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TED (15) – 6014

(REVISION — 2015)

Reg. No.....

Signature

DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/
MANAGEMENT/COMMERCIAL PRACTICE — APRIL, 2019

TRANSPORTATION ENGINEERING

[Time : 3 hours

(Maximum marks : 100)

PART — A

(Maximum marks : 10)

Marks

I Answer *all* questions in one or two sentences. Each question carries 2 marks.

1. List different types of roads as per IRC.
2. Define right of way.
3. State the necessity of super elevation.
4. List the components of a permanent way of rail transportation.
5. Define dock.

(5×2 = 10)

PART — B

(Maximum marks : 30)

II Answer any *five* of the following questions. Each question carries 6 marks.

1. Give the significant recommendations of Jayakar Committee report.
2. State the importance of various types of sight distances.
3. Sketch the cross section of a road and explain the functions of each layers.
4. Write short notes on camber.
5. List the functions of sleepers.
6. Differentiate between a bridge and a culvert.
7. Discuss about tunnels and the necessity of tunnelling.

(5×6 = 30)

PART — C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT — I

- III (a) Explain different types of traffic studies for a highway. 8
 (b) Describe the importance of highway transportation. 7

OR

- IV (a) Write short note on grade separators. Sketch trumpet type grade separator. 8
 (b) Explain different types of road signals. 7

UNIT — II

- V (a) State the necessity and requirements of road drainages. 8
 (b) Write the procedure of construction of WBM road. 7

OR

- VI (a) Explain different phases of bituminous road construction. 8
 (b) Give the importance of gradient for roads with their types. 7

UNIT — III

- VII (a) Explain the need of coning of wheels and adzing of sleepers. 8
 (b) Identify different types of station yards. 7

OR

- VIII (a) Sketch cross section and label the components of a permanent way. 8
 (b) Explain what is inter-locking and its importance. 7

UNIT — IV

- IX (a) Explain different types of bridge foundations. 9
 (b) List the factors to be considered for the site selection of an airport. 6

OR

- X (a) Explain the following terms in short (i) Break water, (ii) Wharf, (iii) Air field, (iv) Runway. 8
 (b) List the factors to be considered for the site selection of bridge alignment. 7

(15)

7

SCHEME OF VALUATION

REVISION 15 Course Code: TED (15) 6014 Course Title: TRANSPORTATION ENGINEERING

Q.NO	Scoring Indicator	Split score	sub total	Total
PART A				
QI.1	IRC(Indian Roads Congress) has classified the roads in the India in the following 5 categories: (a) National Highways (b) State Highways (c) Major District Roads (d) Other District Roads (e) Village Roads.	2		
(2)	The area of land acquired for construction and development of highway is known as right of way. The width of this acquired land is known as land width.	2		
(3)	Super elevation is necessary to counteract the effects of centrifugal force. It is the amount by which the outer edge of a curve on a road is raised above the inner edge to counteract the imbalance caused by outward thrust.	2		
(4)	The Main Components of Permanent Way are as Follows: a) Rails. b) Sleepers c) Fasteners. d) Ballast or Slab Track e) Subgrade.	2		
(5)	Dock is an enclosed place where a ship enters for repair and maintenance.	2	10	10
PART B				
QII.1	Jayakar committee was appointed by Indian legislature for the development of roads in India in 1927. M.R.Jayakar as chairman of the committee and submitted its report by the year 1928. a) The road development in the country should be considered as a national interest. b) An extra tax should be levied on petrol from road users to develop a road development fund called central road fund. c) A semiofficial technical body should be formed to act as an advisory body on various aspects of roads. d) A research organization should be instituted to carry out research and development work. e) They gave stress on long term planning programme (20yeaar plan)	4x1.5 =6	6	
QII.2	Sight distance is the length of the road ahead that is clearly visible to the driver on the curves horizontal and vertical. It is measured along a line which touches the curve at a point between the driver and the obstacle. In the case of vertical curves the line of sight of the driver is taken to be at a height			

