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SCHEME OF VALUATION

Scoring Indicators

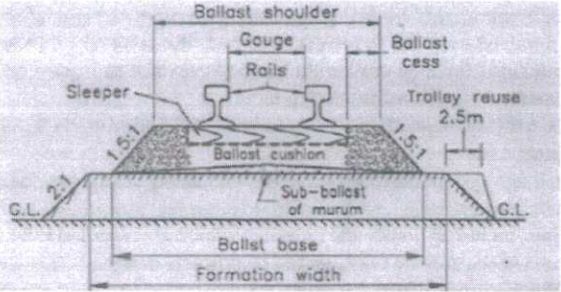
COURSE NAME: TRANSPORTATION ENGINEERING

COURSE CODE :6014 QID -2

REVISION : 2015

Qn No	Scoring indicator	Split up score	Sub total	Total
PART A				
I. 1	4 E's Road Safety :- (i) Education (ii) Enforcement (iii) Engineering (iv) Environment and Emergency care of road accident victims..	1 mark each	2	10
I. 2	Spoil Bank When the quantity of earth obtained from excavation or cutting of channel section is in excess of the quantity required for forming the bank and service road then extra earth is usually deposited in the form of spoil bank Borrow Pit Small pits dug to obtain extra earth for making bank if the soil obtained from cutting is not sufficient.	2	2	
I.3	The combination of points and crossings which enables the train to be diverted from one track to another track or to siding is called Turn Out. The track from which train diverts is called Main line. The turn out may be right handed or left handed depending up on whether the train from the main track is diverted to the right or left in the facing direction.	0.5 mark each point	2	
I.4	Terminal building: A focal point in the terminal area. It provides space for airline operations facilities for convenience of passengers, office for airport management and other non-aeronautical functions.	2	2	
I.5	It is a structure mostly used for bridges and dams as a substructure at the ends of a bridge span or dam and on that superstructure is rest. A bridge with a single span has two abutments that offer vertical and lateral support. It also plays the role of retaining walls to resist lateral movement of the earthen fill of the bridge approach.	2	2	
PART B				
II. 1	I. Extra widening refers to the additional width of carriageway that is required on a curved section of a road over and above that required on a straight alignment II. The reasons for widening the road are III. On a curve a vehicle occupies more width as the rear wheels do not follow the same path as the front wheels IV. The drivers have a tendency to keep away from the edge of the road while driving on curves V. The clearance required between vehicles passing each other is more on curves than on a straight road VI. Extra width is required to increase visibility The extra widening of pavement on horizontal curves is divided in to two parts	6	6	42

	<p>VII. Mechanical widening VIII. Psychological widening.</p> <p>Mechanical widening While negotiating a curve, rear wheels have a tendency to follow the inner track. To accommodate this, there will be a widening is provided called mechanical widening have to be provided. This is due to the offtracking of the vehicle.</p> <p>Psychological widening Extra width of pavement is provided for psychological reasons also. There is a tendency for the drivers to drive close to the edges of the pavement on curves. Some extra space is to be provided for more clearance for the crossing and overtaking operation on curves.</p>			
II.2	<p>In a highway transportation system, various types of signals are used to regulate traffic, ensure safety, and provide information to drivers and pedestrians. These signals can be categorized into different types: Mandatory signs, cautionary signs, informatory signs and temporary signs. Explain each signal with function and example and shape of signals</p>	6	6	
II. 3	<p>1)Traffic volume Study 2) Speed study (a) Spot speed study (b) Speed and Delay study 3) Origin and destination study 4) Traffic flow characteristics 5) Traffic capacity studies 6) Parking study 7) Accident study Brief notes on each one.</p>	6	6	
II. 4	<p>Super Elevation</p> <ul style="list-style-type: none"> ➤ When the fastmoving vehicle on a horizontal curve, the centrifugal force acts on the vehicle from inside towards the outside of the curve and hence lateral stability is affected. In order to avoid such situation, the outer edge of the pavement is raised with respect to the inner edge. This transverse inclination to the pavement surface is known as Super elevation or cant or banking. ➤ The Super elevation 'e' is expressed as the ratio of the height of outer edge with respect to the horizontal width. <p>Advantages of Super Elevation</p> <ol style="list-style-type: none"> 1. To counteract the effect of centrifugal force acting on moving vehicle 2. To help a fastmoving vehicles to negotiate a curved path without overturning and skidding 3. To ensure smooth and safe movement of passengers and goods on the road 4. To prevent damaging effect on the road surface due to improper distribution of road 5. The maintenance cost of road on curve is reduced 	6	6	
II.5	<p>Rail fastenings - Used to connect the rails and sleepers in their correct position</p> <ol style="list-style-type: none"> 1. Fish plate 2. Fish bolt 3. Chair 4. Keys 5. Bearing plates 	6	6	

