GANESH COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

SUB. CODE/NAME: CE2303 – RAILWAYS, AIRPORT & HARBOUR ENGINEERING

YEAR/SEM: III / V

UNIT I

RAILWAY PLANNING AND DESIGN

Role of Indian Railways in National Development - Engineering Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments) Permanent Way, its Components and Functions of each Component:Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks Sleepers – Functions, Materials, Density Ballasts – Functions, Materials, Ballastless Tracks Geometric Design of Railway Tracks – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves (Derivations of Formulae and Problems)

PART - A

TWO MARKS QUESTIONS AND ANSWERS

1) What is mean by transportation?

Transportation is regarded as an index of economic, social, and commercial progress of a country. The transport industry which undertakes nothing more than mere movement of persons and things from the one place to another place has constituted one of the most important activities of men in every stage of advanced civilization.

2) What are the classifications from surface point of view of transport?

i) Land transport (e.g) Highways, railways, cableway, Ropeways etc.

ii) Water transport (e.g) Canalways, River ways, Ocean ways, Lake Ways etc.

iii) Air transport e,g, Airways.

3) Define the types of energy.

The types are:

i) Human energy

ii) Animal energy

iii) Petrol and diesel energy

iv) Steam energy

v) Electric energy

4) What is mean by track alignment?

The direction and position given to the centre line of the railway track on the ground is called the track alignment. The horizontal alignment includes the straight path, its width, deviations in width and curves. The vertical alignment of a railway track includes changes in gradients and vertical curves.

5) What are the basic requirements of good alignment?

The requirements are:

i) Purpose of track

ii) Feasibility

iii) Economy

iv) Safety

v) Aesthetic aspects.

6) What is mean by permanent way?

The combination of rails, fitted on sleepers and resting on ballast and subgrade is called the railway track or permanent way. Sometimes temporary tracks are also laid for conveyance of earth and materials on construction work.

7) Give the four requirements for ideal alignment?

The requirements are:

i) The gauge should be correct and uniform.

ii) The alignment should be correct i.e. it should be free form kinks or irregularities.

iii) The radii and super elevation on curves should be properly designed and maintained.

iv) If there is trouble from the creep, the precaution should be taken to prevent it.

8) What are the factors to be considered in track capacity?

The factors are:

i) By achieving faster movement of trains on a track and

ii) By decreasing the distance between successive trains.

9) Define gauge and wheel gauge.

The gauge of a railway track is defined as the clear distance between inner and running faces of two track rails.

The distance between the inner faces of a pair of wheels is called the wheel gauge.

10) What are the types of gauge?

The types are:

i) Standard gauge

ii) Meter gauge

iii) Narrow gauge

iv) Feeder track gauge or light gauge.

11) Give the various functions of rails?

The functions are:

i) Rails provide a hard, smooth and unchanging surface for passage of heavy moving loads with a minimum friction between the steel rails and steel wheels.

ii) Rails bear the stresses developed due to heavy vertical loads, lateral and barking forces and thermal stresses.

iii) The rail material is such that it gives minimum wear to avoid replacement charges and failures of rails due to wear.

12) What are the types of rail sections?

The three types of rail sections, which have been tried so far for the construction of railway track, are:

i) Double headed rails (D.H.Rails)

ii) Bull headed rails (B.H.Rails)

iii) Flat footed rails (F.F.Rails)

13) What is mean by welded rail joint?

These are the best joints as they fulfill nearly all the requirements of an ideal or perfect joint and will be discussed in next article. It is called as welded rail joint.

14) Define creep.

Creep is the longitudinal movement of rails in a track. Creep is common to all railway tracks, but varies in magnitude considerably; the rail in some places moving several centimeters in a month while in other locations the movement of rails may be negligible.

15) What are the factors in percussions theory?

The creep by this theory will increase due to following factors:

i) Due to weak and loose fish bolts
ii) Due to worn out fishplates.
iii) Due to loose packing at joints
iv) Due to wide expansion gap
v) Due to heavy axle loads moving at fast speed.

