

Model Answer: Summer 2016

Subject & Code: Transportation Engineering (17418)

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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.

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|---|---|----------------------------------|
| Q.1 | a) (i) | <p>Attempt any <u>SIX</u> of the following:</p> <p>State two merits and two demerits of Roadways.</p> <p>Ans.</p> <p><u>Merits of Roadways:</u></p> <ol style="list-style-type: none"> 1. A number of smaller units like scooter, rickshaws, cars, etc. are available for personalized transport. 2. They provide door to door service. 3. It is ideal for non-bulk cargo especially passenger and freight. 4. They transport men and material from one part to other speedily and easily. 5. Starting and destination points need not be necessarily defined unlike in other modes of transport. 6. In hilly or mountainous region roads are the only means of conveyance. 7. Help to provide medical aid to remote places. 8. Safety of goods is assured as the responsibility rest with the driver. <p><u>Demerits of Roadways:</u></p> <ol style="list-style-type: none"> 1. Suitable for short distance only. 2. Rate of accidents are very high as compared to other modes of transportation. 3. Tractive resistance of wheels to the roads is more therefore more power is required. 4. Speed restriction is there in this mode of transport. | <p>$\frac{1}{2}$ mark each (Any two)</p> <p>$\frac{1}{2}$ mark each (Any two)</p> | <p>12</p> <p>2</p> |



