><li>After this, the bit is taken out from the hole and the slurry is removed with the help of a boiler. The spacing of holes may be 10 meters or more and depth several hundred</li></ol>		





Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	c) Ans.	<p>meters.</p> <p><b>ii. Drills carrying equipment.</b></p> <p>The equipment used for carrying the drills while drilling holes in the tunnel heading is known as drill carrying equipment. Following drilling equipments are used for carrying the drills.</p> <ol style="list-style-type: none"><li>1. Supports for Mounting Drills.</li><li>2. Drill Carriage.</li><li>3. Drill Jumbo.</li></ol> <p><b>1. Supports for Mounting Drills:</b></p> <p>For small tunnels, drifts and drills used are usually mounted on bars or columns. Bars or columns are made of steel pipes and equipped at one end or both with screw jacks. Bars are used in tunnels whose widths are less than their lights and are placed horizontally, while columns are installed vertically in a tunnel whose height is less than its width.</p> <p><b>2. Drill Carriage:</b></p> <p>These are portable carriages used for carrying drills, mounted on its cradle. They are provided with a wheeled base and a strut to hold it in a position. They used for drilling small and medium sized tunnel.</p> <p><b>3. Drill Jumbo:</b></p> <p>It is movable steel frame type drill carriage it is fully equipped for drilling the heading of a tunnel. It consists of a number of platforms, known as decks; to support drill. A drill jumbo is commonly used for drilling large size tunnel.</p>	<p>1</p> <p>1 (any one)</p>	

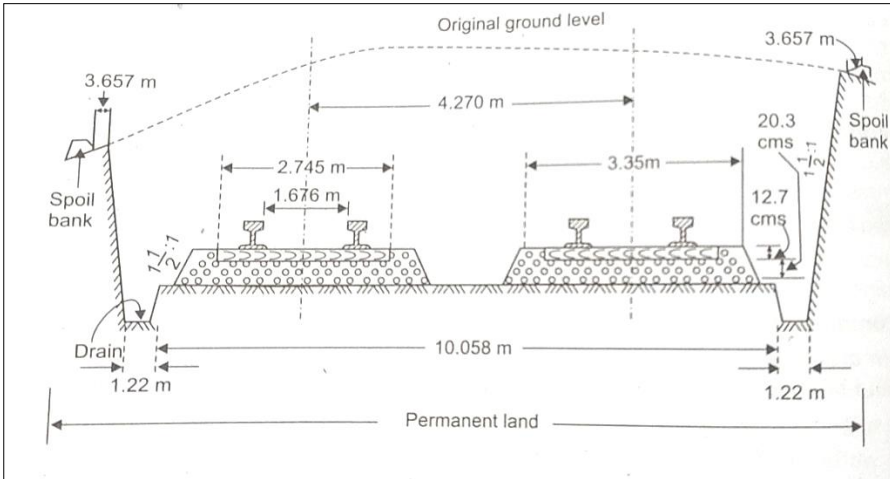
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	d)	<p><b>Draw a labeled sketch of L-section of bridge showing its components.</b></p> <p style="text-align: center;"><b>Fig. L-section of Bridge.</b></p> <p style="text-align: center;"><i>(Note: Two marks for sketch and two marks for labeling.)</i></p>	4	4
	e)	<p><b>List different points to be observed for inspection of bridge.</b></p> <p><b>The following points should be kept in view while inspecting a bridge:</b></p> <ol style="list-style-type: none"> <li>i. Condition of wearing coat and its thickness.</li> <li>ii. Condition of kerbs and railings.</li> <li>iii. Condition of expansion joints, whether functioning well or not in case of concrete bridge.</li> <li>iv. Condition of concrete, whether in good condition or spalling in case of concrete bridge.</li> <li>v. Condition of reinforcement, whether exposed anywhere or not in case of concrete bridge.</li> <li>vi. Condition of paint in case of steel and iron bridge.</li> <li>vii. Condition of steel work, material, members and connections in case of steel or iron bridge.</li> <li>viii. Condition of material used in arches in case of arch bridge.</li> <li>ix. Condition of masonry, whether good or weathered.</li> <li>x. Condition of mortar joints in case of masonry arch bridge.</li> <li>xi. Condition of bearings, whether functioning properly or not.</li> <li>xii. Any sign of development of cracks in masonry or concrete immediately below the bearings.</li> </ol>	<p><math>\frac{1}{2}</math> <b>each</b> <b>(any eight)</b></p>	4

