

SCHEME OF VALUATION

Scoring Indicators

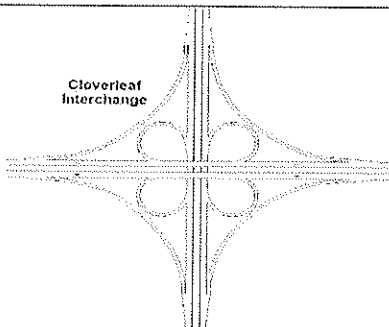
COURSE NAME: TRANSPORTATION ENGINEERING

COURSE CODE :6014 QID 1

REVISION : 2015

Qn No	Scoring indicator	Split up score	Sub total	Total
PART A				
I. 1	Prime coat: It is the first application of low viscosity liquid bituminous material over an existing porous and absorbent pavement surface such as WBM layer. Tack coat: It is the application of bituminous material over an existing pavement surface which is relatively impervious (such as bituminous surface, or cement concrete surface or WBM surface treated with prime coat).	1 mark each	2	10
I. 2	<ul style="list-style-type: none"> ➤ Rapid and rough survey ➤ Physical characteristics of the area are inspected and the proposed route is thoroughly examined ➤ Done without accurate instruments ➤ Use abney level, barometer, pocket compass 	2	2	
I.3	<ol style="list-style-type: none"> 1. Rails 2. Sleepers 3. Ballast 4. Formation 5. Fasteners 	0.5 mark each point	2	
I.4	The sudden rise or heading up of water level on the upstream side of bridge due to the obstruction caused by the bridge to the flow is called afflux	2	2	
I.5	A bridge is a structure that carries a roadway or railway over a physical obstruction. Its span is more than 6 m. A culvert is generally a tunnel like structure that allows water to pass under a roadway or railway. Its span is less than 6 m.	2	2	
PART B				
II. 1	<ul style="list-style-type: none"> • In 1927, Indian road development committee was appointed by the government with M.R. Jaykar as chairman. • Road development in the country should be made as a national interest since local govt. do not have financial and technical capacity for road development. • An extra tax should be levied on petrol from road users to create the road development fund. • To establish a semi-official ,technical institution to pool technical knowledge, sharing of ideas and to act as an advisory body. • To create a national level institution to carry research , development works and consultation. • A Research organization should be instituted to carry out research and development work • They gave stress on long term planning programmes 	1 mark for each point	6	42

II.2	<p>Various types of sight distances are crucial in transportation and road design to ensure safe and efficient traffic flow. Each type of sight distance serves a specific purpose and contributes to road safety.</p> <p>Stopping Sight Distance (SSD):</p> <ul style="list-style-type: none"> • Importance: Stopping sight distance is essential to allow drivers enough time to see an obstacle or hazard ahead, recognize it, and bring their vehicle to a stop safely. It helps prevent rear-end collisions and aids in maintaining safe following distances. <p>Passing Sight Distance (PSD) or Overtaking sight distance</p> <ul style="list-style-type: none"> • Importance: Passing sight distance is necessary for drivers to safely overtake slower-moving vehicles or pass obstacles on a two-lane road. Adequate PSD ensures that there is enough space to complete a passing maneuver without the risk of oncoming traffic. <p>Intersection Sight Distance (ISD):</p> <ul style="list-style-type: none"> • Importance: Intersection sight distance is critical at road intersections, enabling drivers to see cross traffic, pedestrians, and potential conflicts, allowing for safe entry into and crossing of intersections. <p>Head light sight distance (HSD)</p>	6	6	
II. 3	<p>Horizontal curves types: Simple curve, compound curve, reverse curve / Serpentine curve and transition curve – explain each one. Vertical curve types : Summit/crest curve, valley/sag curve. – explain each one</p>	6	6	
II. 4	<p>➤ Process of removing and controlling excess surface and subsoil water with in the right of way</p> <p>➤ Water damages the road surface and decreases the bearing power of the subgrade</p> <p>➤ Proper road drainage is essential to maintain the strength and stability of a road</p> <p>➤ Effective drainage is the most important factor in reducing the maintenance cost of roads</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. ➤ Failure of pavement due to frost action in cold countries. ➤ The prime cause of failure in rigid pavements by mud pumping is due to the presence of water in the fine subgrade soil • Formation of waves and corrugations in flexible pavement is due to poor drainage 	6	6	
II.5	<p>➤ Coning of wheel - In a straight track the wheel touches the rail at the centre of the wheel on both wheels • But in a curved track, outer track has to cover more distance than the inner track • Diameter of the outer wheel touching the rail is greater than diameter of the inner wheel touching the rail • In order to get this</p>	6	6	

