

VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING QUESTION BANK



**V SEMESTER
CE 6504 HIGHWAYENGINEERING
Regulation – 2013
Academic Year 2018– 19**

Prepared by

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DEPARTMENT OF CIVIL ENGINEERING QUESTION BANK

SUBJECT : CE6504 – HIGHWAY ENGINEERING
SEM / YEAR: III/II

UNIT I - HIGHWAY PLANNING AND ALIGNMENT

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – Classification of highways – Locations and functions – Factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods.

PART A

Q.No	Questions	BT Level	Competence
1.	State any two contributions made by Jayakar Committee for the road development in India.	BT 1	Remembering
2.	What are the objectives of engineering survey?	BT 1	Remembering
3.	Identify the salient features of Nagpur Road plan.	BT 3	Applying
4.	Define obligatory point.	BT 1	Remembering
5.	Give the formula pertaining to first category for length given in Nagpur road plan.	BT 1	Remembering
6.	Illustrate about the significance of highway planning.	BT 2	Understanding
7.	Outline the classification of roads according to Nagpur road plan.	BT 2	Understanding
8.	Write short notes on second twenty-year plan.	BT 1	Remembering
9.	Summarize about road ecology.	BT 2	Understanding
10.	List out the four factors controlling highway alignment.	BT 4	Analysing
11.	Define National Highway Act (1956).	BT 1	Remembering
12.	Discuss any two On-going highway projects in Tamilnadu.	BT 6	Creating
13.	Compare the modifications made in Macadam's method with respect to the other methods?	BT 5	Evaluating
14.	Show the purpose for Soil suitability analysis in highway engineering.	BT 2	Understanding
15.	Identify the various types of Engineering surveys?	BT 3	Applying
16.	Explain Modal limitations towards sustainability	BT 5	Evaluating
17.	Discuss the objectives of Highway Research Board.	BT 6	Creating
18.	List the details to be collected during ground reconnaissance survey.	BT 4	Analysing
19.	List out the objectives of Central Road Fund?	BT 4	Analysing
20.	Identify the road pattern used in Nagpur Plan and list out different types of road patterns.	BT 3	Applying

PART B			
1.	Write in detail about the engineering surveys conducted for highway alignment.	BT 1	Remembering
2.	Identify the various requirements of ideal highway alignment	BT 3	Applying
3.	Compare roadways and railways.	BT 4	Analysing
4.	List the different components of National Highway Development programme (NHDP)	BT 4	Analysing
5.	Discuss how modern methods such as GIS and GPS may be used for the reconnaissance survey for highway alignment.	BT 6	Creating
6.	Explain in detail about the salient features of Nagpur road plan and its classification of roads.	BT 2	Understanding
7.	Explain in detail about the roles and responsibilities of CRRRI and HRB	BT 2	Understanding
8.	Write in detail about highway planning in India for the first twenty-year plan.	BT 1	Remembering
9.	Compare Conventional methods with modern methods in Highway.	BT 5	Evaluating
10.	Write some brief notes on: 1. Central Road Fund (4 marks) 2. Indian Roads Congress (5 marks) 3. Motor vehicle act. (4 marks)	BT 1	Remembering
11.	State the construction steps of Macadam method of road formation and compare with telford road construction.	BT 4	Analysing
12.	Illustrate with neat sketch about the obligatory points controlling highway alignment.	BT 3	Applying
13.	Explain the activities of National Highway Authority of India.	BT 2	Understanding
14.	Write various Classification of highways and its Locations and functions	BT 1	Remembering

PART C			
1.	i) State and explain the economic factors influencing highway alignments. (8 marks) (ii) Briefly explain the role of MORTH and IRC in highway development. (7 marks)	BT 2	Understanding
2.	Compare the three “Twenty-year road development plan” in India. Also discuss the merits of each one of them.	BT 4	Analysing
3.	Discuss in detail about various steps involved in a new highway project.	BT 6	Creating
4.	Write in detail about any two ongoing highway projects in India.	BT 1	Remembering

UNIT II - GEOMETRIC DESIGN OF HIGHWAYS

Typical cross sections of Urban and Rural roads — Cross sectional elements - Sight distances – Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