16) What are the functions of sleepers?

Sleepers perform the following functions:

i) To hold the rails to proper gauge.
ii) To hold the rails in proper level or transverse tilt.i,e level in turnouts, cross overs,etc.
iii) To interpose an elastic medium in between the ballast and rails.
iv) Sleepers also add to the general stability of the permanent track on the whole.
v) To support the rails at a proper level in straight tracks and at proper superelevation on curves

17) What is mean by slab and quarter sleepers?

When the pith is at one edge of a sleeper it is called a slab sleeper. This is obtained when two sleepers are got from a girth.

When the pith is at one corner it is called a quarter. This is obtained when four sleepers are got from a single girth.

18) Define the calculation for CSI.

The CSI means COMPOSITE SLEEPER INDEX (C.S.I). The C.S.I. is calculated from the equation;

$$\text{C.S.I.} = \frac{S + 10H}{20}$$

Where, S = Strength Index of timber at 12 % moisture content.

H = Hardness Index of timber at 12 % moisture content.

19) Write short notes on fishplates?

Fishplates are used in rail joints to maintain the continuity of the rails and to provide for any expansion or contraction of the rail caused by temperature variations. They maintain the correct alignment of the line both horizontally and vertically.

20) Define momentum gradient.

These gradients on a section which though more severe than the ruling gradient do not determine the maximum load of the train on account of their favorable position in that, the train before approaching them acquires sufficient momentum to negotiate are known as momentum gradients.

21) Give the various types of ballast?

The types are:

a) Broken stone
b) Gravel or river pebbles or shingle
c) Ashes or cinders
d) Sand
e) Moorum
f) Kankar
g) Brick Ballast
h) Blast Furnace slag
i) Selected earth.

22) What are the elements to be considered in Railway track?

We will consider the following elements:

a) Gradients and Grade compensation
b) Speed of train

c) Radius or degree of the curve

d) Cant or superelevation

e) Curves

f) Widening of gauge on curves.

23) What are the characteristics of good spike?

The characteristics of good spikes are:

i) First of all good spike should be strong enough to hold the rail in position and it should have enough resistance against movement to retain its original position so that it does not lead to creep under any circumstances.

ii) The spike should be as deep as possible

iii) The spike should be easy in fixing and removal from the sleepers.

iv) It should properly maintain the gauge.

24) What is mean by cant?

To counteract the centrifugal force, the level of the outer rail is raised above the inner rail by a certain amount to introduce the centripetal force. This raised elevation of outer rail above the inner rail at a horizontal curve is called superelevation or cant. The term cant is frequently used as a synonym for superelevation but truly speaking cant should be used to represent the angle of a transverse slope.

25) Give the formula for extra width of gauge?

The extra width of gauge (d) in cm is given by the formula:

$$d = \frac{13(B+L)^2}{R}$$

B= Rigid wheelbase in meters.

R=Radius of the curve in meters

L = Lap of flange in meters

$d = 0.02\ \sqrt{h^2} + D.h$ meters.

h= depth of wheel flange below rail in cms.

D = Diameter of wheel in cms.

PART –B

SIXTEEN MARK QUESTIONS

1) What are the classifications in various modes of transportation?
2) Explain briefly about historical development of railways in India?
3) What are the factors to be considered in good track alignment?
4) Explain briefly about Rails?
5) Compare the various characteristics of different types of sleepers on Indian railways in tabular form?
6) What are the functions, requirements and types of ballast?
7) Explain all types of gradients and give some examples?
8) Explain cant deficiency and give some examples?

UNIT-II

RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND OPERATION

Points and Crossings - Design of Turnouts, Working Principle Signalling, Interlocking and Track Circuiting Construction & Maintenance – Conventional, Modern methods and Materials, Track Drainage Track Modernisation– Automated maintenance and upgrading, Technologies, Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings

PART – A

Two Marks Questions and Answers

1) Define the points and crossings.