	<p>variation in diameter the wheel should have a slope of 1 in 20 . It is called coning of wheel</p> <p>➤ Adzing of sleeper - In order to obtain an inward slope of 1 in 20 for the rail, the sleepers are cut to form a table. The process of cutting the wooden sleeper or casting the concrete sleepers accordingly is known as Adzing of sleepers</p>			
II. 6	<p>Functions - Provide level & hard bed for sleepers. Hold Sleepers in position. Transfer & distribute load to wide area. Provide elasticity & resilience to track. Provide longitudinal & lateral stability. Provide effective drainage. Maintain level & alignment of track Prevent vegetation growth</p> <p>Requirements - It should be tough and should not crumble under heavy loads. It should be cubical shape & angular shape with sharp edges. It should be able to non-porous & non-water absorbent particles of ballast are usually more durable due to better resistance. It should not make the track dusty or muddy. It should offer resistance to abrasion and weathering. It should not produce any chemical reaction with rails and sleepers. It should provide good drainage system. It should be cheap & economical or the ballast should be available in nearest quarries. In short, the ballast should be such which fulfils the characteristics of strength, clean ability, durability, economy & stability</p>	6	6	
II.7	<p>Deck-Type Bridge:</p> <ul style="list-style-type: none"> In deck-type bridges, the deck slab is located on the top of the bridge superstructure. It is the part of the bridge that directly supports the traffic load. <p>Through-Type Bridge:</p> <ul style="list-style-type: none"> In through-type bridges, the deck is positioned below the bridge superstructure. The load-bearing elements of the bridge, such as girders or trusses, are located above the deck slab. <p>Semi-Through Bridge:</p> <ul style="list-style-type: none"> Semi-through bridges are a combination of deck-type and through-type bridges. The deck slab is positioned between the top of the superstructure and the bottom, but it does not extend across the entire width of the superstructure. 	6	6	
PART C				
III. a	 <p style="text-align: center;">A cloverleaf interchange is a type of highway interchange that allows for the efficient flow of traffic between two major roads or highways without the need for traffic signals. It's called a "cloverleaf" because, when viewed from above, the interchange resembles the shape of a four-leaf clover.</p>	Fig – 4 4 mark	8	15

	<p>Four Ramp Loops: A cloverleaf interchange has four ramp loops that connect the two intersecting roads or highways. These loops are arranged in a circular pattern.</p> <p>Two Main Roads: There are two main roads, typically an overpass or underpass of one road over the other. The main roads allow traffic on one road to pass over or under the other without stopping.</p> <p>Entry and Exit Ramps: The four ramp loops consist of entry ramps and exit ramps. The entry ramps allow vehicles to enter the main road, and the exit ramps enable vehicles to exit the main road.</p>				
III b	<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>	7	7		
IV.a	<p>First classification of roads by Nagpur Plan</p> <ol style="list-style-type: none"> 1. National Highway 2. State Highways 3. Major District Road 4. Other District Road 5. Village Roads <p>Explain each types of roads.</p>	7	7	15	
IV.b	<p>4 E's Road Safety :-</p> <ol style="list-style-type: none"> (i) Education (ii) Enforcement (iii) Engineering (iv) Environment and Emergency care of road accident victims.. <p>Discuss the importance of each category</p>	8	8		
V.a	<p>Types of Highway Gradient</p> <ol style="list-style-type: none"> 1. Ruling gradient 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>	2	2	8	15