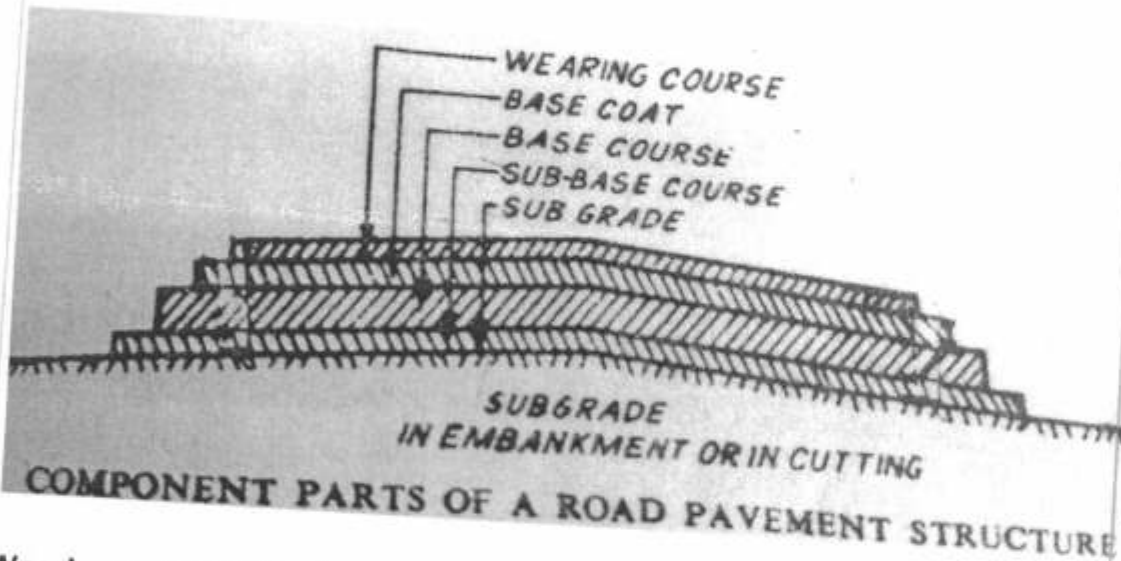
SCHEME OF VALUATION

REVISION 15

Course Code:6014

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Q.No	Scoring Indicator	Split score	sub total	Total
Q11.3	of 1.2m above the road. The height of stationary obstacle is taken to be 100mm above the road. Stopping distance is the distance required to stop the vehicle after the driver sees a danger on the road. It depends upon 1) speed 2) reaction time of the driver 3) breaking distance and 4) coefficient of friction.	2x3 = 6	6	



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Wearing course: Wearing course is the layer directly in contact with traffic loads and generally contains superior quality materials. The functions and requirements of this layer are:

It provides characteristics such as friction, smoothness, drainage, etc. Also it will prevent the entrance of excessive quantities of surface water into the underlying base, sub-base and sub-grade. It gives strength to the road structure. It act as a cushion between wheel and base.

Base course: The base course is the layer of material immediately beneath the surface of binder course and it provides additional load distribution and contributes to the sub-surface drainage It may be composed of crushed stone, crushed slag, and other untreated or stabilized materials.

SCHEME OF VALUATION

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Q.No	Scoring Indicator	Split score	sub total	Total
QII.4	<p>Sub-Base course: The sub-base course is the layer of material beneath the base course and the primary functions are to provide structural support, improve drainage, and reduce the intrusion of fines from the sub-grade in the pavement structure. If the base course is open graded, then the sub-base course with more fines can serve as a filler between sub-grade and the base course. A sub-base course is not always needed or used. For example, a pavement constructed over a high quality, stiff sub-grade may not need the additional features offered by a sub-base course. In such situations, sub-base course may not be provided.</p> <p>Sub-grade: The top soil or sub-grade is a layer of natural soil prepared to receive the stresses from the layers above. It is essential that at no time soil sub-grade is overstressed. It should be compacted to the desirable density, near the optimum moisture content.</p> <p>CAMBER : The cross slope in the transverse direction of road is called Camber (or Cant). It is generally provided for the purpose of draining the rain water from the road surface towards the edges, to Protect the subgrade, and for safety, as wet pavement conditions are quite undesirable from safe driving point of view. The central part of the road which is raised is called the crown.</p> <p>The cross slopes can be expressed as 1 in n or in percentages as n%. Steep cambers are effective in quick removal of surface water but are undesirable as they will erode the surface.</p> <p>Types of camber</p> <p>There are generally three types of cambers provided along the road surface, namely straight line, parabolic and composite cambers.</p>	3	6	

Straight line camber: These are provided with two equal uniform straight line slopes at both sides of the crown and are also known as Plane cross slopes.