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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|------------|--------------------|--|--|-------------|
| Q.1 | a) (ii) | State role of transportation in national development. Ans. Transportation plays a very important role development of India in the following ways. <ol style="list-style-type: none">1. Easy and quick transportation of men, machines, animals, material, and goals can be made.2. Transportation system increases the social awareness among people.3. Transportation is essential for strategic movement in emergency for defense of the country and to maintain better law and order.4. Transportation network creates job opportunities for millions of people.5. 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. | 1 mark each (Any two) | 2 |
| | (iii) | State the necessity of cross drainage works for roads. Ans. <ol style="list-style-type: none">1. Excess Moisture content causes reduction in bearing strength of base course bed materials.2. Excess moisture content in layers of road way causes permanent failure.3. Due to poor drainage, waves and corrugations are formed in flexible pavements.4. At places where temperature often reaches to freezing point, frost action of water entering the pavements structure may cause the damage. | 1 mark each (Any two) | 2 |
| | (iv) | Define “Gradient”. State the types of gradient. Ans. <u>Gradient</u> : the rate of rise or fall provided to the formation of railway track along its alignment is known as gradient or grade. <u>Types of Gradient</u> ; <ol style="list-style-type: none">1. Ruling Gradient2. Momentum Gradient3. Pusher Gradient4. Station Yard Gradient | 1 mark 1 mark (Any two) | 2 |
| | (v) | Enlist the types of Marshalling Yard. Ans. <ol style="list-style-type: none">1. Flat yards2. Gravitational yards3. Hump yards | 2 marks | 2 |
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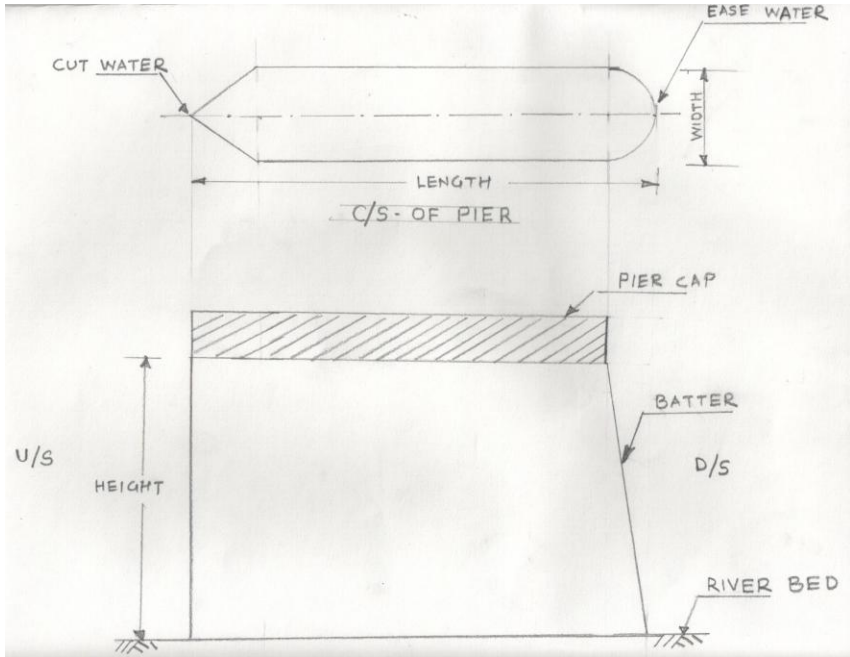
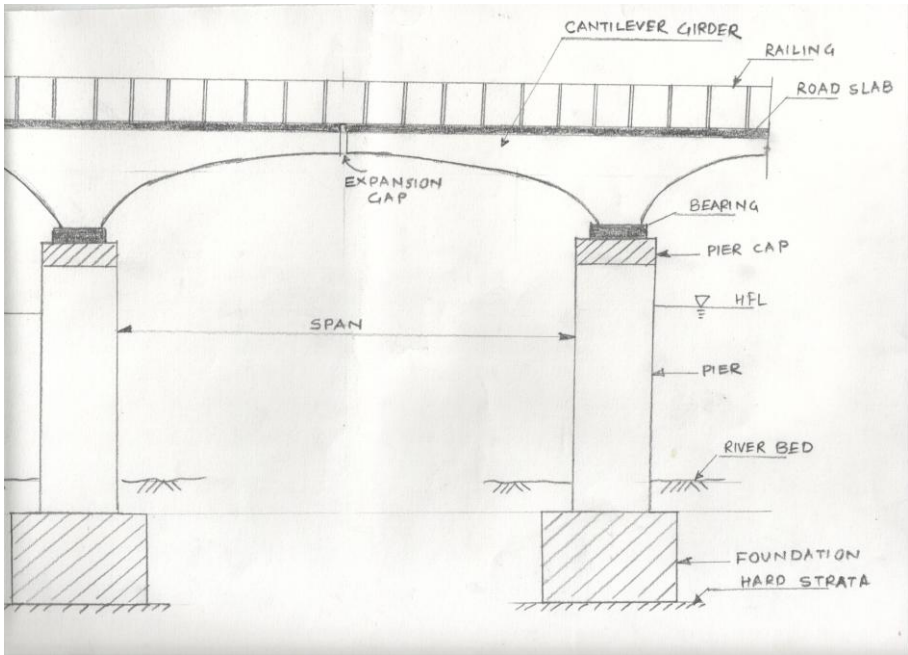
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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|--|-------------|
| Q.1 | (vi) | <p>Define the term – HFL and freeboard.</p> <p>Ans. <u>HFL</u>: The level of the highest flood ever recorded or calculated level for the highest possible flood discharge in a stream or river is called Highest Flood Level (H.F.L).</p> <p><u>Freeboard</u>: The difference between the highest flood level after allowing the afflux, if any and the lowest point on the underside of the bridge super structure is called free board.</p> <p style="text-align: center;">OR</p> <p>It is the difference between the H.F.L. and the level of the crown of the road at its lowest point.</p> | <p>1 mark</p> <p>1 mark</p> | 2 |
| | (vii) | <p>Define the term – Effective span and clear span.</p> <p>Ans.</p> <p><u>Effective span</u>: The center to center distance between any two adjacent supports of the bridge superstructure is called as effective span.</p> <p><u>Clear span</u>: The clear distance between any two adjacent supports of the bridge superstructure is called as clear span.</p> | <p>1 mark</p> <p>1 mark</p> | 2 |
| | (viii) | <p>State any four functions on which shape and size of tunnel depends.</p> <p>Ans.</p> <p>The factors on which the shape and size of tunnel depends are as follows;</p> <ol style="list-style-type: none"> 1. It is largely governed by the type and nature of ground through which it is driven. 2. Depends upon the purpose for which it is to be used. 3. Internal and external pressures to which it is subjected. 4. Easy drainage should be possible. 5. Construction whether in hard rock or soft rock. 6. Ease in construction. 7. Size of a tunnel is also affected by the thickness and allowance for settling down of lining, since it reduces the size of the tunnel. | <p>½ mark each (Any four)</p> | 2 |
| | (b) | <p>Attempt any TWO of the following:</p> | | 8 |
| | (i) | <p>Define “Gauge of Railway track”. State the factors governing selection of gauge.</p> <p>Ans.</p> <p><u>Gauge</u>: The clear horizontal distance between the inner faces of the two rails forming a track is known as gauge.</p> <p>The following factors govern the choice for the selection of gauge;</p> <ol style="list-style-type: none"> 1. Cost of construction: <ol style="list-style-type: none"> i. The cost of earthwork, ballast, sleepers, rails, etc. would increase with increase in gauge width. ii. There is little increase in the acquisition of land for permanent track with increase in gauge. | <p>1 mark</p> <p>1 mark each (Any three)</p> | 4 |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|------------|-------------|---|--|-------------|
| Q.1 | (i) | <p>2. Volume and nature of traffic: It is evident with greater traffic volume and greater load carrying capacity; the trains should be run by a better traction technique.</p> <p>3. Development of the area: Narrow gauge can be used to develop the thinly populated areas by joining them with developed or urban areas.</p> <p>4. Physical features of the country: Use of narrow gauge is warranted in hilly regions where broad and metre gauge are not possible due to steep gradients and sharps.</p> <p>5. Speed of the movement: The speed of train is almost proportional to the gauge. Speed is the function of diameter of wheel, which in turn is limited by the gauge. The wheel diameter is generally 0.75 times that of gauge. Lower speed discourages the customers and so for maintaining high speeds, broad gauges are preferred.</p> | | |
| | (ii) | <p>Draw the L-section and c/s of pier and explain the terms pier height, width, batter, length, cap, cut-water and ease water.</p> <p>Ans.</p> <p><u>Pier height:</u> The height of a pier is measured from top of its foundation up to the support level of girders or springing point of the arch in case of an arch bridge.</p> <p><u>Width:</u> The top width of pier is provided to accommodate two bearings with a clearance of about 15 cm in between their seats.</p> <p><u>Batter:</u> It is the slope provided along the sides of pier on the downstream side of the flow.</p> <p><u>Length:</u> It is the length along the centerline of pier between the cut water and ease water.</p> <p><u>Cap:</u> Cap is provided on the top of pier to distribute the loads from the bearings to the pier column more uniformly.</p> <p><u>Cut – water and Ease water:</u> The projection of the pier on the u/s side known as cut water and the projection of the pier on the d/s side known as ease water.</p> | <p>$\frac{1}{2}$ mark each</p> | 4 |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.1 | b) (ii) |  <p><i>Note: 1 mark for sketch and 1 mark for labeling.</i></p> | 2 marks | |
| | (iii) | <p>Draw a labeled sketch of cantilever bridge.</p> <p>Ans.</p>  <p><i>Note: 3 marks for sketch and 1 mark for labeling.</i></p> | 4 | 4 |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.2 | a) | <p>Attempt any <u>FOUR</u> of the following:</p> <p>Define ‘Alignment’. State the factors governing rail alignment.</p> <p>Ans.</p> <p><u>Alignment:</u> Marking the position of center line on the ground and giving direction to the railway track is known as alignment of the railway track.</p> <p>Factors governing the rail alignment are as follows;</p> <ol style="list-style-type: none">1. Obligatory Points: Alignment of track has to be deviated from straight line because it has to pass through obligatory points like market places, educational centres, etc. Certain undesirable locations have to be avoided, for e.g. Low lying areas, marshy places, areas requiring deep cutting, etc.2. Traffic: The alignment should suit the traffic growth and its impact should be studied carefully and the alignment should pass the thickly populated areas.3. Geometric Designs: The gradient must not exceed the permissible limits and the curves from economical point of view should be of maximum possible radii.4. Topography of Area According to topography, the alignment of a track may be classified as:<ol style="list-style-type: none">i. Valley Alignment: If the two terminal points lie in the same valley then the straight shortest alignment may be chosen without any difficulty and a uniform rate of gradient may be adopted.ii. Cross Country Alignment: In such type of alignments, the water sheds of two or more streams of different sizes have to be crossed and it is not possible to give a uniform grade to the track. Thus, the routes in cross country have sags and summit in succession.iii. Mountain Alignment: The main object in railway alignment is to keep the track as straight as possible. In mountainous region it is achieved by increasing the length of the track keeping the gradient upto the limit of ruling gradient.5. Economic Consideration The alignment should also be economical. The initial cost, cost of maintenance and vehicle operation cost should be taken into consideration.6. Other consideration From drainage point of view, marshy tracks should be avoided. The alignment should be such that the excessive cutting of the rock is avoided. Cutting in snowfall areas should be avoided as it will create problem of cleaning the track in cold season. | <p>1 mark</p> <p>1 mark each (Any three)</p> | <p>16</p> <p>4</p> |