	6. Anticreepers 7. spikes Briefly explain each one with their function			
II. 6	 <p>The diagram shows a cross-section of a railway track on an embankment. Key components labeled include: Ballast shoulder, Gauge, Ballast cess, Sleeper, Rails, Trolley reuse (2.5m), Ballast cushion, Sub-ballast of murum, Ballast base, Formation width, and G.L. (Ground Level). Slopes are indicated as 1:1 on both sides.</p> <p>Typical Cross section of a permanent way on Embankment</p>	6	6	
II.7	<p>Necessity of Tunnels</p> <ul style="list-style-type: none"> To meet the requirements of rapid transportation in big cities. To connect two terminals separated by a mountain by the shortest route, when the surface route of railway track or road for reaching the other side of a hill is much longer. To reduce very steep grades. To avoid the excessive cost of maintenance of an open cut subjected to landslides or snow drifts. To avoid the expensive acquisition of valuable built up land, tearing up pavements and holding up traffic for long periods in large cities. When the depth of ordinary cutting exceeds 20 m and the ground rises rapidly for a considerable distance afterwards. <p>List any 3 necessity</p> <p>Advantages of Tunnels</p> <ul style="list-style-type: none"> Tunnels are more economical than open cuts beyond certain depths. Tunnels avoid interfering with surface life and traffic during construction. In case of aerial warfare and bombing, the tunnels will grant better protection as compared to bridges. Tunnels avoid the dangerous open cut very near to the structure. Tunnels prove to be cheaper than bridges or open cuts to carry public utility services like water, sewer, gas, electricity and telephone lines. If tunnels are provided with easy gradients, the cost of hauling is decreased. Free from snow and iceberg hazards. Overall reduction in cost because of reduction in distance. Lesser maintenance cost. Tunnels avoid interference with surface and air rights. The movement of traffic with high speed is made possible. <p>List any 3 advantages</p>	6	6	
PART C				
III. a	Different types of sight distances	7	7	15

	<p>1. Stopping sight distance (SSD) 2. Over taking sight distance (OSD) 3. Head light sight distance (HSD) 4. Intermediate sight distance (ISD) 5. Intersection sight distance Explain each one with 2 or 3 sentences</p>			
III b	<p>Highway alignment : The position or lay out of centre line of the highway on the ground is called the alignment. Highway alignment includes both horizontal and vertical alignments of roadway Horizontal Alignment: This covers the horizontal path of the road either it's straight or curved or both. Top view of road alignment gives horizontal alignment of the road. Vertical Alignment: This deals with the gradients, slopes and levelling of the ground. Perspective view or front view or side view of the road alignment makes you understand about Vertical alignment. <u>Factors controlling alignment</u> (i) Obligatory points (ii) Traffic (iii) Geometric Design (iv) Economics (v) Other considerations <u>Additional care in hill roads</u> Stability Drainage Geometric standards of hill roads Resisting length Describe each one with 2 or 3 sentences.</p>	8	8	
IV.a	<p>First classification of roads by Nagpur Plan 1. National Highway 2. State Highways 3. Major District Road 4. Other District Road 5. Village Roads Explain each types of roads.</p>	7	7	
IV.b	<p>Intersections are classified depending upon the treatment of crossing conflicts as follows (i) At Grade Intersection and (ii) Grade Separated Intersection. At grade intersection : All the roads which meets at same level and involve traffic maneuvers like merging diverging and crossing. <u>Requirements</u> <input type="checkbox"/> Area of conflict should be minimum <input type="checkbox"/> Relative speed and angle of approach has to small <input type="checkbox"/> Should have adequate visibility <input type="checkbox"/> Sudden change of path should be avoided <input type="checkbox"/> Geometric features (turning radius, width) must adequate. <input type="checkbox"/> Proper signs must be provided <input type="checkbox"/> Good lighting in the night is desirable <u>Main Types</u> ❖ Unchannelized Intersections ❖ Channelized Intersections ❖ Rotary intersections</p>	8	8	15