Parabolic Camber: In parabolic camber, the cross slope is in the shape of simple quadratic parabola.

Composite camber: Composite camber may be composed of partly parabola and partly straight line or two straight lines having different slopes.

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G

Q II.5 Functions of sleepers are,

- (1) support the rails firmly and evenly
- (2) To hold the rails to proper gauge
- (3) To hold the rails at proper level or at inward transverse tilt
- (4) To transfer load from the rails to ballast and distribute it
- (5) To act as an elastic medium rail and ballast and to counteract the tendency of wheel loads to disturb the track
- (6) To provide stability to permanent way

Gx1

Q II.6 The purpose of both *bridges and culvert* is providing a transportation route over obstructions, but the span length chiefly differentiates between the two structures. Some other differences between bridges and culverts are given below:

G

S/No	Bridge	Culvert
1	A bridge is a passage of transportation (for people or vehicles) over a large body of water or physical obstruction	A culvert is generally a tunnel-like structure that allows water to pass under a roadway or railway

2	The basic components of a bridge are superstructure substructure and deck	The components of a culvert are comparatively simpler and include concrete boxes , pipes, a top deck or slab and supporting parts.
3	Bridges are constructed at a height more than 20 feet.	Culverts are built at less than 20 feet high over the obstruction.
4	A bridge spans from 6 meters (minor bridges) to more than 120 meters	The length of culverts is typically not more than 6 meters.
5	A bridge contains no floor	A culvert is an enveloping structure that consists of two sides, a roof, and a floor.
6	The construction of a strong and deep foundation is very important.	No deep foundation is required for a culvert
7	Construction of bridges generally requires a lot of time and manpower.	Culverts are simpler in structure and design, so it can be constructed with less time and labor.
8	Bridges provide an easier route of transportation that saves time and reduces distance	Culverts prevent water logging, flood, and erosion, and allows water to flow to natural course.

6x1
= 6

6

QII.7 The artificial underground ways that are constructed for transportation are called tunnels. The tunnels are required for highways, railways , sewerage, water supply and canals. To avoid high gradients tunnels can be preferred. Regarding economy point of view the initial expenditure and returns are to be taken in to account to purpose a tunnel. Considering the factor and safety of the traffic and other public utilities the provision of tunnels becomes necessary under the following circumstances. 1) When the surface route of railway track or road for reaching the other side of a hill is much longer. 2)

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when the depth of open cut for reaching the other side of a hill more is than twenty meter and it is costlier to construct it than a tunnel. 3)when acquisition of valuable land and property for a railway or road project is to be avoided. 4) when there is necessity of conduction of water for the generation of power.5) to carry public amenities like water , oil, gas etc across a stream or mountain economically.

PART C

UNIT I

A

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IIIa A traffic study is a survey undertaken to determine the volume and/or nature of traffic utilising a particular route. A traffic survey can be manual or automatic Informations to be collected during traffic studies are

1)Volume of traffic: It means number of vehicles , persons or animal passing a given point on a road during a specified period of time and is expressed as vehicles per day

2) Speed Surveys: It is recorded by means of traffic counters.

3) Nature of traffic: It means whether the traffic is heavy during a certain period of the year due to some festival or harvest or during certain time with in the day when the office workers and come back.

4)Origin and destination of traffic: it means the places from where traffic originate and where if terminates.

5)Accidents: It mean collision of one road user with the other road user or with the fixed object lying with in the road pavement.

4x2

- 8

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III b The importance of highway transportation can be easily judged from the following purposes.

1) They felicitate conveyance of people goods raw materials manufactured articles speedily and easily in the different parts of the country.

- 2) They act as the only source of communication in regions of high altitude and mountainous region.
- 3) They help in growth of trade and other economic activities by establishing contact between towns and villages.
- 4) They help in promoting cultural and social ties among people and thus strength the national unity.
- 5) They provide more employment opportunity.
- 6) They enhance land value and thus bring better revenue.
- 7) They serve as feeders for airways waterways and railways.