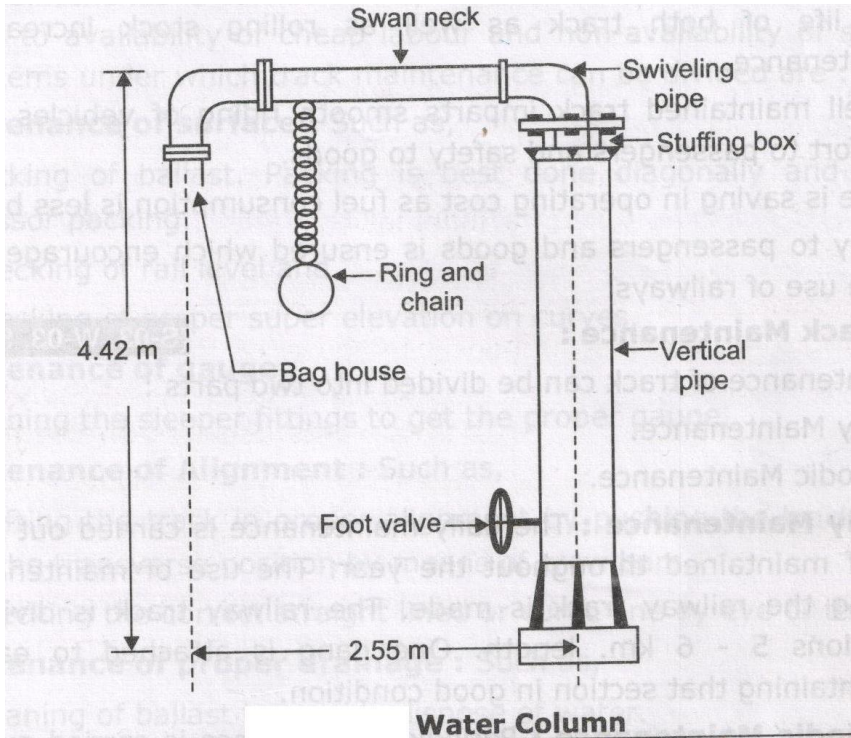
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| Q.2 | b) | <p>What are the requirements of railway station?</p> <p>Ans.</p> <p>Railway station should satisfy the following requirements;</p> <ol style="list-style-type: none"><u>Public requirements:</u><ol style="list-style-type: none">Booking office for issuing tickets to the passengers.Arrangement for the booking of goods.Passenger and goods platform with or without sheds.Name board of the station.Waiting rooms and relaxing rooms.Drinking water arrangements.Bathrooms with sanitary arrangements.Inquiry office.Provision of big boards for schedule of trains.Microphones to announce the arrival and departure of trains.Other facilities like public telephone, refreshment staff, telegraph office, police stations, etc.<u>Traffic staff and Police requirements:</u><p>Staffroom, retiring room and residential quarters for railway staff such as station master, ticket collector, night operator, engine drivers, etc. and for police should be provided.</p><u>Train requirements:</u><ol style="list-style-type: none">Provision for arrangements for controlling the movement of trains by means of signals.Sufficient number of slidings for receiving, sorting, storing and departing of trains.Sufficient number of platforms for handling passengers and goods trains.Arrangements for control and record of train movements.<u>Requirement of locomotives:</u><ol style="list-style-type: none">Proper arrangements for supply of fuel and water to locomotives such as coal, lifting cranes, water columns, etc.Arrangements for cleaning, examining, inspecting and maintaining the locomotives such as ash pits, inspection pits, hydraulic jacks, etc.Turn table for changing the direction of engine.<u>Requirements for development of railways:</u><ol style="list-style-type: none">Easy and comfortable approach roads connecting the nearby town or village to the station without causing congestions.Availability of coolies on the station platform.Clocks to show correct time, guide map of the city, separate boards for arrival and departure of trains with platform numbers. | 1 mark each (Any four) | 4 |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.2 | c) | <p>Explain water column with neat sketch.</p> <p>Ans.</p> <ol style="list-style-type: none">1. They are provided for feeding the water to steam locomotives. Water columns are situated at the ends of the platforms near the starting signals so that engines of running trains can take water when heating on railway stations.2. Water columns are provided at intermediate stations by the side of main line tracks at distance not less than 48 hrs. They may be installed on ash pits so that the engines may remove their ash simultaneously while taking water. At important stations two or more water columns are provided.3. They are fixed in ground in the shape of an inverted 'L' at about 4.42m height from ground.  | <p>2 marks</p> <p>2 marks</p> | <p>4</p> |



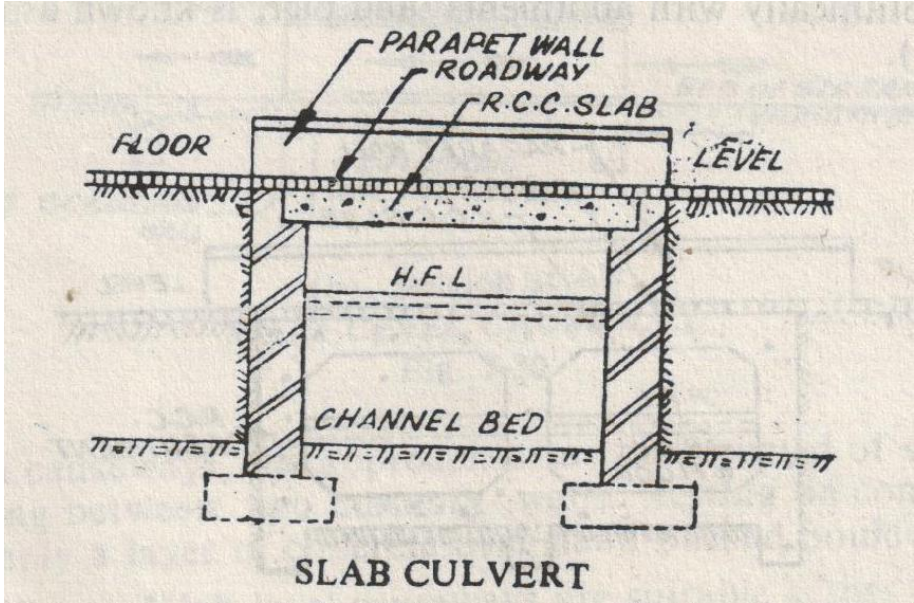
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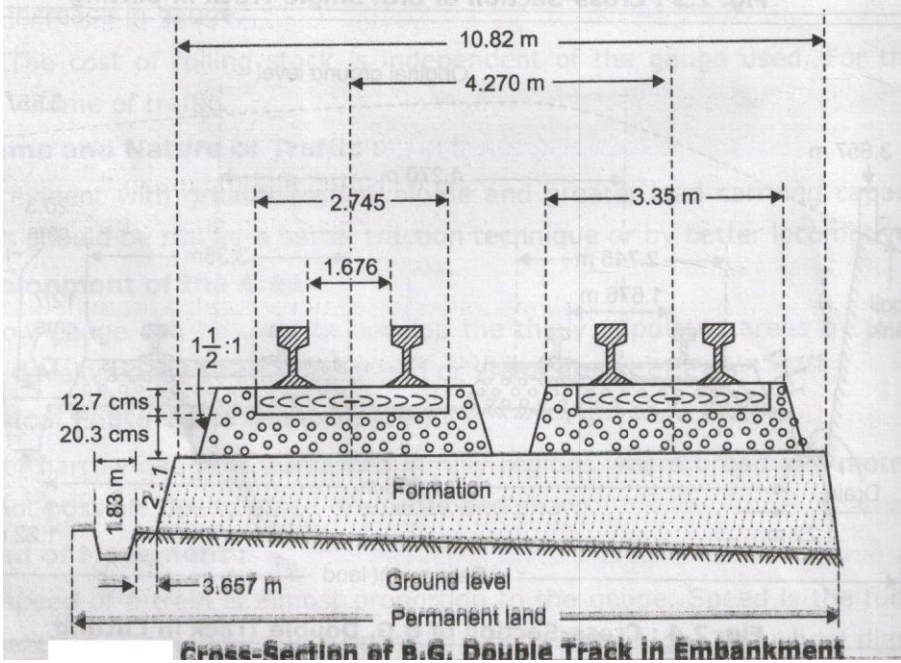
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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|---|-------------------------------|-------------|
| Q.2 | d) | <p>Explain the factors controlling selection of ideal site for bridge.</p> <p>Ans. Generally, following factors affect the selection of site for a bridge;</p> <ol style="list-style-type: none">1. <u>Sub soil conditions of the bed of the river:</u> Suitable, unyielding and non-erodible material for foundation should be available at a short depth for the abutments and piers of a bridge.2. <u>Nature of the river:</u> The stream at the bridge site should be well defined and as narrow as possible. This type of site will help in providing least possible length of bridge, thus resulting economy in the initial cost as well as in maintenance cost.3. <u>Grades and alignment:</u> The axis of stream at bridge site should be crossing at right angles to the centre line of the communication route as far as possible.4. <u>Approaches:</u> 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.5. <u>Banks of stream:</u> The stream at bridge site should have permanent, firm, straight and high banks. High and stable banks near the bridge site will prevent the overflowing of the streams during floods.6. <u>Scouring and silting:</u> There should be no scouring and silting of the stream at bridge site i.e. the stream at bridge site should remain in steady regime condition. It should be free from whirls and cross-currents.7. <u>Obstruction to waterways:</u> There should be minimum obstruction to natural waterway at the site of bridge.8. <u>River training works:</u> The stream bridge should be free from costly river training works. The site requiring no river training work is the best.9. <u>Construction works inside water:</u> No excessive work is required to be carried inside the water.10. <u>Availability of free board:</u> Sufficient free board should be available for the passage boats, streamers or ships, under the bridge superstructure.11. <u>Workers and construction materials availability:</u> Easy availability of cheap workers, construction materials and transport facilities near to the bridge site. | 1 mark each (Any four) | 4 |