	<p>Explain any one briefly</p> <p>Grade separated Intersection: Intersecting roads are at different levels. Crossing is not possible.</p> <ul style="list-style-type: none"> • It is a bridge that eliminates crossing conflicts at intersections by vertical separation of roadways in space. • Grade separated intersection are otherwise known as Interchanges. • Grade separated intersections cause less hazard and delay than grade intersections. <p><u>Classification of Grade Separated Intersection</u></p> <ol style="list-style-type: none"> 1. Underpass 2. Overpass 3. Trumpet Interchange 4. Diamond Interchange 5. Cloverleaf Interchange 6. Partial Cloverleaf Interchange <p>Explain any one briefly</p>			
V.a	<p><u>Highway Drainage</u></p> <ul style="list-style-type: none"> ➤ Process of removing and controlling excess surface and subsoil water with in the right of way ➤ Water damages the road surface and decreases the bearing power of the subgrade ➤ Proper road drainage is essential to maintain the strength and stability of a road ➤ Effective drainage is the most important factor in reducing the maintenance cost of roads <p><u>Necessity of Road Drainage</u></p> <ul style="list-style-type: none"> • Excess moisture in soil subgrade causes considerable lowering of its stability. • Increase in moisture cause reduction in strength of many pavement materials • Sustained contact of water with bituminous pavements causes failure due to stripping of bitumen from aggregates and formations of pot holes • Excess water on shoulders and pavement edges causes considerable damage. • Erosion of soil from top of unsurfaced roads and slopes of embankment, cut and hill side is also due to surface water. • In cold regions presence of water in the subgrade and a continuous supply of water from the ground water can cause considerable damage to the pavement due to frost action. <p><u>Requirement of Drainage System</u></p> <ul style="list-style-type: none"> ➤ Adequate camber and minimum gradient ➤ Side drain of required capacity ➤ Provision of suitable bridges, or culverts ➤ Seepage and other sources of under ground water should be drained off by the subsurface drainage system. ➤ Highest level of ground water table should be kept well below the level of subgrade, preferably by atleast 1.2m. ➤ Flow of surface water across road should not cause formation of ruts of erosion 	7	7	15
V.b	<p>Types of Highway Gradient</p> <ol style="list-style-type: none"> 1. Ruling gradient 	8	8	