PART A

Q.No	Questions	BT Level	Competence
1.	Define Road margins.	BT 1	Remembering
2.	Where the vertical curves are provided?	BT 1	Remembering
3.	Define camber and list its types.	BT 1	Remembering
4.	Define limiting gradient.	BT 1	Remembering
5.	What do you understand by non-passing sight distance?	BT 1	Remembering
6.	Summarize the purpose served by camber.	BT 2	Understanding
7.	Compare ruling gradient and exceptional gradient.	BT 5	Evaluating
8.	Differentiate summit and valley curves.	BT 4	Analysing
9.	Discuss about PIEV theory.	BT 6	Creating
10.	Identify the requirements of an ideal transition curve.	BT 3	Applying
11.	What is meant by off tracking?	BT 1	Remembering
12.	Examine the factors affecting stopping sight distance.	BT 5	Evaluating
13.	Discuss the minimum required value for Lateral and vertical clearance at underpasses.	BT 2	Understanding
14.	Analyse the importance of grade compensation on horizontal curves.	BT 4	Analysing
15.	Explain the use of transition curve?	BT 2	Understanding
16.	Write the special considerations required for hill roads alignment.	BT 6	Creating
17.	Outline the short notes on overtaking zones.	BT 2	Understanding
18.	What is the lag distance required for an automobile moving with a speed of 80Kmph with driver's reaction time of 2 sec?	BT 3	Applying
19.	List out the few cross-sectional elements of road.	BT 4	Analysing
20.	Write the application of super elevation in horizontal curves?	BT 3	Applying

PART B

1.	i. How rural roads are classified? Explain. (7 Marks) ii. State the elements of road margin. (6 Marks)	BT 4	Analysing
2.	i. What are the factors affecting geometric design? (8 marks) ii. What is the super elevation to be provided on a horizontal curve on a National Highway in plain terrain (Hint: Design speed =100 kph), if the curve has a radius of 310 m?(5 marks)	BT 1	Remembering
3.	i. Describe the types of gradient. (7 Marks) ii. Explain with neat sketches about vertical curves. (6 Marks)	BT 1	Remembering
4.	i. A vertical summit curve is formed by $n_1 = +3.0\%$ and $n_2 =$	BT 5	Evaluating

	<p>-5.0%. Estimate the length of the summit curve for $V=80$ kmph. (7 Marks)</p> <p>ii. A valley curve is formed by descending gradient $n_1= 1$ in 25 and ascending gradient $n_2= 1$ in 30. Predict the length of the valley curve for $V =80$kmph. (6 Marks)</p>		
5.	<p>i. Derive the expression for super elevation. (8 Marks)</p> <p>ii. A vehicle travels at a speed of 60Kmph. Find the super elevation to be provided if the radius of curvature is 220m. (5 Marks)</p>	BT 6	Creating
6.	Write the necessity for extra widening of road pavement at horizontal curves? Derive an expression for the extra widening	BT 1	Remembering
7.	A valley curve is formed due to two gradients +2.5% and -1.75%. If the design speed of this highway is 80 kmph, determine the stopping sight distance and design the valley curve to fulfil both comfort and head light sight distance conditions.	BT 4	Analysing
8.	The speed of overtaking and over taken vehicles are 70 and 40 kmph, respectively on a two-way traffic road. If the acceleration of overtaking vehicle is 0.99m/s^2 . Calculate SSD, OSD and ISD	BT 2	Understanding
9.	<p>i. What are transition curves? How will you determine the length of transition curves? (8 Marks)</p> <p>ii. A National Highway passing through rolling terrain of heavy rainfall area, $R=500\text{m}$. Assume suitable data and design the length of Transition curve. (5 Marks)</p>	BT 1	Remembering
10.	Explain and derive the equation for sight distances.	BT 2	Understanding
11.	<p>Calculate the safe sight distance for the design speed of 60 kmph for</p> <p>a. Two-way traffic on a two-lane road (3 marks)</p> <p>b. Two- way traffic on a single lane road (3 marks)</p> <p>c. Two-way traffic on a two-lane road with an ascending gradient of 2% (3 marks)</p> <p>d. Two- way traffic on a two-lane road with an descending gradient of 3% (4 marks)</p>	BT 3	Applying
12.	<p>i. Explain PIEV theory (7 marks)</p> <p>ii. Discuss the methods of attaining super elevation. (6 marks)</p>	BT 2	Understanding
13.	A National highway passing through a rolling terrain has a horizontal curve of radius 220m. If the design speed is 80 kmph, calculate super elevation, extra widening, stopping sight distance and intermediate sight distance. Assume necessary data suitably.	BT 3	Applying
14.	Draw a neat sketch and explain the cross section of an urban arterial.	BT 2	Understanding