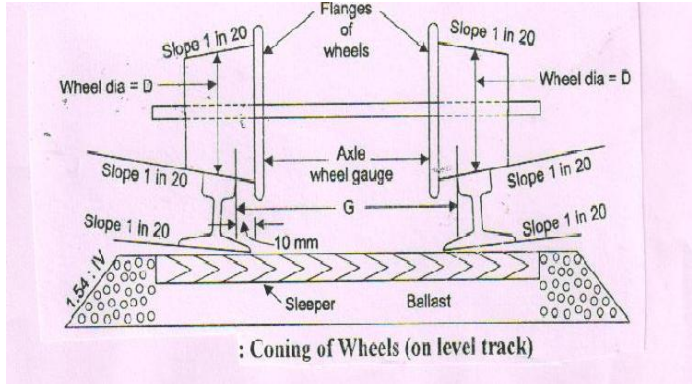
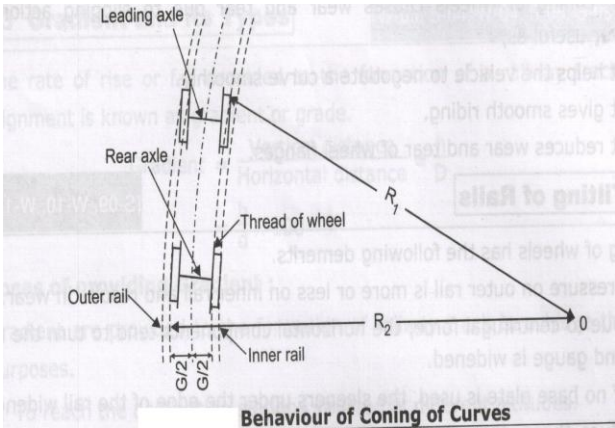
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| Q.2 | e) | <p>Explain the term – Afflux, scouring.</p> <p>Ans.</p> <p><u>Afflux:</u> It is the rise in water surface of water – course, caused due to the obstruction by the bridge in the flow of water. The heading up of the water above its normal level while passing under the bridge is called afflux. It is determined by the difference of water level of upstream and downstream.</p> <p><u>Scouring:</u> The process of cutting or deepening of river bed due to action of water is called scouring. When the velocity of stream water exceeds the limiting velocity, it causes vertical cutting of river bed, which is known as scouring. It differs from erosion which causes horizontal widening of the river.</p> | <p>2 marks</p> | 4 |
| | f) | <p>What is culvert? Explain slab culvert with neat sketch.</p> <p>Ans.</p> <p><u>Culvert:</u></p> <p>In highways work small bridges have to be constructed to cross small streams, distributaries or pool etc. These bridges may be three to four spans and each span not exceeding 3 m in length. In railway, the span does not exceed 6 m and the total linear waterways approximately should not exceed 18 m, the small bridges are known as culverts.</p> <p><u>Slab culvert:</u></p> <p>Slab culvert is adopted for maximum span upto 2.5 m. In this case, a stone slab or R.C.C. slab is directly placed as simply supported beam on piers or abutments. These slabs form the superstructure parapet and wing walls may also be provided as in the case of permanent bridges.</p> | <p>1 mark</p> | |
| | |  | <p>2 marks</p> | 4 |
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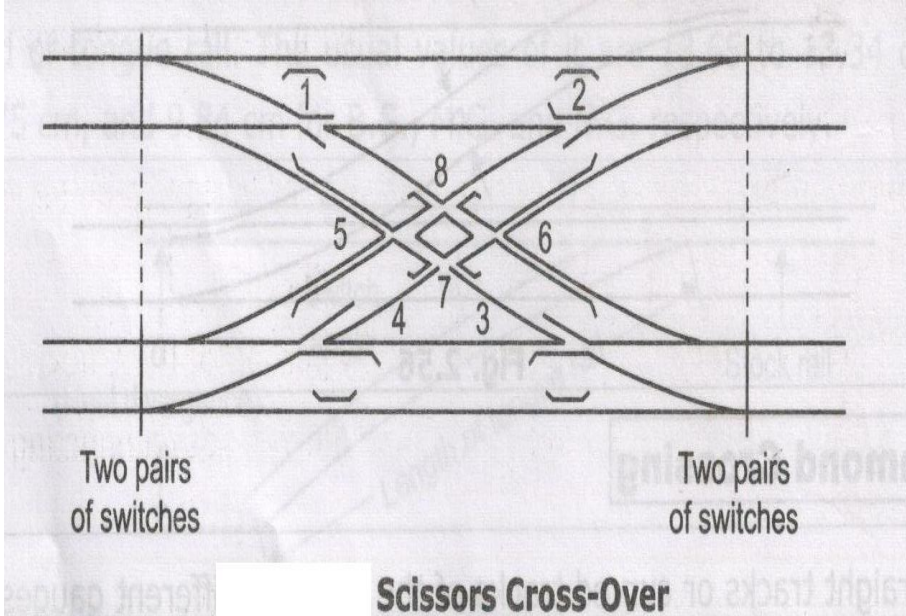
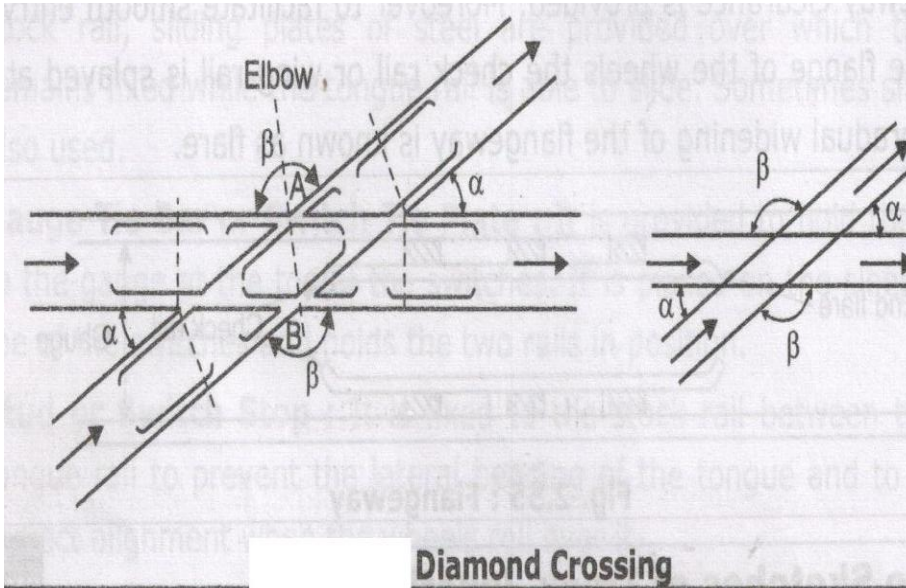
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| Q.3 | a) | <p>Attempt any <u>TWO</u> of the following:</p> <p>Draw a neat labeled cross-section of double line BG track in embankment.</p> <p>Ans.</p>  <p>Cross-Section of B.G. Double Track in Embankment</p> | 8 | 8 |