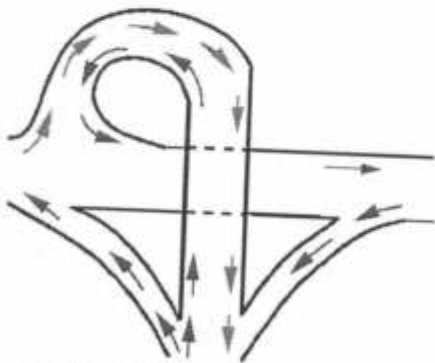
7x1 = 7 7 15

IV a

Write short note on grade separators. Sketch trumpet type grade separators

Grade separation is a method of aligning a junction of two or more surface transport axes at different heights so that they will not disrupt the traffic flow on other transit routes when they cross each other. The composition of such transport axes does not have to be uniform; it can consist of a mixture of roads, footpaths, railways, canals, or airport runways. Bridges (or overpasses or flyovers), tunnels (or underpasses), or a combination of both can be built at a junction to achieve the needed grade separation.

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TRUMPET TYPE GRADE SEPERATOR

IV b

Road safety signs are primarily of three types in INDIA

- 1. Mandatory Signs: These signs indicate to the traffic to comply with certain regulations of traffic. Violation of these signs is an offence, as per law. Halt, Stop, Go, Slow, Keep left etc.

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- 2. Cautionary or warning Signs: These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation. Junction, sharp bent, hill or ghat road, schools zone etc.
- 3. Informatory Signs: These signs guide the road users about destinations, distance, alternative routes, directional signs, and prominent locations like fuel points, public toilets, nearby hospitals, etc.
- 4) Prohibitory Signs: these signs indicate to the traffic that the use of horns is prohibited like no parking, no entry, speed limit etc
- 5) Temporary signs: these are signs which are used at the time of repairs.

UNIT II

V (a)

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.

- 1) A drainage system should have adequate camber and minimum gradient for the road surface to ensure quick drainage of surface water.
- 2) Side drains should have sufficient capacity to drain off all water.
- 3) All sub soil water including water from springs entering the road structure should be taped and drained off by sub surface drainage.
- 4) Flow of surface water across road should not cause formation of ruts of erosion.
- 5) Highest level of ground water table should be kept below the level of subgrade.

V b

Macadam means the pavement base course made of crushed or broken aggregate mechanically interlocked by rolling and the voids filled with screening and binding material with the assistance of water. **WBM** may be used as a sub-base, base or a surface course. The thickness of each compacted layer of **WBM** ranges from 10cm to 7.5 cm.

Construction Procedure:

- 1. Prepare the foundation for receiving the WBM course.
- 2. Lateral confinement may be done by compacting the shoulder to advance, to a thickness equal to that of the compacted WBM layer and by

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- trimming the inner side vertically.
- 3. Spreading of Coarse Aggregate.
- 4. Compaction of coarse aggregate is done by wheeled power roller of capacity 6 to 10 tons or alternately by an equivalent vibratory roller. The rolling is started from the edges proceeding towards the center longitudinally over lapping not less than one third of roller tread.
- 5. Dry screening is applied gradually over the surface to fill the interstices in these.
- 6. The surface is sprinkled with water, swept and rolled.
- 7. Binding material is applied at a uniform and slow rate at two and more layers.
- 8. WBM Coarse is allowed to set overnight.

4	8	15
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QVIa Steps in Bituminous Road Construction

- Preparation of the existing base course layer. The existing surface is prepared to the proper profile and by removing the pot holes or rust if any.
- Application of Tuck Coat. Using a mechanical sprayer or pouring can, bituminous binder is sprayed evenly at the specified rate.
- Preparation and placing of Premix. The premixed bituminous concrete is layed to the required thickness.
- Rolling. The rolling is done with tandem roller of 6 to 8 tonnes weight. The rolling is started from the edges proceeding towards the centre longitudinally over lapping not less than one third of roller tread.
- Finishing and opening to traffic: The surface is checked for camber and opened for traffic after 24 hours.

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VI b Gradient : Gradient is the rate of rise or fall along the length of the road with respect to the horizontal. It is expressed as ratio of level difference to the total horizontal length. The gradients are positive gradient or the ascending and the negative gradient or descending. Although, flatter gradients are desirable, it is evident that the cost of construction will also be very high. Therefore, IRC has specified the desirable gradients for each terrain.