PART C

1.	Calculate the stopping sight distance and intermediate sight distance required to avoid head on collision of two cars approaching from opposite directions at a speed of 75kmph and 85kmph. Assume that the reaction time of driver is 2.5 sec and the coefficient of friction between road surface and tyres are 0.4.	BT 5	Evaluating
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2.	List the various types of horizontal curves with neat sketches.	BT 4	Analysing
3.	Write the necessity for extra widening of road pavement at horizontal curves? Derive an expression for the extra widening	BT 3	Applying
4.	Outline the design elements of hill roads with neat sketches.	BT 2	Understanding

UNIT III - DESIGN OF FLEXIBLE AND RIGID PAVEMENT

Design principles – pavement components and their role - Design practice for flexible and rigid Pavements (IRC methods only) – Embankments

PART A

Q.No	Questions	BT Level	Competence
1.	Define pavement.	BT-1	Remembering
2.	Highlight about equivalent radius of resisting section.	BT-1	Remembering
3.	List the factors in pavement design?	BT-1	Remembering
4.	Define critical load position.	BT-1	Remembering
5.	What are the types of rigid pavement?	BT-1	Remembering
6.	Outline about prime coat and tack coat.	BT-1	Remembering
7.	Summarise about rigidity factor	BT-2	Understanding
8.	Indicate the effect of temperature in rigid pavement?	BT-2	Understanding
9.	Explain ESWL.	BT-2	Understanding
10.	Discuss the function of wearing course?	BT-2	Understanding
11.	Describe about the rigid pavement with sketch.	BT-3	Applying
12.	Write about the flexible pavement.	BT-3	Applying
13.	Illustrate the types of joints in rigid pavements.	BT-3	Applying
14.	Analyze critical wheel load position in rigid pavement. According to you which are critical?	BT-4	Analyzing
15.	Examine about grain to grain transfer of stress and on which pavement it will happen?	BT-4	Analyzing
16.	Categorize the components of flexible pavements.	BT-4	Analyzing
17.	Explain the applications of Rigid pavements.	BT-5	Evaluating
18.	Explain about vehicle damage factor.	BT-5	Evaluating
19.	Formulate the requirements of an ideal pavement.	BT-6	Creating
20.	Build some points about dowel bars in rigid pavement.	BT-6	Creating

PART B			
1.	Find the thickness of the pavement for construction of a new two lane carriage way for the design life of 15 years using IRC method. The initial traffic in the year of completion in each the direction is 150 CPVD and growth rate 5%, VDF based on axle load survey=2.5standad axle per commercial vehicle. Design CBR of subgrade soil=4%.	BT 1	Remembering
2.	Write in detail about the design of joints in rigid pavement.	BT 1	Remembering
3.	Describe any two methods of pavement design.	BT 1	Remembering
4.	List the components and their functions of flexible pavement.	BT 1	Remembering
5.	A cement concrete pavement has a thickness of 18 cm and has two lanes of 7.2 m with a longitudinal joint along the centre. Indicate the dimension and spacing of tie bar using the following details. Allowable working stress in tension=1400kg/cm ² Unit weight of concrete= 2400kg/m ³ Coefficient of friction=1.5 Allowable bending stress in deformed bars in concrete=2.5kg/cm ²	BT 2	Understanding
6.	Explain the various factors influencing design of Rigid pavements and the design procedure as per IRC 58.	BT 2	Understanding
7.	Show the variations in climatic conditions affecting the design of pavements.	BT 2	Understanding
8.	Illustrate the step to step procedure of flexible pavement by IRC method. You have to support your design by assuming approximate values of various elements of pavement design.	BT 3	Applying
9.	Differentiate between flexible and rigid pavement.	BT 3	Applying
10.	Examine the design consideration for spacing of expansion and contraction joints.	BT 4	Analyzing
11.	Compare the different stresses induced in the cement concrete pavement. Discuss the critical combination of these stresses.	BT 4	Analyzing
12.	Calculate the equivalent single wheel load for a given combination of wheel load with design steps.	BT 4	Analyzing
13.	Design the reinforcement of a cement concrete slab of 200 mm thick assuming the following data: Concrete density= 2400kg/m ³ Transverse joint spacing 15m Working stress in steel 140 Mpa Friction coefficient=1.5 Pavement width= 3.75m	BT-5	Evaluating
14.	Construct the design steps of dowel and tie bars in rigid pavement.	BT 6	Creating