Note: 4 marks for sketch and 4 marks for labeling.



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|---------|-------------|
| Q.3 | b) | <p>What is coning of wheel? Explain behavior of coned wheel on curved path.</p> <p>Ans. <u>Coning of wheel:</u></p>  <p>: Coning of Wheels (on level track)</p> <p>The wheels are coned at a slope of 1 in 20 to prevent from rubbing the inside face of the rail head and to prevent Lateral movement of the angle with its. This is known as coning of wheel. The distance between the inside edges of the wheel flanges is generally kept less than the gauge. So there is a gap between the inside edge of flange and the running face of the rail nearly equal to 10 mm on either side.</p> <p><u>Behaviour of coned wheel:</u></p> <ol style="list-style-type: none">1. On correct path, the outer wheels of the train have to travel greater distance than the inner wheels. When train moves on horizontal curve, due to Centrifugal force, vehicle is shifted to outer side of curve and due to coning of wheel; outer wheels cover greater distance than the inner wheels.2. On a straight and level track also, the coning of wheels helps to keep the vehicle in central position.3. If the coning of wheel was not provided, the side movement would have continued and flange of the wheel would have come in contact with the side of the rail causing jerk and uncomfortable riding.  <p>Behaviour of Coning of Curves</p> | 2 marks | 8 |
| | | | 2 marks | |
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| | | | 2 marks | |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.3 | c) | <p>Draw a neat line sketch of scissor cross over and diamond crossing. Ans.</p>  <p>Two pairs of switches</p> <p>Two pairs of switches</p> <p>Scissors Cross-Over</p>  <p>Diamond Crossing</p> | 4 marks | 8 |
| | | | 4 marks | |