Points, crossings, turnouts, cross-overs and such related terms are contrvances or arrangements by which different routes either parallel or diverging are connected and afford the means for trains to move from one route to another. These connections are not only useful for trains to move from one route to another but also for marshalling and shunting work in station yards.

2) What are the ways to be considered in operating personnel?

The ways are:

- Points and crossings provide flexibility of movement by connecting one line to another according to requirements.
- They also help for imposing restrictions over turnouts, which necessarily retard the movements.
- From safety aspect it is also important, as points and crossings are weak links or points in the track and vehicles are suspectable t derailments at these places.

3) What is mean by turn out?

Turn out is the simplest combination of points and crossings, which enables one track either a branch line or siding to take off another track. So the object of turnout is to provide facilities for safe movement of trains in either direction on both the tracks.

4) What are the terms used in points and crossings?

The terms are:

- Facing Direction
- Facing points of turnouts
- Trailing direction
- Trailing points of turnouts
- Right hand and left hand Turnouts
- Right hand and Left hand Switches
- Working principle of a turnout

Important terms:

- Heel clearance or heel divergence
- Flange way clearance
- Flange way depth
- Switch angle
- Throw of switch
- Flare.

5) Give the various types of crossings?

Crossings can be classified as below:

A) On the basis of shape of crossing
   - Acute angle crossing or "V" crossing or Frog
   - Obtuse angle crossing or diamond crossing
   - Square crossing

B) On the basis of Assembly of Crossing
   - Spring or moveable wing crossing
   - Ramped Crossing

6) What are the features in turn outs?

The salient features are:

- To provide facilities for turning of trains from one track to another.
- One turn out provides facilities for turning of vehicles or trains in one direction of the main track.
- Depending upon the facilities provided for turning on right or left of main track the turnouts are called right hand or left hand turnouts respectively.
- A turn out consists of a pair of points two straight lead rails, two curved lead rails, two check rails and a crossing

7) Define telescopic method.

This method of plate lying is extensively used in India. In this method the materials are transported in material trains to the farthest point of new track, and unloaded. These materials are then carried to the railhead and assembled there.

8) Give the various operations in telescopic method.

Following operations are involved:

- Collections and preparation of materials at depot
- Transportation of materials from depot to work site.
- Unloading of materials at worksite and carrying them to the railhead.
- Fixing the rails to the sleepers and joining the two rails with fishplates.
- Packing of track for correct level and alignment.

9) What is the necessity of relaying railway track?

Relaying of a railway track is necessary due to one or more following reasons:

i) The relaying of track becomes necessary when the track materials like rails; sleepers, ballast and fittings are completely worn out or deteriorated.

ii) When a heavier track is required to raise the standard of existing light track due to increased intensity of traffic, heavier axle loads and for higher speed.

iii) When old but serviceable materials are to be replaced by new materials in main line and the released materials of main line are to be used for laying a new branch line loop or a siding.

10) What is mean by track drainage?

Track drainage involves the interception and removal of water from upon or under the track and is accomplished not only by surface interception and drainage arrangements but also where necessary by a sub surface drainage system.

11) Give any four requirements of track drainage system?

i) The surface water from adjoining land should be prevented from entering the track Formation.

ii) Flow of surface water across the track and along the slopes should not cause erosion of the banks and slopes of embankment.

iii) Sub-surface water should be efficiently drained off by the sub surface drainage system.

iv) The highest level of groundwater table should be well below the level of the sub grade.

12) Define cement grouting?

The trouble of water pocket is also controlled by grouting cement in the water pocket and stabilizing the formation. This method is very effective but costlier one so can be adopted on important tracks, with high speed and heavy traffic.

13) Explain the necessity of maintaining the railway track?

The necessity of maintenance arises due to following reasons:

i) The strength of track structure goes on reducing due to high speed of trains, heavy axle loads and repetition of loads. The elastic structure of railway track gets distributed in alignment gauge and surface level of rails.

ii) The track structure is subjected to other deteriorating effects like rain water, action of sun and wind.

iii) The track structure has to bear too many other curvatures, speed and load effects, particularly on curves, points and crossings, bridge approaches and it level crossings.