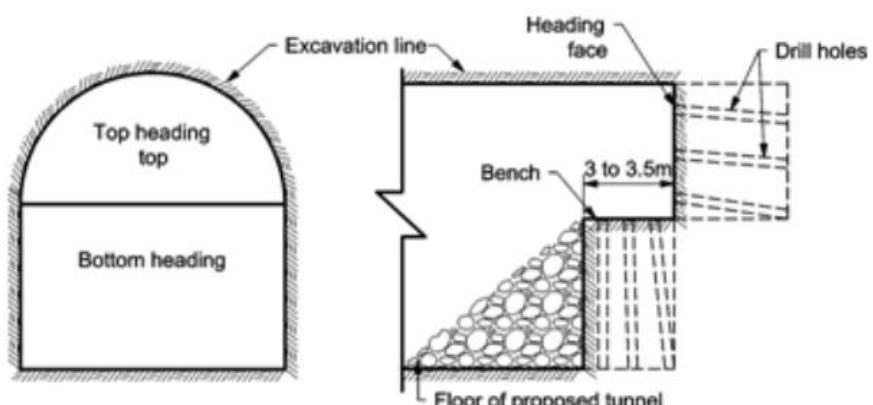


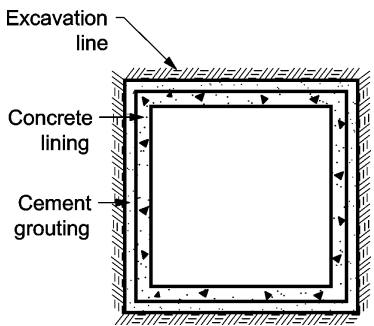
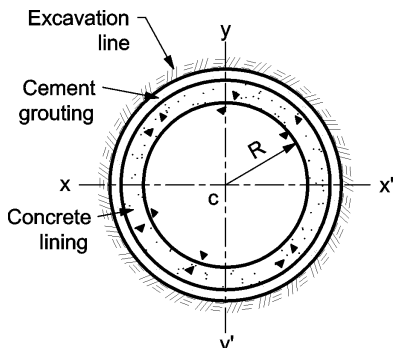
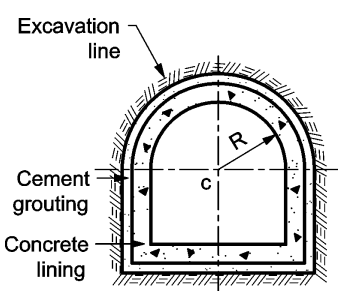
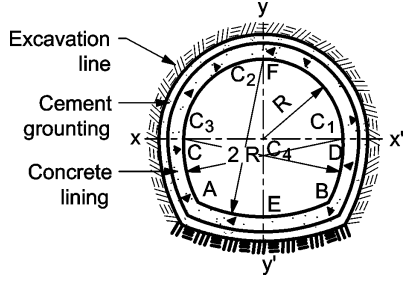
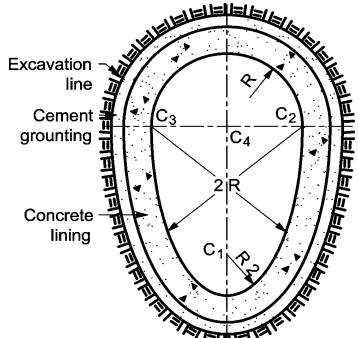
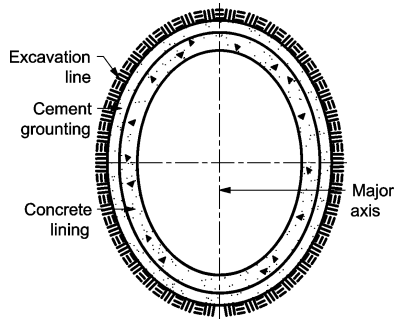
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4	e) Ans.	xiii. Condition of abutments, piers and wing walls, whether good weathered or bulged. xiv. Any sign of development of cracks in concrete abutments and piers. xv. Any sign of settlement of foundation. xvi. Any sign of scour along with maximum depth of scour.		





Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	<p>b) Draw a neat sketch of standard cross-section of double B.G. Track in cutting.</p> <p>Ans. Standard cross-section of double B.G. Track in cutting:</p>	<p>excessive damage in case driver does not apply the brakes properly. In the circulating area, ticket office, restaurant etc. are provided. This area is directly connected to road. The simple layout of this type of Railway station without additional facilities such as marshalling yards etc.</p>  <p><b>Fig. Standard Cross-section of a Double B.G. Track in Cutting.</b> (Note: Four marks for sketch and two marks for labeling.)</p>	6	6
	<p>c) State steps involved in the construction of Railway Track.</p> <p>Ans. Steps involved in the construction of railway track:</p>	<ol style="list-style-type: none"> <li>1. Introduction: Brief history of project starting from proposals end ending with finalization of detailed drawings and estimates.</li> <li>2. A brief description of alternative routes - primarily chosen and finally rejected.</li> <li>3. Main requirements for project.</li> <li>4. Alignment: details of alignment with respect to proposed gauge, gradients etc.</li> <li>5. Specifications.</li> <li>6. Design standards.</li> <li>7. Execution of work laying at ballast/sleepers and laying of track.</li> <li>8. Safety measures and trial and allow for the traffic.</li> </ol>	6	6