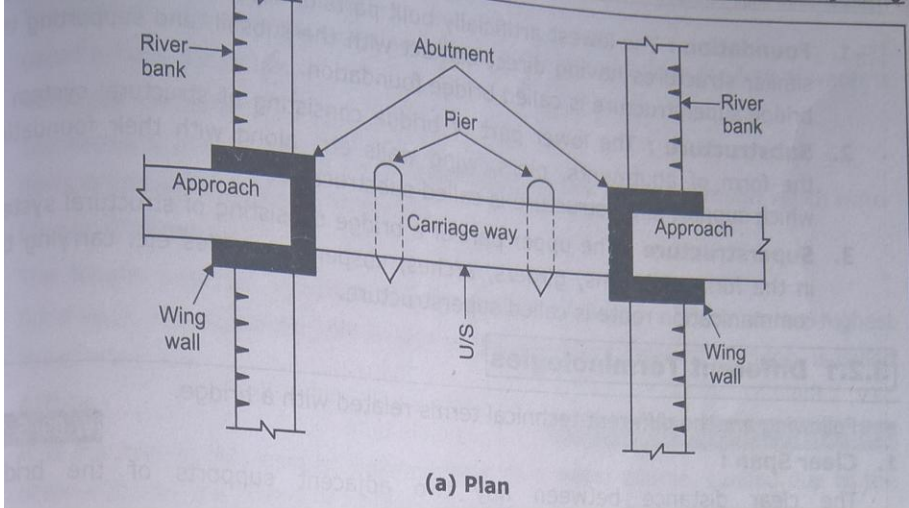
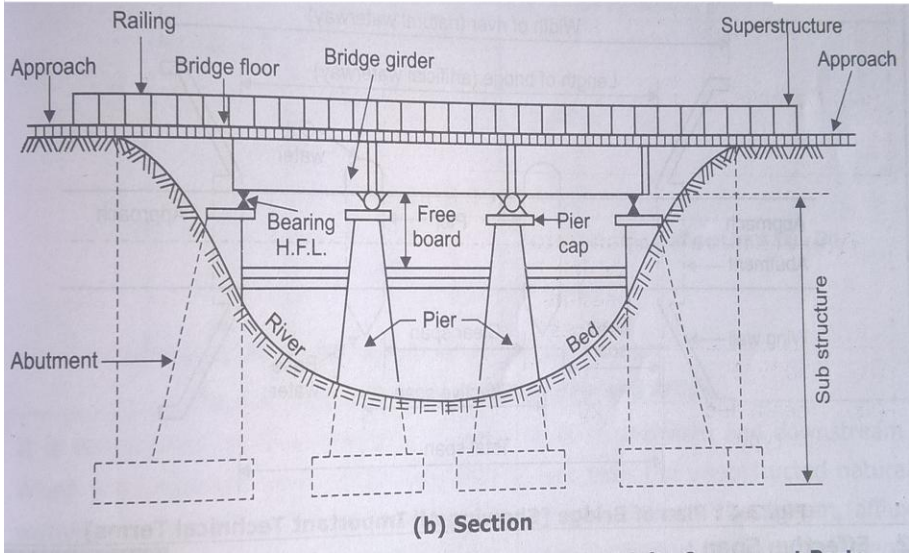
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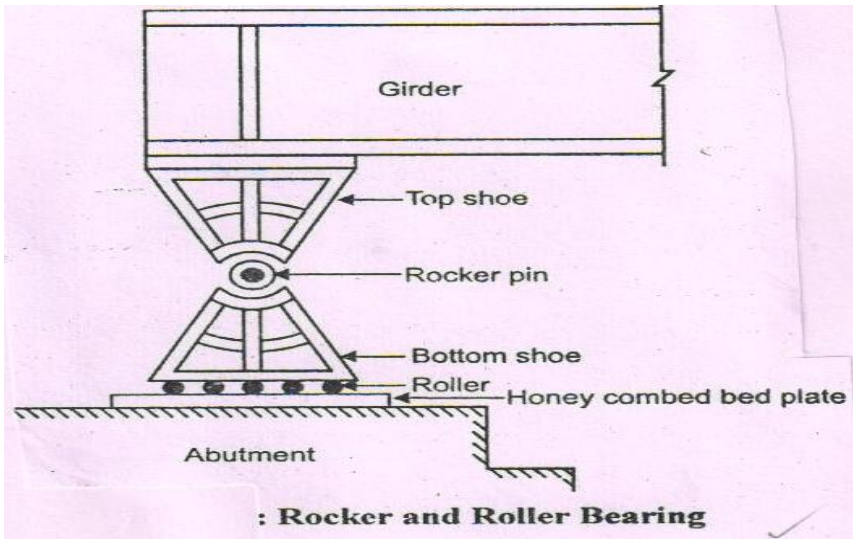
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|------------|-----------|--|----------------|-------------|
| Q.4 | a) | Attempt any <u>TWO</u> of the following: Classify the bridges according to function, material, span length and alignment. Ans. Bridges can be classified into various types depending upon the following factors and condition; 1. According to functions: a. Aqueducts b. Viaducts c. Foot bridges d. Highway bridges e. Railway bridges | 2 marks | 16 |
| | | 2. According to materials: a. Timber bridges b. Masonry bridges c. Steel bridges d. Reinforced cement concrete bridges e. Prestressed concrete bridges | 2 marks | 8 |
| | | 3. According to span length: a. Culverts b. Minor bridges c. Major bridges d. Long span bridges | 2 marks | |
| | | 4. According to alignment: a. Straight bridges b. Skew bridges | 2 marks | |



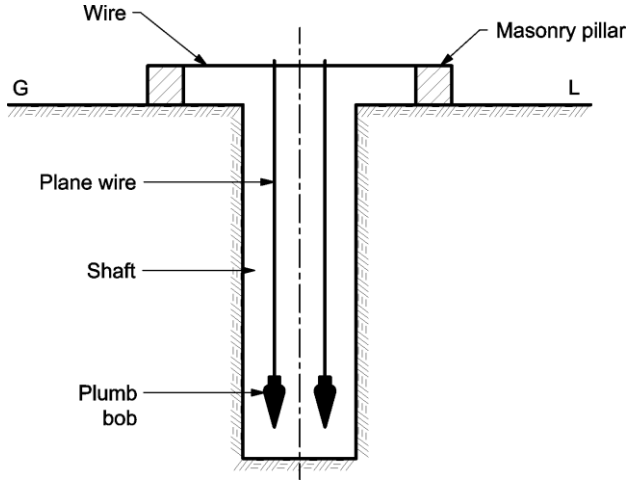
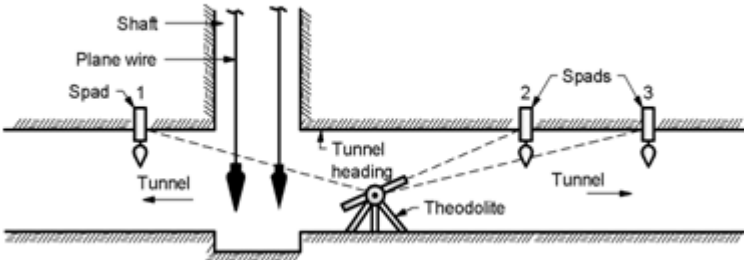
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| Q.4 | b) | <p>Draw a neat sketch of plan and L-section of bridge. Show component parts their on.</p> <p>Ans.</p>  <p>(a) Plan</p>  <p>(b) Section</p> <p>Note: 3 marks – Sketch and 1 mark – Labeling for each diagram.</p> | 4 marks | 8 |



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| Q.4 | c) | <p>Explain Rocker – Roller bearing with neat sketch.</p> <p>Ans.</p> <p><u>Rocker and Roller bearing:</u></p> <p>This type of bearing consists of a rocker bearing having its bottom shoe resting on a number of steel rollers which in turn roll on a honey combed bed plates is anchored to the top of the masonry of abutment. Thus, this type of bearing allows for free longitudinal as well as angular movements of the bridge girder. This type of bearing is suitable for span more than 20 m. generally, for spans over 20 m, a rocker bearing is provided on one end and a rocker and roller bearing on the other end of the bridge girder.</p>  <p>: Rocker and Roller Bearing</p> | <p>3 marks</p> <p>5 marks</p> | <p>8</p> |

Note: 3 marks for sketch and 2 marks for labeling.