	<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>	2		
V.b	<p><u>Preparation of foundation</u></p> <ul style="list-style-type: none"> • Subgrade has to be prepared to required gradient and camber • Existing road has to be scarified and reshaped • Foundation has to be well drained. <p><u>Lateral confinement of aggregates</u></p> <ul style="list-style-type: none"> • Shoulders are prepared using good earth or moorum in advance to a thickness equal to thickness of WBM course. • It is rolled to retain the road structure between them. <p><u>Spreading coarse aggregate</u></p> <ul style="list-style-type: none"> • Coarse aggregates are spread uniformly and evenly upon the prepared base to a proper profile with the help of templates. <p><u>Rolling</u></p> <ul style="list-style-type: none"> • It is done for compaction using 6 to 10 ton rollers. • Rolling is done from edges towards the crown making longitudinal passes and with an overlap of half the width of the roller between two consecutive passes. • In superelevation, rolling is started from the lower edge towards the other edge. <p><u>Application of Screenings</u></p> <ul style="list-style-type: none"> • Screenings are applied on the compacted coarse aggregate in thin layers. • It is broomed to make them fill the voids and dry rolling is continued. • Three or more applications of screenings are made. <p><u>Sprinkling of water and rolling</u></p> <ul style="list-style-type: none"> • Plenty of water is sprinkled of the screening and is swept using broom. • Sweeping helps to fill the voids with wet screening. • Rolling is continued. • Additional screenings are applied if needed. <p><u>Application of Binding Materials</u></p> <ul style="list-style-type: none"> • Thin layer of binding material is applied and plenty of water is sprinkled. • It is broomed and the wet slurry is swept into voids and is rolled. • During rolling, water is applied to the wheels of the roller to wash down the binding material from its surface. • Two or more applications should me made. • Rolling is continued till the slurry of binding material and water forms a wheel ahead of the moving roller wheel. <p><u>Setting and Drying</u></p> <ul style="list-style-type: none"> • The surface is allowed to set over night • If depressions are found, it is filled with screenings and binding materials and is rolled if necessary. <p><u>Opening to traffic</u></p> <p>Road is made open for traffic after completing all necessary corrections.</p>	7	7	

VI.a	<h3 style="text-align: center;">Road in Cutting</h3>	8	8																	
VI.b	<h3 style="text-align: center;">Difference between Flexible & Rigid Pavement</h3> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Flexible Pavement</th> <th style="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>	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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VII.b	<h3>Object of Signalling</h3> <ul style="list-style-type: none"> To provide safety to passengers the staff, the good and the rolling stock by preventing a running train from coming in contact with another moving or stationary train To provide safe distance between trains running on the same track in the same direction To make the shunting operations safe and efficient To provide directional indications at diverging junctions To restrict the speed of trains during repairs of track 	8	8																	

	<ul style="list-style-type: none"> In marshalling and locoyards to provide safety to shunting operations <p><u>PRINCIPLES OF INTERLOCKING OF SIGNALS</u></p> <ol style="list-style-type: none"> It should not be possible to turn off (lower) any 2 signals at the same time that can lead to collision of train It should not be possible to turn off a signal unless all points relating to the line are set and locked After the signal has been lowered (turned off) it should not be possible to makes adjustments in the points or locks on the route It should not be possible to lower the warner signal and outer signals unless corresponding home signal is lowered. 			
VIII.a	<p>Function of sleepers</p> <ul style="list-style-type: none"> To hold the rails to proper gauge. To support the rails firmly and evenly To interpose an elastic medium in between the ballast and rails. To distribute the load from rails to the ballast. Add general stability of the track. To support the rails at a proper level in straight tracks and at proper super elevation on curves. <p>Requirements of sleepers</p> <ul style="list-style-type: none"> Should be strong to bear stress Should provide sufficient bearing area for rail Should be stable and should not get disturbed easily Should not get damaged while packing and tamping Should maintain proper gauge Should permit track circuiting 	7	7	
VIII.b	<p>Station yards : System of tracks at a station for storing, sorting and dispatching vehicles</p> <p>According to the purpose of the yards they are divided into</p> <ol style="list-style-type: none"> Passenger Yard Marshaling yard Locomotive yard Goods yard <p>Explain each one with functions and requirements</p>	8	8	
IX.a	<p>Classification of Bridge</p> <p>There are various classification of bridge such as;</p> <ol style="list-style-type: none"> based on materials used for construction based on structural action based on alignment based on location of flooring based on position of H.F.L based on the purpose of bridge based on life based on live load standards as per IRC <p>Briefly explain each one</p>	8	8	15
IX.b	<p>Necessity and uses 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. 	7	7	