	<ol style="list-style-type: none"> 2. Limiting gradient 3. Exceptional gradient 4. Average gradient 5. Floating gradient 6. Minimum gradient <p>Ruling gradient : Usually adopted while making the alignment of a road, Ruling gradient is also known as 'Design gradient'. It is fixed in such a way that all vehicles can overcome long distance without uneconomical fuel consumption, For selection of ruling gradient factors such as type of terrain, length of the grade, speed, pulling power of vehicle etc are considered.</p> <p>Limiting gradient : Steeper than ruling gradient. In hilly roads, it may be frequently necessary to exceed ruling gradient and adopt limiting gradient. It is also known as Maximum gradient or momentum gradient it depends on i) Topography ii) Cost of constructing the road</p> <p>Exceptional gradient : The gradient steeper than the limiting gradient which may be used in a short length of the road, only in an extraordinary situation is called exponential gradient. This type of gradient is adopted only in a very difficult situation and for a short length not exceeding 100 m at a stretch.</p> <p>Average gradient : Total rise or fall between any two point to Horizontal distance between two points.</p> <p>Floating gradient: The gradient on which a motor vehicle moving with a constant speed continues to descend with the same speed without any application of power brakes is called floating gradient.</p> <p>Minimum gradient : This is important only at locations where surface drainage is important. Camber will take care of the lateral drainage. But the longitudinal drainage along the side drains require some slope for smooth flow of water.</p>																					
VI.a	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Difference between Flexible & Rigid Pavement</th> </tr> <tr> <th style="width: 50%; text-align: center;">Flexible Pavement</th> <th style="width: 50%; text-align: center;">Rigid Pavement</th> </tr> </thead> <tbody> <tr> <td>1. Deformation in the sub grade is transferred to the upper layers</td> <td>1. Deformation in the subgrade is not transferred to subsequent layers</td> </tr> <tr> <td>2. Design is based on load distributing characteristics of the component layers</td> <td>2. Design is based on flexural strength or slab action</td> </tr> <tr> <td>3. Have low flexural strength</td> <td>3. Have high flexural strength</td> </tr> <tr> <td>4. Load is transferred by grain to grain contact</td> <td>4. No such phenomenon of grain to grain load transfer exists</td> </tr> <tr> <td>5. Have low completion cost but repairing cost is high</td> <td>5. Have low repairing cost but completion cost is high</td> </tr> <tr> <td>6. Have low life span</td> <td>6. Life span is more as compare to flexible</td> </tr> <tr> <td>7. Surfacing cannot be laid directly on the sub grade but a sub base is needed</td> <td>7. Surfacing can be directly laid on the sub grade</td> </tr> </tbody> </table>	Difference between Flexible & Rigid Pavement		Flexible Pavement	Rigid Pavement	1. Deformation in the sub grade is transferred to the upper layers	1. Deformation in the subgrade is not transferred to subsequent layers	2. Design is based on load distributing characteristics of the component layers	2. Design is based on flexural strength or slab action	3. Have low flexural strength	3. Have high flexural strength	4. Load is transferred by grain to grain contact	4. No such phenomenon of grain to grain load transfer exists	5. Have low completion cost but repairing cost is high	5. Have low repairing cost but completion cost is high	6. Have low life span	6. Life span is more as compare to flexible	7. Surfacing cannot be laid directly on the sub grade but a sub base is needed	7. Surfacing can be directly laid on the sub grade	7	7	15
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VI.b	<p><u>Penetration Maccadam</u></p> <p>❖ Also called Grouted Maccadam. Used as a base or binder course</p> <p><u>Method of making</u></p> <ul style="list-style-type: none"> • Coarse aggregates are spread first and compacted in dry state • Hot bituminous binder of relatively high viscosity is sprayed in large quantity over the top. • Bitumen penetrates into the voids from surface of compacted aggregate and fill up the void parts. 	8	8																			