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|---------|-------------|
| Q.5 | a) | <p>Attempt any <u>TWO</u> of the following:</p> <p>Explain the method of transferring the centre line from the ground through a shaft.</p> <p>Ans.</p> <p>Transferring the alignment (centre line) at the bottom of the shaft</p>  <p>Transferring the alignment to inside of the Tunnel</p>  <p>First of all shaft is constructed. After construction of shafts, the center line of tunnel is to be transferred down the shafts. For this purpose, generally two small pillars are constructed on opposite edges of the shaft along the center line of the tunnel. On the top of pillars, the points corresponding to the centre line are correctly marked and a wire is then stretched between them. After this two plumb bob are suspended by piano wire inside the shaft as shown in figure above. Two points are then marked by lowering plumb bob to the bottom of the shaft. The line joining the two points represents the center line of the tunnel marked on the ground. These lines are further extended into the tunnel heading as the work advances, by a theodolite placed in the shafts. Points along the centre line are marked by a peg provided with plumb bobs (spads), fixed to the roof of the tunnel as shown in figure above.</p> | 2 marks | 16 |
| | | | 2 marks | 8 |
| | | | 4 marks | |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.5 | b) | <p>What is ventilation of tunnel? State necessity of it. Explain mechanical method of tunnel ventilation.</p> <p>Ans.</p> <p><u>Tunnel ventilation</u> The art of providing freshness of air inside tunnels during or after their construction is known as ventilation in tunnels.</p> <p><u>Necessity of tunnel ventilation :</u></p> <ol style="list-style-type: none">1. To supply fresh air inside the tunnel.2. To remove poisonous gases, dust smoke etc.3. To reduce temperature in tunnel situated at great depth.4. By providing ventilation in tunnel which helps to reduce suffocation produce during and after construction of it. <p><u>Mechanical ventilation</u> is done by blowing fresh air into a tunnel or by exhausting the foul air or dust from the tunnel by any system listed below :</p> <ol style="list-style-type: none">1. Blowing process : In this method of mechanical ventilation, fresh air is forced by one or two blowers through the ducts, provided in the tunnel. By this method, positive supply of fresh air at the working place can be obtained. But the disadvantage lies in that the foul air, smoke and dust slowly move out, fogging the atmosphere inside the tunnel, especially in long tunnels. OR2. Exhausting process : In this method of mechanical ventilation, air is sucked by one or two exhaust fans installed near the tunnel heading. This creates vacuum due to which fresh air enters inside the tunnel. This method has the special advantage of quick removal of dust and smoke from the working face. OR3. Combination of blowing and exhausting process : In this method, blower and exhaust fans are provided for forcing fresh air in the tunnel and sucking foul air from the tunnel. The blower and exhaust fans are installed in suitably spaced inlet and outlet shafts connected to the tunnel. Immediately after the blasting operation, the exhausting system is operated for 15 to 30 minutes, to remove the objectionable air. After which blowing system is operated for forcing fresh air in the tunnel. This method provides the most efficient ventilation system of tunnels. | <p>1 mark</p> <p>3 marks (Any three)</p> <p>1 mark</p> <p>3 marks (Any one)</p> | 8 |



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| Q.5 | c) | <p>State any three advantages –disadvantages –suitability of needle beam method of tunneling.</p> <p>Ans.</p> <p><u>Advantages of needle beam method :</u></p> <ol style="list-style-type: none">1. This method is economical.2. Brick lining can be easily done by this method.3. Needle beam forms the main temporary support during the excavation <p><u>Disadvantages of needle beam method :</u></p> <ol style="list-style-type: none">1. Concrete lining by mechanical method is difficult.2. It requires large number of french jacks and the interfere with the efficient working of the labour gang.3. Pushing of beam by hand is difficult and cumbersome. <p><u>Suitability :</u></p> <p>This method is useful for tunneling in soft ground whose roof soil can stand without support for few minutes</p> | <p>1 mark each</p> <p>1 mark each</p> <p>2 marks</p> | 8 |



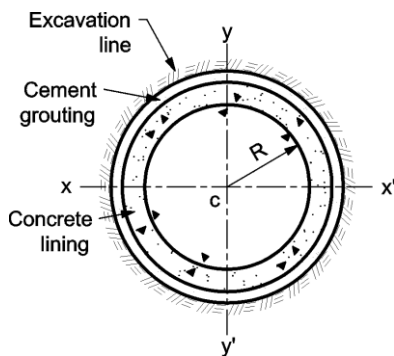
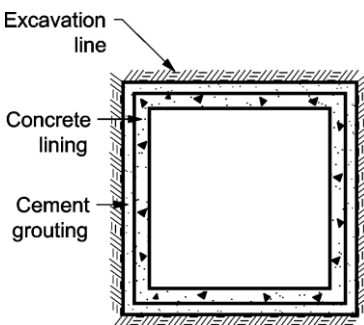
Model Answer: Summer 2016

Subject & Code: Transportation Engineering (17418)