14) Difference between daily maintenance and periodic maintenance?

Daily maintenance:

Daily maintenance is carried out by the full time staff maintained throughout the year. The use of maintenance gangs all along the railway track is made. The railway track is divided in suitable sections 5 to 6 km.length.One gang is attached to each section for maintaining that section in good condition.

Periodic maintenance:

Periodic maintenance is carried out after an interval of two of three years. During periodic maintenance the gauge, level, alignment, points and crossing etc. The track is made in perfect condition by removing all its major and minor defects.

15) Define scissor packing.

Packing diagonally under a rail seat is called scissor packing. Nice packing of ballast is achieved by this method .In scissor packing two gang men take their positions back to back and pack the corners with beater pick axe in the direction A-A.

16) What is mean by shovel packing?

This method of packing the track is adopted at points and crossings where the use of beaters for packing becomes difficult due to closer spacing of sleepers. In shovel packing the track is lifted by means of track jack or Tommy bar and the requisite quantity of stone chips varying from 6m.m.

17) How to maintenance of super structure?

For maintaining superstructure the following measures are taken:

- The maintenance of expansion joints, sliding plates and bearings should be done periodically.
- The corroded portions of grider bridges should be painted with red lead at least once in 5 years.
- The loose rivets of steel bridges should be punched off and replaced.

18) Write short notes on modernization of track?

The experience of advanced railways, particularly of German railways and Swiss Federal Railways has indicated that the speeds at best on conventional track may be raised safely up to 250km. The conventional track will have to be replaced by new ballast less track consisting of concrete slabs fastened to rails with elastic fastenings.

19) Define S.W.P and L.W.R?

S.W.P is known as Short Welded Panels (S.W.P) or short Welded Rails (S.W.R) with the development of technology a new concept of locking up of stresses in the rail, which resists the longitudinal movements of the rails. L.W.R. Long Welded Rail as it stands today is a welded rail, the central part of which does not undergo any longitudinal movement due to temperature variations. Minimum length of L.W.R is 200 meters and maximum length of L.W.R. has been prescribed to be one kilometer under Indian conditions.

20) What are the characteristics to be considered in elastic fastening?

The characteristics are:

- It should be able to maintain correct and uniform gauge.
- It should be strong enough to hold the rail in position during service life.
- It should have enough resistance to lateral and longitudinal forces for maintaining track stability and creep free track respectively.
- It should be universal type so that it can be used on all types of sleepers.
- It should require less maintenance.i, e should be of "fit and forget type."

21) What is mean by pandrol clip?

Pandrol 401 clip is a universal type of elastic fastening on Indian Railways, which can be fixed on wooden.steel, cast iron concrete sleepers with specific arrangements. It possesses almost all the characteristics of an ideal fastening.

22) What are the reasons to justify the Mechanized maintenance?

The following reasons justify the need of Mechanized Maintenance:

- For long welded rails and heavy concrete sleepers laid on modern tracks, the manual maintenance is found to be difficult and unusable.

- Pick beater packing method of maintenance is very tedious and hard job.
- Quality of compaction under the sleepers by manual methods is not uniform due to multiple reasons such as physical strength of labour keenness of labour to work.

23) What is the purpose of railway station?

The purposes are:

- For exchange of passengers
- For exchange of goods
- For control of train movements
- To enable the following express trains to overtake.
- For taking diesel or coal and water for locomotives.
- For detaching or attaching of compartments and wagons.

24) What is mean by Non-Block stations?

These are called "D" class or "flag" stations. These are situated between two consecutive block stations. They do not define the boundary of any block section. They are neither telegraphically connected to adjacent station nor have any apparatus or staff for controlling the movement of trains.

PART - B

16 MARKS QUESTIONS

1) Write short notes on Points and crossings?