PART C			
1.	Describe in detail about the IRC method of flexible pavement design. Discuss the limitation of this method.	BT 1	Remembering
2.	Explain in detail about embankment in pavement.	BT 2	Understanding
3.	Write the design procedure for rigid pavements.	BT-3	Applying

4.	Calculate the stresses at interior, edge and corner region of cement concrete pavement using westergaard's equation. Use the following data. Wheel load =5200kg Pavement thickness=20 cm Poissons' s ratio of concrete=0.15 Subgrade Modulus=6kg/cm ³ E=3x10 ⁵ kg/cm ² Radius of contact area=15cm	BT-6	Creating
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UNIT IV - HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) - Quality control measures - Highway drainage — Construction machineries.

PART A

Q.No	Questions	BT Level	Competence
1.	List the significance of CBR test?	BT-1	Remembering
2.	Describe about elongation index.	BT-1	Remembering
3.	Define flakiness index.	BT-1	Remembering
4.	State the purpose of conducting abrasion test?	BT-1	Remembering
5.	Write the desirable properties of soil as highway material?	BT-1	Remembering
6.	Specify how geotextiles improve safety and stability of highway embankment.	BT-1	Remembering
7.	Explain how adding the waste plastics help in the improvement of bituminous pavement.	BT-2	Understanding
8.	Summarise about California bearing ratio?	BT-2	Understanding
9.	Discuss about softening point.	BT-2	Understanding
10.	Indicate about elongation Indices.	BT-2	Understanding
11.	Explain water bound macadam road.	BT-3	Applying
12.	Discuss a few desirable properties of highway materials.	BT-3	Applying
13.	Outline the names of tests recommended by Indian standards for testing highway materials.	BT-3	Applying
14.	Compare flash and fire point test.	BT-4	Analyzing
15.	Differentiate between cut back bitumen and emulsions.	BT-4	Analyzing
16.	Illustrate specific gravity test on bitumen.	BT-4	Analyzing
17.	Recommend some points between Tar and Bitumen.	BT-5	Evaluating

18.	Compare the different types of construction machineries.	BT-5	Evaluating
19.	Discuss about highway drainage.	BT-6	Creating
20.	Build up some points on adding plastic pavement which will improve the Strength of the pavements?	BT-6	Creating

PART B

1.	Write about California bearing ratio test.	BT 1	Remembering
2.	Enumerate the different forms of bitumen.	BT 1	Remembering
3.	List the desirable properties of aggregate and brief out each.	BT 1	Remembering
4.	Describe about the ductility test and softening point test.	BT 1	Remembering
5.	Explain any two tests on road aggregates.	BT 2	Understanding
6.	Discuss any two tests on bitumen.	BT 2	Understanding
7.	Summarise the construction procedure of a flexible pavement. Explain the equipment required for various layers while constructing the flexible pavement.	BT 2	Understanding
8.	Illustrate about i) Penetration test (7) ii) Viscosity test of bitumen.(6)	BT 3	Applying
9.	Demonstrate the essential properties of good highway materials.	BT 3	Applying
10.	Examine the steps involved in the construction of cement road.	BT 4	Analyzing
11.	Illustrate the test procedure for ductility test on bitumen.	BT 4	Analyzing
12.	Compare the types of highway drainage.	BT 4	Analyzing
13.	Recommend importance and procedure of Field density test (7) Crushing strength test (6).	BT 5	Evaluating
14.	Elaborate the merits and demerits of cement concrete roads.	BT 6	Creating

PART C

1.	What are all the modern construction materials used for construction of pavement. Explain the usage and characteristics in detail.	BT 1	Remembering
2.	List the applications of geotextile and geomembrane in road pavement.	BT 2	Remembering
3.	Explain any four laboratory tests on aggregates and write its inferences.	BT 3	Applying
4.	Compare the construction procedure of polymer modified bitumen, Fibre, glass and plastic used in pavements.	BT 5	Evaluating

UNIT V - EVALUATION AND MAINTENANCE OF PAVEMENTS

Pavement distress in flexible and rigid pavements – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements –Types of maintenance – Highway Project formulation.