	<ul style="list-style-type: none"> • It binds up stone aggregates together <p>Depending upon quantity of bitumen and extend of penetration there are two types, Full grout : bitumen penetrates to full depth of compacted aggregates. Semi grout : bitumen penetrates to half the depth of compacted aggregates. Full grout is used in the regions where rainfall is heavy</p> <p>Penetration Maccadam - Construction steps</p> <ol style="list-style-type: none"> Preparation of existing surface Spreading the coarse aggregates Rolling Bitumen application Spreading of key aggregates Seal coat Finishing Opening to traffic <p>Bituminous Maccadam (BM)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Also called Bitumen Bound Maccadam <input type="checkbox"/> It's a premixed construction method <input type="checkbox"/> One or more courses of crushed aggregates are premixed either bitumen binder and laid immediately after mixing. <input type="checkbox"/> BM is laid in a compacted thickness of 75mm or 50mm <input type="checkbox"/> BM is used as base course or binder course and is covered with suitable surface course. <input type="checkbox"/> BM is far superior than WBM and others as base course with respect load dispersion characteristics and durability. <p>Materials used:</p> <ul style="list-style-type: none"> • Bitumen of grade 30/40, 60/70 and 80/100 • Binder 3 to 4 percentage of weight of mix • Good quality well graded aggregates with low porosity • Plants and Equipment: • Sprayer . • Mechanical mixer or improvised hand mixer Spreader • Roller <p>Bituminous Macadam (BM)Construction Steps</p> <ol style="list-style-type: none"> Preparation of existing layer Tack coat or prime coat application Premix preparation Placement Rolling and finishing the paving mix 			
VII.a	<p>The operation of laying out rails on the prepared formation and connecting up of rails and sleepers is called plate laying</p> <p>Base-starting point of plate laying. The point from where the plate laying is commenced</p> <p>Railhead-End point. The point upto which the new track has been layed</p> <p>Methods of plate laving</p> <ol style="list-style-type: none"> 1. Side method/ tram method 2. Telescopic method 3 American method <p>SIDE METHOD / TRAM METHOD</p>	8	8	15

	<p>The materials are collected on formation either by i) Through existing railway line ii) Service road parallel to the track iii) In the absence of existing line a temporary line known as tram line is laid parallel to the track. This method is called tram line method</p> <p>TELESCOPIC METHOD Widely used method in India Track is prepared for some length and then the material is transported through that rail for the further laying.</p> <p>AMERICAN METHOD Rails and sleepers are assembled at the workshop and then complete set are move to the site of work.</p>			
VII.b	<p>Requirements of a good rail joint</p> <ul style="list-style-type: none"> • Should be strong • Should hold the two rails at the same level and in the same line • Should permit expansion and contraction of rails due to change in temperature • Should be such that a rail can be easily taken out without disturbing the whole track • Should be cheap • Should require less maintenance 	7	7	
VIII.a	<p>According to the position of joints i. Square joint ii. Staggered joint Explain both with brief notes and sketches According to the position of sleeper i. Suspended joint ii. Supported joint iii. Bridge joint Explain with brief notes and sketches.</p>	8	8	
VIII.b	<p>BULL HEADED RAILS</p> <p>Head is thicker than foot Require chair & key arrangement Key for connecting rail with the chair Round bolt/ round spike for fixing chair with sleeper Chairs are made up of cast iron Gauge distance can be easily maintained by adjusting the key</p> <p>Flat Footed Rail</p> <ul style="list-style-type: none"> • Also called Vignoles rail (invented by Charles Vignoles). • Used in 90% of the track in the world. • Foot is thinner and wider than the head. • It is cheaper and stronger in every direction than bull headed rails. It has better rigidity and stiffness to resist lateral and vertical forces. • Easy to fix on sleepers without chairs and keys. 	7	7	15
IX.a	<p>i. Runway : A long and comparatively narrow strip of paved way for landing and take-off of flight.</p>	7	7	15