2) Requirements and characteristics of good crossings:

3) Explain briefly about design calculations and different methods of turnouts?

4) Write short notes on:

i) Warner signals

ii) Shunting signals

iii) Colour light signals

iv) Routing signals

v) Bracketed signals

UNIT III
AIRPORT PLANNING AND DESIGN
PART A
1. Define cross wind component and wind coverage.*
2. Differentiate between domestic airport and international airport citing examples of Indian Airports.
3. Explain the terms cross wind component and wind coverage.
4. What is the need for clear zone?
5. List the various imaginary surfaces around the airport.
6. Define wind rose diagram.
7. Explain the term cross wind components and wind coverage.
8. Define Airport capacity (runway capacity).
9. What is a Master plan?
10. How ICAO classified the Airports?
11. What is Air Traffic Potential?
12. Name the Airport Organisations.
13. Mention factors of Air Traffic Potential.
14. What is an Exit Taxiway?
15. List the assumed conditions in deciding Basic Runway Length.
16. What is meant by Zoning Laws?
17. What is meant by Ponding in airport drainage?
18. List the assumptions made in the design of airport sub grade drainage.
19. Classify airports based on functions and aircraft types.
20. What is the Airside part of an airport?
21. List the data to be collected for a Regional Planning. Mention any five factors to be considered for Airport site selection.
22. What is a Wind rose diagram and mention its types.
23. List the objectives of Surface drainage in airport.
24. List the elements to be considered in the Geometric design of runways.
25. List the elements to be considered in the Geometric design of taxiways.
26. What are the criteria to evaluate the effects on airport system?
27. What are the deciding factors of an aircraft size?
28. What is an Airport?
29. What are the cases to be considered for deciding Basic Runway length?
30. What are Imaginary Surfaces?
31. What are the types of Imaginary surfaces?

PART B
1. (i) Explain the steps in the determination of proper orientation for runway.*
(ii) Give the various geometric standards for different classes of runways and taxiways.*
2. (i) Explain in detail about airport zoning.
(ii) The length of a runway at mean sea level, standard temperature and zero gradients is 1600m. The site has an elevation of 320m, with a reference temperature of 33.6ºC. The runway has to be constructed with an effective gradient of 0.25%. Determine the actual length of the runway at site.
3. (i) List the factors to be considered for the selection of site for a commercial airport.*

(ii) What are the functions of airport drainage system?
4. (i) Summarize briefly the various runway geometrics as recommended by ICAO
(ii) What is a wind rose diagram? Explain different types of wind rose diagrams.
5. The length of runway under standard conditions is 1620m. The airport site has an elevation of 270m. Its reference temperature is 32.90ºC. If the runway is to be constructed with an effective gradient of 0.20%. Determine the corrected runway length.
6. What are the basic patterns of runway configurations? Discuss each pattern.
7. Explain about Exit taxiway and factors for the location of an Exit taxiway.
8. Explain the necessity, functions and special characteristics of airport drainage.
9. Explain the sub surface drainage system of airport.
10. Explain the importance of airport planning.