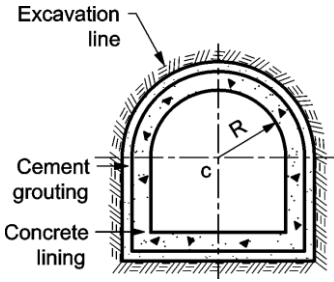
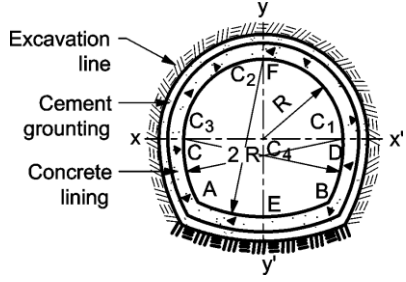
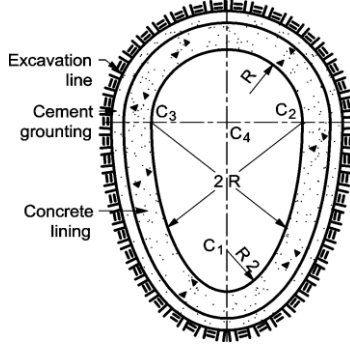
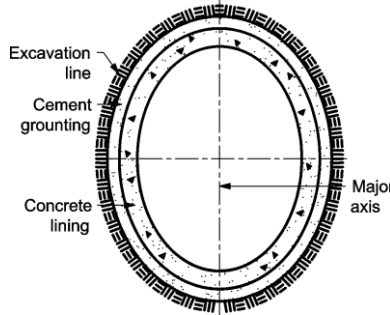
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| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|------------------------------|-------------|
| Q.6 | a) | Attempt any <u>FOUR</u> of the following List any four points for inspection of bridge substructure and superstructure. Ans. The following points should be kept in view while inspecting a bridge; Substructure: <ol style="list-style-type: none">1. Condition of mortar joints in case of masonry arch bridge.2. Condition of bearings, whether functioning properly or not.3. Any sign of development of cracks in masonry or concrete immediately below the bearings.4. Condition of abutments, piers and wing walls, whether good weathered or bulged.5. Any sign of development of cracks in concrete abutments and piers.6. Any sign of settlement of foundation.7. Any sign of scour along with maximum depth of scour.8. Condition of material used in arches in case of arch bridge.9. Condition of masonry, whether good or weathered. Superstructure: <ol style="list-style-type: none">1. Condition of wearing coat and its thickness.2. Condition of kerbs and railings.3. Condition of expansion joints, whether functioning well or not in case of concrete bridge.4. Condition of concrete, whether in good condition or spalling in case of concrete bridge.5. Condition of reinforcement, whether exposed anywhere or not in case of concrete bridge.6. Condition of paint in case of steel and iron bridge.7. Condition of steel work, material, members and connections in case of steel or iron bridge.8. Condition of material used in arches in case of arch bridge.9. Condition of masonry, whether good or weathered. | 1 mark each (Any two) | 16 |
| | | | | 4 |
| | b) | State necessity of shaft in tunnel. Ans. <ol style="list-style-type: none">1. To provide opening for removal of muck.2. To expedite the construction work of the tunnel by starting excavation at several points at the same time.3. To provide passageway for pumping out the water from the tunnel.4. To provide natural ventilation during construction of the tunnel. | 1 mark each | 4 |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks | | | | | | | | | | | | | | | | |
|--------------------------------------|--|--|--------------------------------------|-------------|-------------------------------|--|----------------|---|-----------------|--|------------------|--|----------------|---|------------------|--|----------------------|---|---|---|
| Q.6 | c) | <p>Classify tunnels according to shapes draw line sketches of them. State suitability of any four types according to shape.</p> <p>Ans.</p> <p>The various types of tunnels according to shapes are;</p> <table><tr><th>Types of tunnels according to shapes</th><th>Suitability</th></tr><tr><td>Rectangular or box type shape</td><td>These tunnels are suitable for pedestrian purpose.</td></tr><tr><td>Circular shape</td><td>These tunnels are commonly use for carrying water under pressure.</td></tr><tr><td>Segmental shape</td><td>Segmental tunnels are suitable as traffic tunnels These tunnels are commonly used in subways or as navigation tunnels.</td></tr><tr><td>Horse shoe shape</td><td>These tunnels are suitable in soft rock.</td></tr><tr><td>Egg type shape</td><td>Suitable for flow of sewage in dry and wet seasons.</td></tr><tr><td>Elliptical shape</td><td>These tunnels are suitable for carrying water.</td></tr><tr><td>Poly – centric shape</td><td>Such tunnels provide flat base to suit traffic tunnels for road and railway traffic</td></tr></table> <p><u>Rectangular shaped tunnel section</u> <u>Circular shaped tunnel section</u></p> <div></div> | Types of tunnels according to shapes | Suitability | Rectangular or box type shape | These tunnels are suitable for pedestrian purpose. | Circular shape | These tunnels are commonly use for carrying water under pressure. | Segmental shape | Segmental tunnels are suitable as traffic tunnels These tunnels are commonly used in subways or as navigation tunnels. | Horse shoe shape | These tunnels are suitable in soft rock. | Egg type shape | Suitable for flow of sewage in dry and wet seasons. | Elliptical shape | These tunnels are suitable for carrying water. | Poly – centric shape | Such tunnels provide flat base to suit traffic tunnels for road and railway traffic | <p>$\frac{1}{2}$ mark each (Any four)</p> <p>$\frac{1}{2}$ mark each (Any four)</p> | 4 |
| Types of tunnels according to shapes | Suitability | | | | | | | | | | | | | | | | | | | |
| Rectangular or box type shape | These tunnels are suitable for pedestrian purpose. | | | | | | | | | | | | | | | | | | | |
| Circular shape | These tunnels are commonly use for carrying water under pressure. | | | | | | | | | | | | | | | | | | | |
| Segmental shape | Segmental tunnels are suitable as traffic tunnels These tunnels are commonly used in subways or as navigation tunnels. | | | | | | | | | | | | | | | | | | | |
| Horse shoe shape | These tunnels are suitable in soft rock. | | | | | | | | | | | | | | | | | | | |
| Egg type shape | Suitable for flow of sewage in dry and wet seasons. | | | | | | | | | | | | | | | | | | | |
| Elliptical shape | These tunnels are suitable for carrying water. | | | | | | | | | | | | | | | | | | | |
| Poly – centric shape | Such tunnels provide flat base to suit traffic tunnels for road and railway traffic | | | | | | | | | | | | | | | | | | | |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| Q.6 | c) | <p><u>Segmental shaped tunnel section</u> <u>Horse-shoe shaped tunnel section</u></p> <div></div> <div></div> <p><u>Egg-shaped tunnel section</u> <u>Elliptical shaped tunnel section</u></p> <div></div> <div></div> | | |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|---|-----------------|
| Q.6 | d) | <p>State the advantages and disadvantages of tunnels.</p> <p>Ans.</p> <p>Advantages :</p> <ol style="list-style-type: none">1. They connect the two terminal stations by the shortest route.2. They facilitate less route length and thus results in less transportation cost.3. They carry railway lines, roads and public utilities like water, oil, gas etc across a stream or mountain.4. They help in avoiding acquisition of costly valuable land and property for road or railway projects.5. They eliminate excessive cost of maintenance of an open cut subjected to land slide.6. They provide free movement of traffic throughout the year even during snowfall and land slide.7. They facilitate conduction of water to generate power. <p>Disadvantages :</p> <ol style="list-style-type: none">1. They require special equipment and method for their construction.2. They require more time for their construction.3. Skilled labour and supervision is required in their construction.4. They may cause suffocation if not properly ventilated. | <p>1 mark each (Any two)</p> <p>1 mark each (Any two)</p> | <p>4</p> |
| Q.6 | e) | <p>Define lining of tunnels and state its various types.</p> <p>Ans.</p> <p><u>Tunnel Lining</u>: A layer of timber, iron, masonry or concrete provided on the inside of a tunnel is known as lining.</p> <p><u>Types of tunnel lining</u>:</p> <ol style="list-style-type: none">1. Timber - lining2. Stone - masonry lining3. Brick lining4. Iron lining5. Cast steel lining6. Precast pipe lining7. Pressed steel plate lining8. Precast block lining9. Concrete lining10. Reinforced concrete lining | <p>1 mark</p> <p>1 mark each (Any three)</p> | <p>4</p> |



| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|----------|-----------|--|---|-----------------|
| Q.6 | f) | <p>State the types of drift explain with sketch centre drift method.</p> <p>Ans.</p> <p>The various types of drift are</p> <ol style="list-style-type: none">1. Central drift2. Bottom drift3. Top drift4. Side drift <div data-bbox="638 600 944 985"><p style="text-align: center;">Centre drift method</p></div> <p>It consists in driving small size heading. Centrally at top or bottom of the face, this is later enlarged by widening and benching.</p> <p>The main operations involved in this method are as follows :</p> <ol style="list-style-type: none">(i) Boring or blasting a top centre heading of drift.(ii) Widening and enlarging.(iii) Benching in stages. <p>In this method, a drift of 2.5 m × 3 m (minimum) size or sufficient to accommodate the tunneling machinery, labour and mucking equipment etc. After making the central drift, holes are drilled for widening the face of the proposed tunnel. These drilled holes are then loaded with suitable explosive and fired step by step</p> | <p>1 mark</p> <p>1 mark</p> <p>2 marks</p> | <p>4</p> |