	<ul style="list-style-type: none"> 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. 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. 			
X.a	<p>Regional plan</p> <ul style="list-style-type: none"> The site selected should fit well into the regional plan. Thereby, it should form an integral part of the national network of airport. <p>Use of airport</p> <ul style="list-style-type: none"> The use of airport whether for civilian or military is an important factor for the selection of site. <p>Proximity to other airports</p> <ul style="list-style-type: none"> The site selected should be at a considerable distance from the existing airports. The aircraft landing in one airport should not interfere with the movement of aircraft at other airport. <p>Accessibility to ground</p> <ul style="list-style-type: none"> The site selected should be adjacent to main highway. Availability of public transportation facilities (bus, taxi etc.) is preferred. <p>Topography</p> <ul style="list-style-type: none"> This includes natural features like ground contours, trees, streams etc. A hill top or raised ground will be an ideal site for an airport because of <ul style="list-style-type: none"> Less obstructions in approach zone and turning zones Natural drainage Uniform wind Better visibility due to less fog <p>Obstructions</p> <ul style="list-style-type: none"> When aircraft is landing or taking off, it loses or gains altitude very slowly. 	8	8	15

	<ul style="list-style-type: none"> For this reason, long clearance areas are provided on either side of runway known as approach areas over which the aircraft can safely gain or lose altitude. Approach areas for the selected site should be kept free of obstructions. The obstructions may be fences, trees, pole lines, buildings and other natural or manmade objects. The future growth of undesirable structures is to be controlled. <p>Visibility</p> <ul style="list-style-type: none"> The poor visibility lowers the traffic capacity. Fog, smoke and haze should be less in the locality. <p>Trend of the future development of industrial area should also be studied and the site should be selected accordingly</p> <p>Wind</p> <ul style="list-style-type: none"> Runway is oriented in such a way that landing and take-off is done by heading into the wind. Wind data (direction, duration and intensity of wind) should be collected over a minimum period of about 5 years. This helps in proper orientation of runway and influences the shape of the site needed for the development of airport. <p>Noise nuisance</p> <ul style="list-style-type: none"> The extent of noise nuisance depends upon the type of engine propulsion and gross weight of aircraft. The problem becomes more acute with jet engine aircrafts. Therefore, site selected should be free from residential or industrial development. <p>Future development</p> <ul style="list-style-type: none"> When the traffic increases, extra runways have to be provided. More facilities are to be provided for processing of passengers, cargo, baggage and shelter for aircrafts. <p>Economic considerations</p>			
X.b	<p>A harbour is a basin or a roadstead of navigable waters well protected naturally or artificially from the action of wind and waves, and is situated along sea-shore or river estuary or lake or canal connected to sea. It is a sheltered body of water where ships, boats, and barges can be docked. Harbour is used to take in and discharge passengers and cargo, refueling and repairs.</p> <p>Harbours may be natural or artificial. An artificial harbor can have deliberately constructed breakwaters, sea walls, or jettys or they can be constructed by dredging, which requires maintenance by further periodic dredging.</p> <p>Based on the protection needed</p> <ul style="list-style-type: none"> Natural harbour Semi-natural harbour Artificial harbor <p>Explain the types with suitable sketch.</p>	7	7	