UNIT IV

AIRPORT LAYOUTS, VISUAL AIDS AND AIR TRAFFIC CONTROL

PART A

1. How the runway numbering is done?
2. Draw a typical pattern of motor vehicle parking in an airport/
3. List the factors affecting the locations of exit taxi- way.
4. Define the term gate position.
5. What are factors affecting airport operating capacity?
6. Define ramp time.
7. How do you select the site for terminal building?
8. List the types of parking from motor vehicles.
9. What is a Terminal area and what are its functions?
10. What are the Planning concepts of a terminal building?
11. What are the Design aspects of a terminal building?
12. What are the Site requirements of terminal building?
13. Mention the facilities provided by the Operational buildings?
14. List the Sequence of activities of Passenger flow in terminal building.
15. List the factors to be considered for an Airport Vehicular circulation.
16. What are the Aircraft service facilities?
17. What are the four groupings of Aircraft parking system?
18. What is a Hangar and mention its types.
19. What are the methods to control Soil erosion due to Jet exhaust?
20. What are the Characteristics of a Balanced Airport Layout?
21. What are the Characteristics of a Helicopter?
22. Mention the classification of Heliports based on usage.
23. What are the factors to be considered for Heliport Site selection?
24. What are the Lighting requirements in a Heliport?
25. What is meant by a Control Tower?
26. What are the Markings required for an airport?
27. What are the types of Visual aids for Aircraft Navigation?
28. What are the Markings in Runway used for Navigation?
29. What are the Markings in Taxiway used for Navigation?
30. What are the informations provided for Proper landing?
31. Mention the elements of efficient Airport Lighting
32. List the Purposes of Air Traffic Control
33. What are the types of Flight Rules for ATC?
34. Differentiate between VFR and IFR.
35. Mention the three parts of ATC network.
36. What are the categories of ATC aids?
37. What are the different Route aids (Airway aids)?
38. What is the different Landing aids (Terminal aids)?

PART B

1. (i) Draw a layout of any one international airport in India and explain the concept.*
(ii) Explain the planning concept of airport buildings.*
2. (i) Explain the various runway and taxiway markings.

(ii) Explain in detail about air traffic control.
3. (i) Describe briefly the salient features and functions of aprons in an airport.
(ii) What are the passenger facilities, required at an airport terminal? Explain using sketches.
4. (i) Discuss the importance of air traffic control and list the various equipments needed foe en-route air traffic control.
(ii) Describe the importance of runway lighting. Explain threshold lighting with the help of sketches.
5. Describe the different systems of aircraft parking.
6. Write notes on the following with neat diagrams:
(i) Terminal facilities
(ii) Airport markings
7. Briefly explain the Night- time aids provided at Airports.
8. What are flight rules? Discuss the advantages and disadvantages of each system.
9. Explain the characteristics of commercial airport layout and military airport layout.
10. Draw a typical layout of airport for a single runway and two parallel runways.

UNIT V

HARBOUR ENGINEERING

PART A

1. How the positions of light houses are decided?
2. Write a brief note on inter- modal transfer facilities.
3. Differentiate Quay and Pier.*
4. List the various mooring accessories.
5. What do you understand by littoral drift?
6. What are the basic requirements of signals?
7. What is the necessity of docks?
8. What do you understand by littoral drift?
9. What are coastal structures?
10. What is a breakwater? Name its types.
11. What is a wharf? Name the types
12. Distinguish between fog signal and audible signal.
13. What are the requirements of a marine signal?
14. What are sand dunes?
15. Distinguish between diurnal and semi-diurnal tides.
16. How to design the entrance of a harbour?
17. What is dredging?
18. Why a shore protection work is needed?
19. What are the construction methods for mounds?
20. What is sounding? Name the equipment used for sounding.
21. Define Hydro graphic Surveying.
22. Mention some of the features of a harbour.
23. What is Mean Sea Level (MSL)?

PART B

1. Explain about the different types of break waters with the sketches.
2. (i) Write descriptive notes on mooring and mooring accessories.*
(ii) What are the different components of a harbor? And explain them with the layout.
3. (i) Discuss the tides and wave effects and its action on coastal structures.
(ii) Distinguish between wet docks and dry docks. Explain with sketch the features and functioning of a dry dock.
4. (i) List the common types of break waters in use and bring out the advantages of each of them.
(ii) Discuss briefly container transportation.
5. Write a detailed note on break waters. Explain all essential aspects.
6. (i) What are the types of Navigational Aids?
(ii) Discuss the fixed navigation structures and floating navigation aids.
7. Classify harbours on broad basis and on the basis of utility and explain them.
8. (i) Define a port and bring out the differences between a port and a harbor. What are the requirements of good port?

(ii) Classify different types of break water. Explain any one in brief.
9. Explain the different natural phenomena to be studied before the design of harbours.
10. What is littoral drift? How it affects the location of a harbour?