	<p>ii. Taxiway: It is a path for aircraft at an airport connecting runways with aprons, hangars, terminals and other facilities.</p> <p>iii. Apron: A defined area which is used to accommodate aircrafts for loading and unloading of passengers and cargo, parking, refueling etc. It is usually paved and planned adjacent to terminal building or hangars.</p> <p>iv. Hangar: The primary function of a hangar is to provide an enclosure for servicing and doing repairs of the aircrafts. They are usually constructed of steel frames and covered with galvanized iron sheets. They are also provided with machine shops and stores of spare parts. The size of hangar depends upon the size of aircraft and its turning radius. Adequate lighting inside the hangar is of prime importance. The number of hangars depends upon the peak hour volume of aircrafts and demand of hangars.</p>			
IX.b	<p>Breakwater</p> <ul style="list-style-type: none"> • A structure which acts as protective barrier to enclose a harbour from the effects of waves and to maintain calm and undisturbed water. • Most prominent feature of an artificial harbor. • Prevent the waves from exerting their destructive influence within enclosed area of harbor. • These are artificially created with rubble or tetrapod, vertical concrete walls and a combination of both. • Such a construction makes it possible to use the area thus enclosed as a safe anchorage for ships and to facilitate loading and unloading of cargo in comparatively calm waters. • Hence, breakwater is an artificial construction to break the force of incoming waves. <p>Classification:</p> <ul style="list-style-type: none"> ❖ Heap/ Mound breakwater ❖ Composite Breakwater ❖ Upright Wall Breakwater <p>Briefly explain each one in 2 or 3 sentences.</p>	8	8	
X.a	<p>Docks</p> <ul style="list-style-type: none"> • A dock is an enclosed marine structure for berthing vessels. They are controlled by gates. It is for execution of repairs, cleaning, painting of ship bottom or for berthing vessels for loading and unloading of cargo or passengers. • Dock denotes an artificial basin for vessels where the variation in level of the water in the shore does not affect the level of water <p>Types of Docks</p> <p><input type="checkbox"/> Dry Dock</p> <ul style="list-style-type: none"> • Dry dock is used for the repair, inspection and painting of vessels. • It is a long excavated chamber with side walls, a semi-circular end wall and a floor. Open end is provided with a gate. • Dock floors are provided with keel blocks on which a ship is brought to rest on emptying the dock. • It is provided with big capacity pumps, lifting and hoisting machines and repair equipments. 	8	8	15

	<ul style="list-style-type: none"> • Ship enters the dock on adjusting the water level inside the dock to that outside. Entrance to the dock is then closed. Powerful pumps remove water and ship is lowered on to keel. ☐ Wet Dock • Docks required for berthing of ships or vessels to facilitate loading and unloading of passengers and cargo are called wet docks. • Equipped with entrance lock and massive gates operated by machinery. • Needed when the tidal level varies considerably (tidal range around 15 m). The level of wet docks is maintained at a uniform level by means of entrance lock. • The main advantages of the wet dock are:- • They maintain uniform level of water which helps in handling cargo. • They prevent the rubbing of the ship sides against the quay walls. • The effect of storms in the outer sea and the harbour do not obstruct a dock enclosure. 			
X.b	<p>Factors to be considered for site selection for bridge alignment</p> <ul style="list-style-type: none"> • MINIMUM WIDTH: Width has to be minimum to reduce the span of bridge and its construction cost. • GOOD FOUNDATION: Good foundation must be available at reasonable depth. • STRAIGHT REACH AND FIRM BANKS: The bridge must be located on a straight reach. the firm banks on the upstream and downstream can give safety and stability to the bridge. • SQUARE ALIGNMENT: The crossing should be perpendicular the river flow. It ensures uniform flow and minimize erosion. • STRAIGHT APPROACHES: Straight approaches of minimum 15m long has to be provided on either sides. • AVAILABILITY OF SUFFICIENT FREE BOARD: If the river below the bridge is used for navigation, there must be enough free board for easy passage of boats or ships. • WATER WAY: The obstruction to water way is to be minimum at the site of the bridge. • VELOCITY OF FLOW: There must be proper velocity for water flow at the bridge site to avoid silting and scouring. • AVAILABILITY OF MATERIALS AND LABOR: To reduce the construction cost, materials must be available near the bridge site. • EASY DIVERSION OF STREAM: To minimize the work under water, there must besufficient space to divert the stream. • CONFLUENCE OF TRIBUTARIES: The bridge must be away from the confluence of tributaries to avoid the possibilities of disturbance 	7	7	