PART A

Q.No	Questions	BT Level	Competence
1.	Discuss about Bleeding.	BT 2	Understanding
2.	Differentiate Pumping and Ravelling.	BT 2	Understanding
3.	Write down the works under routine repairs.	BT 1	Remembering
4.	Summarize about Mud pumping.	BT 6	Creating
5.	List the parameters that should be observed for evaluating a rigid pavement.	BT 1	Remembering
6.	Describe the causes of cracks.	BT 1	Remembering
7.	Write short notes on Alligator Crack.	BT 1	Remembering
8.	Examine about FWD and state its use.	BT 1	Remembering
9.	Write few examples of surface defects in pavements.	BT 1	Remembering
10.	Explain pavement evaluation.	BT 2	Understanding
11.	Discuss about pavement roughness index.	BT 2	Understanding
12.	Examine about serviceability of pavements.	BT 3	Applying
13.	Illustrate with neat sketch about spalling of joint.	BT 3	Applying
14.	Examine the causes of Scaling.	BT 3	Applying
15.	Investigate and write how pot holes are formed?	BT 4	Analysing
16.	Classify the types of cracks formed in the cement concrete roads.	BT 4	Analysing
17.	Identify when is overlay needed in pavements.	BT 4	Analysing
18.	Explain unevenness index.	BT 5	Evaluating
19.	Compare delamination and depression.	BT 5	Evaluating
20.	Summarize the remedial measures for the edge cracks in rigid pavements.	BT 6	Creating

PART B

1.	Examine the possible causes for longitudinal cracking.	BT 1	Remembering
2.	Describe in detail about any four methods of strengthening of pavements.	BT 1	Remembering
3.	Describe the procedure for structural evaluation of pavements.	BT 1	Remembering
4.	Examine the evaluation of pavement by Deflection measurements.	BT 1	Remembering
5.	Discuss in detail the i) possible causes for joint failure and (6) ii)its remedial measures. (7)	BT 2	Understanding
6.	Interpret the methods employed for evaluation of pavements.	BT 2	Understanding
7.	Summarize the evaluation of pavement by Benkelman Beam method.	BT 2	Understanding
8.	Illustrate briefly the different types of failures of rigid pavements.	BT 3	Applying

9.	Examine any three non-destructive testing methods of pavement deflection.	BT 3	Applying
10.	i) List any eight cracks and defects in flexible pavements and infer their ii) respective symptoms iii) possible causes iv) treatment for each defect	(4) (3) (3) (3)	BT 4 Analysing
11.	Investigate Overlay and Procedure for design and construction of overlays.	(4) (9)	BT 4 Analysing
12.	Explain the principle of Benkelman Beam test and its Uses	BT 4	Analysing
13.	Prioritize the causes for the disintegration of flexible pavements.	BT 5	Evaluating
14.	Compose the various methods of pavement evaluation.	BT 6	Creating

PART C

1.	Explain briefly the maintenance of bituminous surface.	BT 2	Understanding
2.	i.) Compose on rutting ii) Summarize its symptoms, causes and treatment.	(4) (11)	BT 6 Creating
3.	i) Investigate flexible overlays ii) Explain how the Benkelman Beam is used to design the thickness of the overlay.	(5) (10)	BT 4 Analysing
4.	Examine any two commonly employed methods for the structural evaluation of flexible pavements.	BT 3	Applying



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QUESTION BANK

S.no	Subject		BT1	BT2	BT3	BT4	BT5	BT6	Total Question
1	Unit-1	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	1		1		1	4
2	Unit-2	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	3	2	1	1	14
		Part-C		1	1	1	1		4
3	Unit-3	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	1	1			1	4
4	Unit-4	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C	1	1	1		1		4
5	Unit-5	Part-A	6	4	3	3	2	2	20
		Part-B	4	3	2	3	1	1	14
		Part-C		1	1	1		1	4

TOTAL NO.OF QUESTIONS IN EACH PART

PART A	100
PART B	70
PART C	20
TOTAL	190