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Terrain	Ruling	Limitings	Exceptional
Plain/Rolling	3.3	5.0	6.7
Hilly	5.0	6.0	7.0
Steep	6.0	7.0	8.0

IRC Specifications for gradients for different roads

- (1) Ruling gradient-It is desirable upper limit of gradient 1 in 20 to 30
- (2) Limiting gradient-- It is the limit of steepest gradient 1 in 15 to 20
- (3) Exceptional gradient It is the gradient steeper than Limiting gradient which are provided in the exceptional case 1 in 12 to 15
- (4) Minimum gradient - to drain surface water -1 in 100 to 200

UNIT III

QVIIa The wheels of trains are not made flat They are made in the shape of frustum of a cone having a slope of 1 in 20 .On curves outer wheel has to travel more distance than inner wheel. Coning of wheel is done for this purpose . Even on straight tracks the trains have a tendency to move sideways. Coning of wheels helps to check and minimize this tendency .Hence riding will be smooth, giving comfort to passengers. Due to coning of wheels the load of train is concentrated on the inner edges of heads of rails. In order to minimize the disadvantages caused by **coning of wheels**, the rails are tilted inwards at an angle of 1 in 20. Tilting of rails can be achieved by **Adzing of Sleepers**. This reduces wear on the rail as well as on the tread of the **wheel**. The process of cutting the wooden **sleeper** or casting the concrete **sleepers** to achieve this slope is known as **Adzing of sleepers**

QVIIb A yard is a system of tracks laid out to deal with the passenger as well as goods traffic being handled by the railways. This includes receipt and dispatch of trains apart from stabling, sorting, marshalling, and other such functions. Yards are normally classified into the following categories.
Passenger yards. Goods yards. Marshalling yards. Locomotive yards

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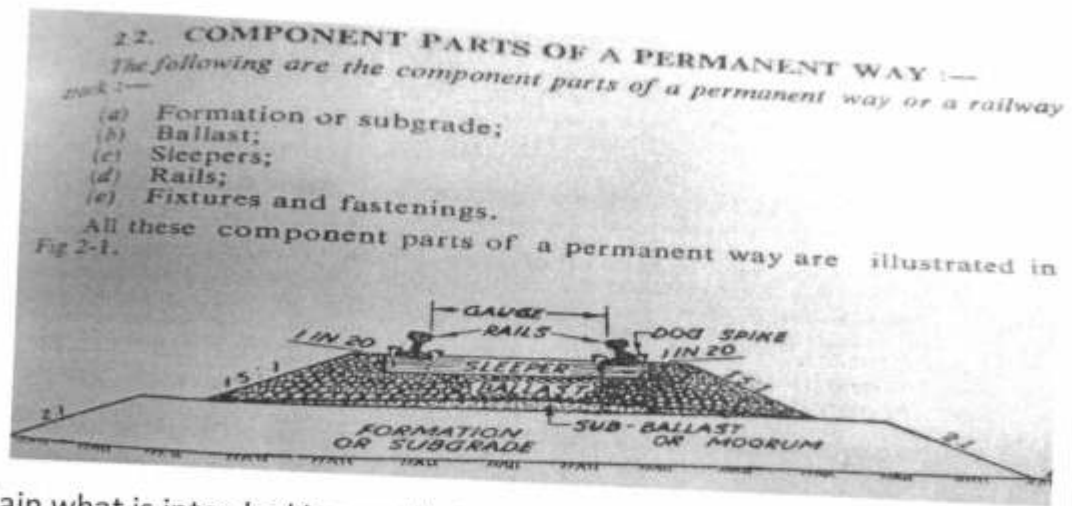
- **Passenger yard:**The main function of a coaching yard is to deal with the reception and dispatch of passenger trains. Depending upon the volume of traffic, this yard provides facilities such as watering and fuelling of engines, washing of rakes, examination of coaches, charging of batteries, and trans-shipment of passengers.
- **Goods yard:**A goods yard provides facilities for the reception, stabling, loading, unloading, and dispatch of goods wagons. Most goods yards deal with a full train load of wagons. No sorting, marshalling, and reforming is done at goods yards except in the case of 'sick' wagons or a few wagons booked for that particular station. Separate goods sidings are provided with the platforms for the loading and unloading of the goods being handled at that station.
- **Locomotive yard:** This is the yard which houses the locomotive. Facilities for watering, fuelling, examining locomotives, repairing, etc., are provided in this yard. The yard layout is designed depending upon the number of locomotives required to be housed in the locomotive shed. The facilities are so arranged that a requisite number of locomotives are serviced simultaneously and are readily available for hauling the trains. Such yards should have adequate space for storing fuel. The water supply should be adequate for washing the locomotives and servicing them.
- **Sick line yard:**Whenever a wagon or coach becomes defective, it is marked 'sick' and taken to sick lines. This yard deals with such sick wagons. Adequate facilities are provided for the repair of coaches and wagons, which include examination pits, crane arrangements, train examiner's office and workshop
- **Marshalling Yard:**The marshalling yard (Fig. 26.14) is a yard where goods trains are received and sorted out, and new trains are formed and finally dispatched to various destinations. This yard receives loaded as well as empty goods wagons from different stations for further booking to different destinations. These wagons are separated, sorted out, properly marshalled, and finally dispatched bearing full trainloads to various destinations. The marshalling of trains is so done that the wagons can be conveniently detached without much shunting.