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	a)	<p><b>Attempt any <u>TWO</u> of the following:</b></p> <p><b>Describe Heading and Bench method of tunneling in hard rock, with neat sketch.</b></p> <p><b>Ans. Heading and Bench method :</b></p> <p>This method is suitable when large section of the proposed tunnel is to be drive and the quality of rock is not very satisfactory.</p> <ol style="list-style-type: none"> <li>In this method, the driving of the tunnel is done in two portions of its section.</li> <li>The top portion is known as heading and bottom portion is known as bench.</li> <li>The driving of top portion is done in advance of the bottom portion.</li> <li>In this method of tunneling the top portion or heading will be about 3 to 3.5 m ahead of the bottom portion.</li> <li>The holes are drilled into head and bench.</li> <li>Then these holes are loaded together with explosive and then blasted.</li> <li>Firing of bench holes is done just before the heading holes are fired.</li> <li>After this mucking is done manually.</li> </ol>	4	(12)
		 <p style="text-align: center;"><b>Fig. Heading and Bench Method.</b></p>	2	6

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q. 6	b)  Ans.	<p>Sketch various types of tunnel cross-sections. State under what conditions each is adopted.</p>   <p>Fig.1: Rectangular shaped tunnel. Fig.2: Circular shaped tunnel.</p>   <p>Fig.3: Segmental shaped tunnel. Fig.4: Horse-shoe shaped tunnel.</p>   <p>Fig.5: Egg-shaped tunnel Fig.6: Elliptical shaped tunnel</p>	<p>1 each (any three)</p>	<p>6</p>





Que. No.	Sub. Que.	Model Answer	Marks	Total Marks																					
Q.6	b)	<p>The various types of tunnels according to shapes are:</p> <table border="1"><thead><tr><th>Sr. No.</th><th>Types of tunnels according to shape</th><th>Suitability</th></tr></thead><tbody><tr><td>1.</td><td><b>Rectangular or box type shape</b></td><td>These tunnels are suitable for pedestrian purpose.</td></tr><tr><td>2.</td><td><b>Circular shape</b></td><td>These tunnels are commonly use for carrying water under pressure.</td></tr><tr><td>3.</td><td><b>Segmental shape</b></td><td>Segmental tunnels are suitable as traffic tunnels These tunnels are commonly used in subways or as navigation tunnels.</td></tr><tr><td>4.</td><td><b>Horse shoe shape</b></td><td>These tunnels are suitable in soft rock.</td></tr><tr><td>5.</td><td><b>Egg type shape</b></td><td>Suitable for flow of sewage in dry and wet seasons.</td></tr><tr><td>6.</td><td><b>Elliptical shape</b></td><td>These tunnels are suitable for carrying water.</td></tr></tbody></table>	Sr. No.	Types of tunnels according to shape	Suitability	1.	<b>Rectangular or box type shape</b>	These tunnels are suitable for pedestrian purpose.	2.	<b>Circular shape</b>	These tunnels are commonly use for carrying water under pressure.	3.	<b>Segmental shape</b>	Segmental tunnels are suitable as traffic tunnels These tunnels are commonly used in subways or as navigation tunnels.	4.	<b>Horse shoe shape</b>	These tunnels are suitable in soft rock.	5.	<b>Egg type shape</b>	Suitable for flow of sewage in dry and wet seasons.	6.	<b>Elliptical shape</b>	These tunnels are suitable for carrying water.	<b>1 each (any three)</b>	
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	c)	<p><b>Explain Tunnel Surveying and 3 steps involved in Tunnel surveying.</b></p>																							
	Ans.	<p><b>Tunnel surveying:</b></p> <p>The process of setting out the alignment of the tunnel on the ground and then transferring the same to inside of the tunnel through shafts is called tunnel surveying.</p> <p><b>i) Locating centre line of the tunnel on ground :</b></p> <ol style="list-style-type: none"><li>1. After fixing the route for the tunnel, its centre line (alignment) is accurately set out on the hills or ground.</li><li>2. When the length of tunnel is small, the centre line can be located by means of theodolite.</li><li>3. When the tunnel is long, and to be constructed under high</li></ol>	<b>1</b>        <b>2</b>	<b>6</b>																					