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VIII a



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VIII b

Explain what is inter-locking and its importance. The levers operating the various signals and points are mechanically connected in order to avoid the possibility of pulling wrong levers and to ensure safe movement of trains. This is known as inter locking of signals. The main object of inter locking is to eliminate human error in the operation of signals and points. At each station there are number of points and signals. At the time of operating points their corresponding signals should be lowered. If points are set for one track, and signal is lowered for other track it may cause serious accidents. There for all the levers of points and signals should be inter locked in such a way that if points are set for a track the man must be able to pull the lever for lowering the signal only of the same track. Generally the lowering of signal of track becomes only possible when all the points of that line are set. Hence inter locking of levers of points and signals is necessary to avoid possibility of pulling wrong levers and to prevent conflicting movements of trains.

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UNIT IV

IX. a. Various types of bridge foundations and their suitability.

- 1) Spread or Open foundation : The foundation constructed in open excavation by increasing the area at the base of the structure by means of offsets or batter is called spread or open foundation.
- 2) Raft foundation: the foundation consisting of a thick RCC slab covering the entire area beneath the bridge which supports all the piers and abutments is known as Raft or mat foundation.
- 3) Pile foundation: An element of constructed driven vertically in the ground to increase the bearing capacity of the soil or to take up the load of the structure is known as pile. The foundation constructed on piles is known as pile foundation. Piles distribute the load of the structure to the soil either by friction or by friction combined with bearing at their tips or ends. This may be constructed of any suitable material like wood, concrete, steel, RCC, sand etc and are named accordingly.
- 4) Well foundation: The foundation constructed by sinking single large well, a twin well or a multiple well under each abutment or pier is known as well foundation.
- 5) Caisson foundation: the foundation constructed by sinking a caisson to rest on firm base under water and then filling the same with concrete or stone masonry to act as the pier is known as the caisson foundation.

4x2
= 8m
= 9

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IX(b) List the factors to be considered for the site selection of an airport.

- | | |
|---|--------------------------------|
| 1) Regional plan | 2) Use of air port |
| 3) Proximity to other air ports | 4) Accessibility to the ground |
| 5) Topography | 6) Obstructions |
| 7) Visibility | 8) Wind direction |
| 9) Noise nuisance | 10) Soil Characteristics |
| 11) Drainage | 12) Future developments |
| 13) Availability of utilities from town | 14) Economic studies |
| 15) Availability of materials of construction | |
| 16) Availability of infrastructure like road, railway, power water etc. | |

12x5
= 6

6 15

OR

Xa Explain the following terms

- (a) Break water: A structure which act as protective barrier to enclose a harbor from the effects of waves and to maintain calm and undisturbed water These are artificially created with rubble or tetrapod , vertical concrete walls and a combination of both.
- (b) Wharf: It is a wall constructed along the shore for loading and unloading cargo. One side of wharf is water where ships and vessels can come close and other side is a platform of back fill for the transporting vehicles and containers.
- (c) Air field: The free area of land for landing and takeoff of flights with runway taxiway approach areas but excluding terminal stations apron, hangers, cargo storage etc.
- (d) Runway: A long and narrow strip of paved way for landing and takeoff of flight.

4x2
= 8

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X(b) The various factors to be considered for the site selection of a bridge are:

- (1) The alignment should have minimum width across the drainage
- (2) Good foundation should be available at the selected site.
- (3) Straight reach should be available with firm banks
- (4) A square alignment is preferred
- (5) The site should be away from the confluence of tributaries
- (6) Availability and sufficiency of free board
- (7) Velocity of flow to avoid silting and scouring
- (8) Availability of adequate material and labour.
- (9) Minimum obstruction to water way

7x1,
7

7 15